Evaluating collaborative science teacher professional development: Teton C.R.E.S.T. (Combining Research and Education in Science Teaching) at the Teton Science School in Grand Teton National Park Wyoming

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EVALUATING COLLABORATIVE, SCIENCE TEACHER PROFESSIONAL DEVELOPMENT: TETON C.R.E.S.T. (COMBINING RESEARCH AND EDUCATION IN SCIENCE TEACHING) AT THE TETON SCIENCE SCHOOL IN GRAND TETON NATIONAL PARK, WYOMING.

by

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In June of 2001, eleven middle school and high school teachers participated in the first year of the Teton CREST (Combining Research and Education in Science Teaching) program. The three-week professional development program took place at the Teton Science School in Grand Teton National Park, Wyoming. The program had four main components: 1) getting to know the place, 2) working with ecologists, 3) project design, and 4) project facilitation. My objective was to evaluate how the CREST program provided teachers with the techniques necessary to integrate ecological field research into their science curricula. The CREST program evaluation was split into two parts. The first followed a traditional evaluation path, focusing primarily on summative or outcome data, and the second part of the evaluation used a more comprehensive evaluation model developed by Stake in 1977. Implementation of Stake’s model allowed for emergent themes to be discovered that would have otherwise been excluded. The synthesis of these two approaches provides a complete look at the CREST program, its outcomes, and the processes that facilitated those outcomes. Multiple data sources from teachers, ecologists and students were analyzed and included interviews, journals writings, and survey. Follow-up interviews revealed that the CREST program did not meet its goal of integration into science curricula, despite the high approval ratings that participants gave to the program in areas of content and environment. The program was successful in engaging teachers in “sense of place” explorations with their students.
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Chapter 1: A Review of Science and Environmental Education Literature, Related to Science Teacher Professional Development Involving Authentic Inquiry-based Practice.

"In the end we will conserve only what we love; we will love only what we understand..." – Baba Dioum

INTRODUCTION

Environmental education has been focused on developing understanding since its birth. Bill Stapp’s 1969 definition of environmental education defined the field at that time, and some feel it still defines the field (Disinger, 2001). Stapp (1969) wrote:

*Environmental education is aimed at producing a citizenry that is knowledgeable about the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution.*

The vision for science literacy proposed by the American Association for the Advancement of Science (AAAS, 1990) in *Science for all Americans* is congruent with Stapp’s environmental education definition. The AAAS report emphasizes science literacy as the central goal of science education:

*Science, energetically pursued, can provide humanity with the knowledge of the biophysical environment and of social behavior that it needs to develop effective solutions to its global and local problems.*

Synergy is possible with such closely aligned ideals between environmental education and science education (Manzanal, Barreiro, & Jimenez, 1999; Zelezny, 1999; Disinger, 2001; Kolsto, 2001). Ecological literacy focuses on ecological content, science process, and citizenship (Risser, 1986; Orr, 1992 & 1994; Berkowitz, 1997). With these three components being essential to realizing both Stapp’s definition and the AAAS’s goal, ecological literacy appears to be the forum where the union of science and environmental education ideals can flourish.
The purpose of this chapter is to review the literature of science education and environmental education regarding ecological literacy. I approach this work with three guiding personal beliefs: 1) that the environmental challenges we face today are ultimately rooted in our detachment from the natural world, 2) that general education, which integrates the local environment into the classroom experience, can assist students in re-establishing connections to the natural world, and 3) that model applied to science education will be the only effective way of reaching the goals of ecological literacy. With these biases in mind I present a working definition of ecological literacy, its components, and related educational strategies. I also discuss the importance of educator professional development in promoting ecological literacy in the classroom (e.g., Supovitz & Turner, 2000), particularly through creating teacher-scientist partnerships (e.g., National Resource Council [NRC], 1996a & 1996b; Feinsinger, Margutti, & Oviedo, 1999). Finally, this review will focus on viable means for assessing the effectiveness of teacher professional development programs.

**HISTORY OF THE ECOLOGICAL LITERACY MOVEMENT**

_The Dictionary of Ecology_ (Art, 1993), defines ecology as “the branch of biology that studies relationships.” These relationships often are viewed as complex and not easily understood without intensive study (Drayton & Falk, 1997). Despite the complexity, there is professional consensus that students should learn about the science of ecology and its principles throughout their education (Berkowitz, 1997; Drayton & Falk, 1997; Caduto, 1998; Armstrong, 2000; Barlow, 2000; Capra, 2000) and national standards exist for science education and environmental education that both address the
three components of ecological literacy (NRC, 1996b; North American Association of Environmental Education [NAAEE], 1999).

Ecological literacy finds its roots in science and biological literacy. Throughout the past three decades science, biological, and ecological literacy have been debated. In 1986, former Ecological Society of America president, Paul Risser, addressed the society with a charge to address ecological literacy. In defining ecological literacy, Risser cited the science literacy characteristics established by the National Science Teachers Association in 1971 (cited in Risser, 1986) and the themes used to define biological literacy by Yeager (1981). Risser ultimately proposed a definition of ecological literacy related to themes common to biological and science literacy. Three major themes, science concepts, science process, and understanding of the relationship between science and society, were used in Risser's (1986) definition of ecological literacy.

Since Risser's (1986) definition of ecological literacy, the science of ecology has grown and science education has undergone "reform" (AAAS, 1993; Berkowitz, 1997). Thus creating a current working definition of ecological literacy for this review begins within the larger scope of science literacy. It was important to recognize that science literacy is a continuum of understanding. People function with various degrees of science literacy. The goals of education should not be to view science or ecological literacy as an endpoint, put as a process of moving forward on the continuum (Bybee, 1997).

Bybee, as chair of the "Working Group on Science Content Standards", outlined the four levels of science literacy:

- **Nominal**: recognizes terms as being scientific.
- **Functional**: understands terms
- **Conceptual and Procedural**: understands content and process
- **Multidimensional**: understands science's role in society

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Like science literacy, ecological literacy goes beyond a basic knowledge of ecological concepts. Three common components of ecological literacy typically described in the literature (Berkowitz, 1997; Drayton & Falk, 1997; Caduto, 1998; Zelenzy, 1999; Armstrong, 2000; Barlow, 2000; Capra, 2000; Disinger, 2001; Kolsto, 2001) and are similar to those proposed by Risser (1986): 1) ecological content knowledge, 2) science process skills, and 3) science citizenship (or the relationship between science and culture).

Ecological Content

The first two levels of science literacy (nominal and functional) suggested by Bybee (1997) require a conceptual framework. Several authors in the literature have proposed ecological conceptual frameworks (AAAS, 1991; Vance, Miller, & Hand, 1995; NRC, 1996b; Berkowitz, 1997; Feinsinger, Grajal, Berkowitz, 1997; Crawford, 2000; Capra, 2000). These varied only slightly in specific content details proposed. One framework, proposed by the Center for Ecoliteracy, defined content in a way that was broad enough to incorporate the others. Capra (2000), Center for Ecoliteracy’s director, suggests these “fundamental concepts”:

- Networks – interconnection of members of an ecosystem as part of the larger whole
- Nested systems – systems function as part of the larger world
- Cycles – exchange of resources by members of ecological community
- Flows – solar energy driving the cycles
- Development – lifecycles of individual as well as evolution at species level
- Dynamic balance – regulation and organization within ecological community

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Science Process

In 1996, the National Resource Council (NRC) established science standards for K-12 science education (NRC, 1996b). The NRC report stated that science should be viewed as a “process of doing”, as well as a body of knowledge, and students should develop inquiry skills at all levels of K-12 education. Indeed, the science education literature has many examples of how an inquiry-based approach to science education was effective when introducing science process (Lawson, Devito, & Nordland, 1976; Watson and Konicek, 1990; NRC, 1996b; Ebert-May et al., 1997; Caton, Brewer, & Brown, 2000; Keys & Bryan, 2001). Review of the literature did not result in studies refuting the effectiveness of inquiry as an approach; however there was a suggestion that approaches to inquiry may vary in effectiveness (Crawford, 2000).

Citizenship

Citizenship has been defined as person’s ability to use their content and process knowledge to act on the needs of society through an informed-decision making process (Hines et al., 1986; AAAS, 1990; Bybee, 1997; McClaren, 1998; Armstrong, 2000). Commenting on citizenship, McClaren (1998) defined literacy as, “the capacity to engage in one’s culture.” McClaren continued by stating that preparing students to be citizens was the “ultimate task of schools”. In one of the most widely cited environmental education papers, Hines, Hungerford, and Tomera (1986) commented on the citizenship’s role in environmental education:

…it can now be said that the development of environmentally responsible and active citizens has become the ultimate goal of environmental education.
Stein Kolsto (2001), in an article entitled, "Scientific Literacy for Citizenship," focused on the interpretations citizens must be able to make to be active participants in decision-making. Kolsto states:

_The quality and adequacy of such interpretations depend in part on the general knowledge possessed by the decision maker. Such prerequisite knowledge includes knowledge of the nature of science and scientific knowledge._

In today's world, the public's role in environmental policy is increasing. These decisions are no longer the sole responsibility (or privilege) of the scientific community, (Basile, 2000; Bonney, 2002; Kolsto, 2001). For evidence, one need only get involved in public comment on an environmental impact statement, to observe the variety of stakeholders. Much of what we base our decisions on relies on scientific evidence. Unfortunately, there is little understanding of the process and nature of that science, by the nonscientist. The result is often a misunderstanding and misrepresentation by special interest groups on both ends of the environmental spectrum.

Understanding the role science plays in our society and how science was used to inform decisions was also part of Risser's (1986) definition for ecological literacy, though there is not general agreement on this point. With this in mind, the scope of ecological literacy had moved beyond the scope of science literacy and is considered essential to the education of a well-rounded student (Volk, 1990; McLaren, 1998; Armstrong, 2000; Barlow, 2000; Capra, 2000).

**SCIENCE EDUCATION AND ENVIRONMENTAL EDUCATION**

What is the link between science education and environmental education? Kolsto (2001) argued that science knowledge was "prerequisite knowledge for thoughtful decision making." Kolsto went on to state one of the major challenges in addressing
citizenship through science was providing relevance. Addressing this need, environmental education has been praised for its ability to "make science come alive", to give concepts relevance to students' lives, and to provide authenticity (Berkowitz, 1997; Salmon, 2000). Yet despite their complementary nature, environmental education and science education have followed parallel, yet perceptively separate paths. The division between the two fields of education could be traced to the perceived certainty of the science field conflicting with the perceived ambiguity of the environmental education movement. As Lucas (1980) observed, environmental education has three distinctly different approaches; "education about the environment, education for the environment, [and] education in the environment." Often, the general public perceives environmental education as being "education for the environment", and is hesitant to incorporate this advocacy-based approach into a general science curriculum. Whereas, the approach of "education in the environment" can be complementary to a general science curriculum, by way of providing a context for the science learning experience (e.g. ecological field research; Volk, 1990).

In order to truly explore the complementary nature of science and environmental education, one must explore the origins of the environmental education movement. The "conceptual change" movement of the early 1970's focused on inquiry in the science classroom. It was also at this time that environmental education movement was beginning to take shape. The early seventies were marked with widespread concern for the environment often attributed to Rachel Carson's (1962) book Silent Spring. Later, Carson (1964) melded her environmental views with an educational philosophy in her book The Sense of Wonder. Similar to ecologist Aldo Leopold's (1949) writings,
Carson’s work prompted a change in the way we viewed our relationship to nature. The environmental education movement took on the responsibility to promote effective education influencing this new view (Stapp et al., 1969).

Despite the ecological roots of environmental education, by the 1980’s the environmental education movement seemed to split from science education. Early papers in the environmental education literature critiqued both science and environmental education for their inability to reach the goals of literacy for their respective disciplines. In an often-cited review (Lucas, 1980, “Science and environmental education: pious hopes, self-praise and disciplinary chauvinism”) the author explored the failure of science and environmental education to teach citizenship. Lucas also criticized science education for “disciplinary chauvinism” by citing the numerous environmental education studies, related directly to science education, that were continually ignored by science educators. Lucas ultimately stated that the lack of interdisciplinary work was the reason for failure of both fields to reach their educational objectives.

Peyton’s (1984) meta-analysis of research in environmental education supported Lucas’s claims of lack of integration. Peyton studied environmental education research literature related to teacher training, and concluded that the emphasis on environmental science (education about the environment) rather than methods of teaching environmental education (education in the environment) was resulting in teachers ill-prepared to facilitate environmental literacy. Peyton stated:

Studies of [the effectiveness of environmental education training for] in-service teachers generally indicate that teachers are not trained to prepare environmentally literate students, nor are teachers themselves competent in all aspects of environmental literacy.
In the 1980's both science education and environmental education were not on a clear path to working together. One of the main reasons was the lack of interdisciplinary work, essential to current science reform efforts defined by the NRC (1996b). The push by both movements for a more interdisciplinary approach was made at the beginning of the 1990’s and continues today (Yager, 1991; AAAS, 1993; NRC, 1996b; Zelezny, 1999; Salmon, 2000; Brewer, 2001). Evidence of current progress was detailed in an article entitled, “Defining environmental literacy: a call for action.” In this paper, Berkowitz (1997) described the cooperative effort between the North American Association for Environmental Education (NAAEE) and the Ecological Society of America (ESA), two professional societies that have worked together to establish the themes and guidelines for knowledge needed by K-12 students for ecological literacy. The NAAEE (1999) released *Excellence in Environmental Education: Guidelines for Learning (K-12)* as one product of the partnership with the ESA. These guidelines were developed to support local and state environmental education efforts, and to promote environmental education as a viable means of addressing traditional disciplines’ standards, such as the science standards developed by the NRC (1996b).
WHAT IS MISSING?

One study links together science education and environmental education. Ma and Bateson (1999) studied the effect of an individual's attitude toward science on that individual's attitude toward the environment. Surveying 1,011 ninth-grade students, Ma and Bateson concluded that attitudes towards science and attitudes towards the environment were significantly correlated (p<0.05). The study implied that positive experiences in science education were associated with positive environmental attitudes. As promoting positive environmental attitudes has been stated as an aim for environmental education, this study illustrates the vested interest that environmental education should have in science education. But is environmental education able to provide quality resources to assist in obtaining the shared goal of ecological literacy?

In 1995, The George C. Marshall Institute funded a program to assess the current quality and ability of environmental education resources. The Independent Commission on Environmental Education (ICEE), was formed to conduct that assessment. Salmon (2000) reported on the ICEE's findings in his article, "Are we Building Environmental Literacy?" The ICEE noted that the environmental education movement’s success in reaching its established goals relied heavily on teachers having effective resources to teach the desired content. Environmental education materials reviewed by ICEE did not provide a framework for building knowledge and commonly contained factual errors. Regarding environmental literacy, the ICEE report concluded, "...materials that are not based on the best available science do not promote environmental literacy."

While authenticity and integration have been established as essential qualities in effective pedagogy related to ecological literacy (NRC, 1996b; Crawford, 2000; Salmon,
2000; Barab and Hay, 2001), the ICEE cited integration and authenticity as key missing components in environmental education materials (Salmon, 2000). Experiences were judged to be authentic or to provide authenticity, when the learner perceived a connection between the curriculum and the real-world value of the practice (Barab, Squire, & Dueber, 2000). Ownership was defined in terms of student investment. When students perceived the value of a project beyond the classroom, then their motivation was driven by that value (Crawford, 2000).

LESSONS IN THE FIELD

There is still debate on the value of classroom versus out-of-classroom education programs on student knowledge and attitudes about the environment. Students do most of their academic work in the classroom, thus it is not surprising that a meta-analysis of effective practice (Zelezny, 1999) concluded that interventions in the classroom were more effective at improving environmental behavior than were interventions in “nontraditional” settings.

Other studies have reported “nontraditional” settings to be effective at improving student ecological content knowledge. Two studies noted the impact of field-based ecology courses on student ecological content knowledge. Lisowski and Disinger (1991) analyzed field-based ecological instruction, finding that students scored significantly higher on posttests (p<0.001) compared to pretest scores on specific ecological content knowledge. Lisowski and Disinger concluded that field-based programs were effective in enhancing student knowledge of “selected ecological concepts.” Those concepts were related to relationships between organisms as depicted in food webs. This study did not
provide an experimental design to compare the effectiveness of “field-based instruction” versus the classroom.

The Sea Turtle Ecology Program (STEP) engaged students in hands on monitoring of leatherback turtle populations. Pankratz, (2000) reported significant improvement from pre-test to post-test scores on specific conservation and ecological knowledge (p<0.01). Pankratz concluded that the students’ knowledge of sea turtle ecology and conservation were positively affected, and that the student attitudes toward the sea turtles were also positively affected. This study did not provide a comparison to a similar course taught in the classroom.

In another study, Manzanal et al. (1999) compared the relationship between ecology fieldwork and student environmental attitudes. Their results showed that the experimental (fieldwork) group scored higher on 13 out of 14 conceptual and attitudinal questions than did the control group (classroom). Significant differences were reported on 11 of the 13 ecological content questions, on which the experimental (fieldwork) group scored higher on (p<0.05). Based on these results, Manzanal et al. concluded students developed a “more favorable environmental protection” attitude as a result of participating in ecological fieldwork due to the clarification of concepts that the fieldwork promoted.

The benefits of engaging in ecological fieldwork experiences may reach beyond ecological content knowledge and environmental attitudes. Liberman and Hoody (1998) studied an educational model called, “Using the Environment as an Integrating Context for Learning” (EIC). They reported that students taught with the EIC model scored higher on subject comprehension tests compared to students in traditional classrooms.
(language arts, 94%, math, 73%, science, 99%, and social studies, 95%). The study's implications bode well for the trend for methods providing greater disciplinary integration. Liberman and Hoody provided evidence that an environmental focus provided a viable forum around which to center that integration. This is not surprising given environmental education's interdisciplinary nature. Once criticized for lack of interdisciplinary work by Lucas (1980), environmental education more recently has been praised for promoting relevance and interdisciplinary work (Liberman & Hoody, 1998; McClaren, 1998; Barab et al. 2000; Salmon, 2000).

AN INQUIRY BASED APPROACH FOR TEACHING AND LEARNING

Science education reform has focused on inquiry in K-12 science standards for science students (NRC, 1996b), and also the professional development standards for science teachers include learning science content through inquiry methods. The NRC (1996b) advocates authentic experiences to promote inquiry methods:

*Science learning experiences for teachers must involve teachers in actively investigating phenomena that can be studied scientifically, interpreting results, and making sense of findings consistent with currently accepted scientific understanding.*

Teaching with an inquiry approach was suggested in the science education and environmental education literature as being essential pedagogy for ecological literacy because its use promotes both authenticity and ownership (Crawford, 2000; Barnett & Hobson, 2001; Eick & Reed, 2002). The NRC (1996b) defined inquiry as, "...the activities of students in which they develop knowledge and understanding of scientific ideas." Crawford (2000) found that successful inquiry-based science teaching required high-level combinations of pedagogical content and nature of science content, coupled with strong coaching and mentoring skills (Crawford, 2000).
Supporting professional development as a means of promoting inquiry use, Supovitz and Turner (2000) found a correlation between the amount of time a teacher spends in professional development and the amount of time they engage their students in the inquiry process. The authors reported the highest correlation between time spent on professional development and high use of inquiry in the classroom ($r^2 = 0.160, p<0.05$) for those teachers who reported having engaged in 80-159 hours (the highest category of time spent) on professional development. Supovitz and Turner concluded, "[Our] work demonstrates a strong and significant relationship between professional development and teachers' practices and classroom cultures." Eick and Reed (2002) reported that the extent to which science teachers engage in inquiry practice depend highly on their prior experience with science. They found that teachers who had experienced "doing science" integrated inquiry with greater success. The researchers concluded that effective pre-service and in-service curricula aimed at inquiry should include a scientific research experience. These two studies illustrate the need for professional development, which promotes science literacy, and engages teachers in authentic practice or "doing science." (Eick & Reed, 2002).

**Partnerships**

Ecologists, conservation biologists and other natural historians increasingly recognize the need to become involved in public education. An ecologically literate public may be the 'last best hope' for a sustainable biosphere. Partnerships between ecologists and educators may be the best hope, though not the last, for moving towards an ecologically literate public (Feinsinger, Margutti, & Oviedo, 1997).

In the 1996 publication, "The Role of Scientists in the Professional Development of Science Teachers," the NRC provided a guide for institutions wishing to develop partnership programs, and listed a variety of opportunities that scientists can provide for
science teachers. First and foremost the NRC stated, “Scientists can provide opportunities for teachers to learn how the scientific process works – what scientists do and how and why they do it.” In that publication, the NRC listed 190 programs involving scientist partnerships with education. A critical element for successful scientist-educator collaborations cited in some recent studies is establishing partnerships on foundations of equality and respect (NRC, 1996a & 1996b; Feinsinger, Margutti, & Oviedo, 1997; Caton et al., 2000). This means that the expertise of both participants must be respected and utilized (NRC, 1996a & 1996b). Yet not all scientist-teacher partnership programs described in the literature met this standard.

In general, effective professional development programs that incorporated scientist-teacher partnerships have several characteristics in common (NRC, 1996a & 1996b; Caton et al., 2000).

- The program provided ample opportunities and support for networking (teacher-teacher, teacher-scientist, scientist-scientist, program-teacher, program-scientist).
- The resources of the program were developed in collaboration with teachers and researchers.
- The program offered opportunities to engage in current research.
- Partnerships were nurtured towards equality, with an understanding that both partners valued the others perspectives and experiences.
- Evaluation was an integral part of the program from the start and continued throughout the program’s scope.
- Involvement by participants and program extended beyond direct participation in the program.
- A charismatic leader was involved in the program.

Partnership programs can take several forms. I will describe apprenticeships and citizen science examples, and then comment on measures of success.

*Apprenticeships* have a long tradition in the training of young scientists. Graduate training is, essentially, an apprenticeship. Now this model is reaching into the K-12
arena. Barab and Hay (2001) describe a program in which middle school students were paired with university researchers in a program called the "Student Apprenticeship Camp." Based primarily on anecdotal evidence, the authors concluded that the apprenticeships' most valuable contribution was engaging students in the community of science. Barab and Hay concluded that the experience provided students with a chance to engage in "authentic scientific discourse". In regard to the teachers' role in the apprenticeship, Barab and Hay reported that scientists viewed teachers as a "bridge" to the students, but not a "credible" source for scientific information. This view on the part of the scientists accents the limitations of scientist-teacher relationships developed in this particular program. Investments and benefits that flow only one way establish a power structure. When the scientist was viewed as the expert throughout a "partnership" experience, they miss the opportunity to learn from the teachers. The long-term effects of this program on teachers and students were not reported.

Richmond and Kurth (1999) also observed middle school students engaged in science apprenticeships and identified three distinct communities that developed over the course of a 7-week summer science camp. The first community centered on student work with a scientist. The second community centered on their relationships with peers (bonding through common experience). The third community centered on the program (program staff, and guest lecturers). Richmond and Kurth's findings on community development are almost identical to those described by Barab and Hay (2001; community of scientific practice, learner research group, and entire camp).

Citizen science partnerships bring nonscientists to research with two typical goals: engaging citizens in the process of science, and having the citizens collect massive
amounts of information. The citizen, through the experience of research participation, received the benefit of learning new knowledge through project readings, experiences, and focused observations, without having to do all of the project development. Scientists' benefits were in the form of amassing large datasets that normally could not be collected due to limited resources (Bonney, 2002). Trumball, Bonney, Bascom, and Cabral (2000) described the advantages and disadvantages of one of the largest citizen science projects in the United States. The Cornell Lab of Ornithology involved more than 17,000 participants in Project Feeder Watch. The data collected by citizens proved to be of sufficient quality for Cornell scientists to use it in their research and several publications resulted. Trumball et al. commented that citizen involvement in the science process was limited to following directions laid out by the scientists. Despite the limited involvement in the process, citizens were exposed to the conservation issues surrounding the project. Addressing that point, Noss (2002) supported the value of citizen scientists, stating that “even if the data he or she collects are never used, the amateur naturalist is a better citizen of the planet” as a result of the experience.

A common “downside” of the apprenticeship and citizen science programs I reviewed was the establishment of a hierarchy. The flow of knowledge was unidirectional, with the scientists in the role of “source” and the teachers or students as the “target” (NRC, 1996b). These types of relationships limited the depth to which teachers or students were involved in the scientific process, and it limited the depth to which scientists were engaged in the educational process. Caton et al. (2000) reported that overcoming this hierarchy was the major barrier to facilitating effective teacher-scientist partnerships. Nurturing the relationship with common experiences through
"shared vision, inquiry instruction, and learning" was a necessary component to effective partnerships. Once these barriers were overcome, Caton et al. reported the partnership’s benefits begin to be experienced by both scientists and teachers. Others in the literature reported similar benefits to both partners when relationship was founded on mutual respect and shared experience (see Falk & Drayton, 1997; Feinsinger, Margutti, & Oviedo, 1997; Mayer & Fortner, 2001).

Feinsinger, Margutti, and Oviedo (1997) relayed how they facilitated ecologist–teacher partnerships, in Argentina, by engaging both partners in the same simulated survey of the schoolyard. The exercise was focused on taking partners through the inquiry process; the ultimate goal of the partnership was for both partners to contribute to the development of an inquiry exercise for the schoolyard. Ecologists aided the teachers in the inquiry process, while the teachers aided the ecologists in designing an exercise that would be appropriate for their students. The result was a partnership where both participants engaged in inquiry, which created the desired shared experience. Providing a measure of success for their program, Feinsinger, Margutti and Oviedo, reported that the partnerships continued to function after the workshop’s conclusion.

Breaking down communication barriers often is the first step toward building a successful partnership (see Feinsinger, Margutti, & Oviedo, 1997; Caton et al., 2000). Professional ecologists have been known for their use of jargon and complex concepts (Feinsinger, Grajal, & Berkowitz 1997). Avoiding jargon, and focusing instead on a clear, concise conceptual framework, aided the formation of partnerships by addressing the hierarchy that certain language use could have established (Watson & Konicek, 1990; Falk & Drayton, 1997; Feinsinger, Grajal, & Berkowitz, 1997; Barab & Hay, 2001).
Partnerships are often described in the literature in terms of benefits that they provide to participants, yet the research base in what partner scientists, teachers, and the associated students gained from engagement in partnerships often is limited (Falk & Drayton, 1997; Caton et al., 2000). The information about partnership benefits to scientists was split into two categories: professional (within the scientific community) and personal (NRC, 1996a). The professional rewards for scientists were centered on developing pedagogical strategies for their own future teaching with their teacher partners as mentors. This not only assisted scientists in teaching better at their campus, but also in their community outreach efforts (Caton et al., 2000). Sometimes, scientists also received recognition within their universities and professional societies (NRC, 1996a). Recently, there has been a call to the scientific community to increase the professional rewards for scientists to encourage more involvement in education (Brewer, 2002b).

Personal rewards self-reported by scientists revolved around gaining "enthusiasm" from the partnership, both from seeing the teachers' interest and investment in the scientists' work, and seeing their work integrated into K-12 classrooms (Falk & Drayton, 1997; Barab & Hay, 2001). Caton et al. (2000) reported ecologists in their partnership program continued contact with their teacher partners after the program ended. This appeared to support longer-term influences on teacher and student learning, compared to programs that did not nurture the scientist–teacher relationships.

Partnership programs address recommended professional development standards (NRC, 1996b) that advocate teachers participating in professional development programs have the opportunity to learn science through inquiry, just as their students would. As
previously stated, inquiry is effective when an element of authenticity is incorporated. Then it follows authentic research experience, which ecologist-teacher partnerships offer, would be an effective means of promoting inquiry use. Falk and Drayton (1997) commented on the value of teachers becoming a part of the ecologists’ culture. For example, in the Teacher Enhancement in Pedagogy and Ecology (TEPE) program, teachers participated in teacher-ecologist partnerships. The goal of this program was to “reengage science teachers as adult learners.” Based on the journal entries of the 89 teachers involved in TEPE, Falk and Drayton identified in five broad categories of benefits for teachers:

- Enthusiasm about ecology
- Science content and process
- Ecologist as a provider of resources
- Ecologist providing continuing support
- Modeling pedagogical approaches to the teaching of science

Similar to scientists, the most frequently self-reported teacher benefit was enthusiasm. The material that had become monotonous over years of teaching was energized through the teacher’s first-hand experience. Teachers went back to the classroom with new perspectives and new stories to share with students. Many teachers expressed a feeling of rejuvenation after engaging in a research-based partnership (see Falk & Drayton, 1997; Mayer & Fortner, 2001). The enthusiasm gained by teachers and scientists went beyond feeling good about the experience and was translated into reflection on practice or metacognition.

The value of reflective practice cannot be understated. NRC (1996a) lists reflective practice as a benefit of partnerships for both scientists and teachers, affording both the opportunity to critically analyze the value and effectiveness of their work.
Teacher-scientist partnerships promote an atmosphere where partners are thinking about and discussing how and why they engage in their work. For example, a scientist may relay to the teacher how they designed the research the partners are engaged in. While explaining the design to the teacher, the scientist is exploring how or why they knew to choose this process. According to Blank (2000), metacognition, or reflecting on how or why we know information, is a key step in the learning cycle. Supporting the occurrence of reflective practice during partnerships, Caton et al. (2000) reported scientists reflected on their own teaching at the university level. And, Falk and Drayton (1997) concluded, that besides the content gains, "such a [partnership] also provides teachers with a context for metacognition about themselves as learners and practitioners of science."

**Reporting the Value of Partnerships**

The NRC (1996a) reported on over 180 programs that involved scientist-teacher partnerships to some degree; yet little comparative work has been reported, and even fewer studies document impact (Falk & Drayton, 1997; Caton et al., 2000). Despite the assumed professional and personal benefits of ecologist-teacher partnerships, some have rightly called for more exploration into the effectiveness of partnership programs for two main reasons: (1) the limitations of outcome-based only approaches and (2) concerns for lack of rigor in data collection (Gall, Gall, & Borg, 1999; Caton et al., 200; Mayer & Fortner, 2001). Stake (1991) questioned the value of solely using outcome-based assessment in professional development, commenting that much of the program value was rooted in the transactions or relationships that occur during professional development programs. Exploring those transactions led to fuller description of the program (Stake, 1991; Gall, Gall, & Borg, 1999). Addressing the second concern, Brewer (2001)
questioned the lack of rigor in related educational methods, attributing the lack of rigor to confusion over the "type of evidence needed." Often confusion exists about when to apply and how to interpret educational research versus educational evaluation (J. Heimlich, personal communication, October 11, 2001). Educational evaluation has traditionally not been reported. Stake (1967) stated one definition of the difference between evaluation and research; "Evaluation is expository...it differs from educational research in its orientation to a specific program rather than to variable common to many programs."

One source of ambiguity surrounding evaluation has been attributed to differentiating between summative and formative evaluation (Stake, 1991; Wood, 2001). Although the data collected in both types of evaluation was often the same, the application of that data varied. Gall et al. (1991) state formative evaluation data has been used to refine a product during development, while summative evaluation determines the final value of a program relative to other programs and may not lead to generalizable results. For example the data reported by Falk and Dayton (1997) on teacher and ecologist gains from a partnership program would be summative. How those gains were promoted or nurtured by the program would be an example of formative data. Such formative data was most valuable to program designers and facilitators when they discussed how to maintain and improve program components. The literature has suggested that an accumulation of formative evaluations would lead to valuable generalizations (Stake, 1991; NRC, 1996a).

One model of evaluation seems to integrate proven to provide both formative and summative evaluation. Stake's evaluation matrix offers an organizing model for
exploring the effectiveness of professional development courses (Stake, 1977; Stake, 1991; Abma & Stake, 2001). Recently, Wood (2001) used the “Stake’s Countenance Model” for program evaluation to assess the impact of a professional development program. The model provided for a mixed methods approach and resulted in both summative and formative data. Wood concluded, “…[Stake’s Responsive Evaluation] facilitated a thorough examination of both qualitative and quantitative data during all phases of program execution.” Based on Woods (1991) findings the Responsive Evaluation model appears to address the concerns associated with studies in the literature by providing program description that goes beyond outcome and providing for a variety of methods to improve rigor in the data.

CONCLUSION

Some important goals of science education reform and environmental education focused on disciplinary literacy. The approach to ecological literacy has benefited from an integration of science education and environmental education goals and recognizing what each field has to offer (Ma and Bateson, 1999; Basile, 2000; Capra, 2000; Keys and Bryan, 2001). Science education can contribute the necessary process and content knowledge, while environmental education provides relevance to the methods (Berkowitz, 1997; Salmon, 2000).

Partnerships, when implemented in a manner resembling the true definition, create a two-way flow of benefits to both partners, and achieve sustainable working relationships that focus on the common goals of improving science curricula (NRC, 1996b; Caton et al., 2000). In the best case, teachers and students are no longer just the consumers of information, but actively engaged in process of gathering information. The
scientists, too, gain both professionally and personally from their relationship with teachers and students. When partnerships work, teaching practices lead to development of process skills, content knowledge, and citizen awareness resulting in moving forward along the ecological literacy continuum. In order to assure this impact occurs, teachers need to be equipped with the proper tools and training. If we wish to develop effective professional development partnerships with scientists and teachers, then more research into their effectiveness and what makes them effective is needed (NRC, 1996a; Fortner & Mayer, 1999). Through continued assessment of partnership programs we will learn the best approaches to aiding teachers and scientists in their professional development, while staying focused on the overall science and environmental education goal of promoting ecological literacy.

"Tell me; I forget
Show me; I remember
Let me do; and I know"
- Chinese proverb

The potential of scientist-teacher partnerships has been largely untested (Falk & Drayton, 1997; Caton et al., 2000), yet their importance has been noted in both the scientific and educational literature (NRC, 1996a & 1996b; Feinsinger, Margutti, & Oviedo, 1997; Brewer, 2001). Their potential to influence student ecological literacy was emphasized when Feinsinger et al. (1997) stated, "partnerships between ecologists and educators may be the best hope, though not the last, for moving towards and ecologically literate the public."

Given their place in the science literacy campaign, scientist-partnerships have received much funding and have flourished in the last five to ten years. The National Research Council (NRC, 1996a) identified 190 professional development courses for science teachers. A large number of these programs featured work with university and college scientists in partnerships, yet little data exists on the quality and impact of these programs. Although the NRC (1996a) advocates evaluation of integration throughout a program's life, they also recognized how resource-intensive this can be. Without a rich literature documenting successes and challenges, new programs may miss opportunities to build from the successes of other programs, or worse yet, repeat their mistakes (NRC, 1996a). Another challenge is that limited funding leads to "one-shot" short-lived professional development programs that are not sustainable, contrary to the long-term
approach that is indicative of effective professional development (Falk & Drayton, 1997; Supovitz & Turner, 2000; Mayer & Fortner, 2001).

In this paper, I evaluate a science teacher professional development program with a partnership component that I helped to develop and implement. Teachers reported the CREST program to be highly influential on their professional development, but in the end the program had too short of a life to reach its goal of integration into the teachers’ science curricula. As advocated by experts in the field of evaluation (Stake, 1991; Gall, Gall, Borg, 1999), the evaluation was instituted from the beginning of the CREST program, and described the benefits that partners received from their participation in a scientist-teacher partnership (Falk & Drayton, 1997; Caton et al., 2000). The evaluation focused on two questions: (1) What do participants gain from the program? (2) How were those reported benefits facilitated?

THE TETON CREST PROGRAM

The Teton CREST program (Combining Research and Education in Science Teaching) was a program of the Teton Science School (TSS), situated near the eastern border of Grand Teton National Park, Wyoming, USA. The school has a history of offering ecological education to visiting groups of students and adults since 1967. The CREST program was designed to fit within the institution’s mission of providing and encouraging “experiential education in natural science and ecology while fostering an appreciation for conservation ethics and practices (TSS, 2003).”

During the first three weeks of June 2001, TSS implemented the CREST program for middle and high school science teachers. The CREST program focused on engaging teachers in process of ecological field research through partnerships with
ecologists and high school students. The goal of the program was to train secondary science teachers in the process of ecological research and the use of ecological research as an educational tool. Eleven teachers with various backgrounds participated in CREST. The teachers were from five different states (Iowa, Missouri, Ohio, Wisconsin, and Wyoming). Nine of the participating teachers were from public schools teaching in classrooms, while two of the teachers taught at an outdoor education center. Teacher experience varied from their first year teaching to veterans with more than 30 years of experience. The program format focused on four main program components: (1) getting to know place, (2) working with ecologist, (3) designing projects, and (4) engaging students (see Table 2.1).

*Getting to Know the Place*

The CREST program content was designed to work with a variety of skill levels. Instruction began at a broad scale, initially focused on learning general field techniques and general ecological processes and content. The techniques and content were purposely very general so the teachers would have latitude in translating them to their home environment without drastic modification. During the days, time was spent on research techniques, while nightly seminars focused on integration into teachers' science curricula.

In the role of adult learner, teachers engaged in two different types of inquiry, guided inquiry and semi-guided inquiry, through two different projects. The terrestrial project was inquiry and the aquatic project presented teachers with a more open approach. The terrestrial sampling used methods and questions that were pre-established by a partner agency.
**Table 2.1. Timeline for CREST Program**

<table>
<thead>
<tr>
<th>Week</th>
<th>Focus</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Getting to Know the Place</td>
<td>Teachers explored the natural history of the Tetons. This exploration began with tours of the area during which teachers focusing on patterns in the landscape. As the exploration continued, ecological field research techniques were introduced. Nightly seminars focused on implementing the new techniques in the K-12 classroom.</td>
</tr>
<tr>
<td>1 &amp; 2</td>
<td>Working with Ecologists</td>
<td>At the end of the first week, pairs of teachers worked with local ecologists, assisted them with their work. Teachers spent a total of four days in the field with ecologists.</td>
</tr>
<tr>
<td>2</td>
<td>Designing Projects</td>
<td>Teachers continued to enhance their research skills through practicing data analysis techniques. Putting their techniques to practical use, pairs of teachers designed field research projects.</td>
</tr>
<tr>
<td>3</td>
<td>Engaging Students</td>
<td>During the third week, a group of 28 high school students arrived at TSS. The teachers engaged teams of students in the projects they had designed. At the end of the four days of research, students presented their work to peers and the other teachers.</td>
</tr>
</tbody>
</table>

The second project focused on aquatic sampling techniques using stream sampling protocols. Although the methods in the aquatic project were pre-established, teachers developed their own questions and carried out authentic investigations. The two projects allowed teachers to explore the continuum of inquiry (see Figure 2.1). These two projects, coupled with a tour of the valley on the first day, gave teachers an introduction to place they would be studying. It was intentional to model an exploration of place as part of the full research experience. Sense of place skills introduced included scientific journal use, compass and GPS skills, and map work.
Figure 2.1. Inquiry investigation continuum with desired project focus (described in Feinsinger, Margutti, 1997).

Working with Ecologists

At the end of the first week, teacher teams were formed and each team went into the field with a local ecologist. Teachers continued the role of adult learner, which they had experienced while “getting to know the place,” by transitioning into the role of science apprentice, while working with the ecologist. Teachers spent four days in the field with a local ecologist, working on one of the following on-going ecological investigations:

1. Monitoring Avian Productivity and Survivorship (MAPS): bird banding program with research staff from the Teton Science School
2. Raven Population Dynamics: capturing and using telemetry to track raven movements.
5. Effects of Development on songbird communities: comparing songbird abundance in areas of high and low development.
6. Wildflower phenology: monitoring flowering time variations in relation to elevation and seasonal changes.
Designing Projects

Upon completion of their short apprenticeship with the ecologist, teachers spent the next 3 days designing a field research project. Using the techniques learned during their first week, teachers worked in pairs to develop a proposal for a research project. The proposals outlined a research focus and described the process they planned to use to engage students, while accommodating the conditions that studies must be completed in four days, and be located within a reasonable distance of the Teton Science School campus. Topics chosen by teachers were: 1) fire ecology, 2) insect ecology, 3) bison behavior, 4) ground squirrel behavior, and 5) song bird habitat preference.

Engaging Students

During the last week of the CREST program, 28 high school students joined the teachers. After students arrived, they were introduced to the basic ecology of the area, then teachers presented their research proposals to the students, and the students broke into groups according topic interest. Teachers and students spent the next four days engaged in the field research projects designed by the teachers. The culmination of the field research projects was a research symposium, where students presented their work to the other student groups, the teachers, and members of the TSS staff.

Evaluation Methodology

The guiding principles in the design of the evaluation tools were not only to provide data for the evaluation, but also the evaluation tools should provide program feedback. In this manner the evaluation tools were designed to provide both summative and formative evaluation data. For example, the pre-program surveys sent teachers were not solely aimed at gathering background data, but also requested that teachers state their
personal goals for the program. Seven instruments were used to collect both quantitative and qualitative data (see Table 2.2).

Table 2.2. Evaluation tools and the CREST program participant groups.

<table>
<thead>
<tr>
<th>Evaluation Tools</th>
<th>Data Collected on CREST Participants using each Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teacher</td>
</tr>
<tr>
<td>Pre-program Survey</td>
<td>✓</td>
</tr>
<tr>
<td>Post-program Survey</td>
<td>✓</td>
</tr>
<tr>
<td>Pre-program Interview</td>
<td>✓</td>
</tr>
<tr>
<td>Post-program Interview</td>
<td>✓</td>
</tr>
<tr>
<td>Teacher Journal</td>
<td>✓</td>
</tr>
<tr>
<td>Group Discussions</td>
<td>✓</td>
</tr>
<tr>
<td>Evaluator Observations</td>
<td>✓</td>
</tr>
<tr>
<td>Institutional Feedback Form</td>
<td>✓</td>
</tr>
</tbody>
</table>

Program Surveys

*Teacher* pre-program surveys (see Appendix 3) were sent out three weeks prior to arrival, and returned one week prior to the start of the program. Short-answer, open-ended questions provided data on teacher background, field research experience, personal goals, and expectations of the program. Teachers also were asked to respond to statements regarding administrative support, school resources, and value of field research using a Likert scale of one to five (1 = highly disagree, 2 = disagree, 3 = no opinion, 4 = agree, 5 = strongly agree). Questions used were similar to those Mayer and Fortner (2001), and were professionally reviewed by their colleagues prior to use. Post-program teacher surveys were similar to pre-program surveys, with the additional questions directed at understanding the extent to which CREST program elements had infused the science curricula at the teachers' schools the next year.

*Student* pre-program surveys (see Appendix 3) were administered within two-days of their arrival at TSS. The student pre-program surveys focused on science and
environmental attitudes, ecological understanding, and science process skills. The format of the student pre-program survey included short-answer questions, which were scored using a rubric (see Appendix 3) to assess ecological understanding and science process skills. In addition, students rated their attitudes and interests in science and environmental studies using a Likert scale from one to five. Student attitude questions were similar to those developed by LaTrobe and Acott (2000). Student questions related to ecological understanding and science process were professionally reviewed prior to use. Post-program surveys of students were similar to pre-program surveys with the exception of rewording ecological understanding and science process questions in order to reduce test bias.

Ecologist surveys were not distributed to ecologists prior to the program due to time constraints; therefore participating ecologists completed only post-program surveys. These surveys include questions on the ecologist’s background, their perception of the value of working with educators, and the role of ecologists in promoting ecological literacy. In addition to these short-answer open-ended questions, ecologists rated the value of working with educators and involving students in ecological field research using a Likert scale from one to five.

After all the survey had been collected, the data from short-answer questions were open-coded and themes were developed. Ranked responses (Likert scale data) were analyzed by comparing pre-program and post-program responses to similar questions. Significance of the change in response was determined by using Wilcoxon signed-ranks test for significance (p<0.05).
Interviews

Teachers and ecologists also participated in pre-program and post-program interviews. Interview questions related to the themes presented in surveys and were used to validate responses on participant surveys. As teachers arrived for the CREST program, pre-program teacher interviews were with individuals and with small groups of teachers. Post-program teacher interviews were performed over the phone five to six months after the program ended. Post-program teacher interviews formed the body of data describing actual integration of CREST skills into the teacher’s science curriculum. Ecologist interviews were performed individually (face-to-face or phone) prior to their work with teachers and after the CREST program. Both pre-program and post-program interviews of ecologists and teachers were transcribed (see Appendix 1) and open-coded, and the number of participants reporting each coded response was recorded.

Teacher Journals

Five journal prompts were given throughout the program as a reflective tool and to record the teachers' in-situ perceptions of various program components. Journals were collected twice during the program so that photocopies of journal pages could be made. The copied pages were transcribed (see Appendix 1) and codes were developed from those transcriptions. Out of those five journal prompts, teacher responses to six questions were open-coded. For each code, the number of teachers reporting that response was recorded.

Anecdotal Support

Several types of data provided anecdotal support. An adapted TSS institutional feedback form focused on gathering participant opinions pertaining to facilities and
program staff. These data were not analyzed, but some of the information from the forms was useful in conjunction with, CREST program data. In addition to the institutional feedback, teachers participated in two group discussions near the end of the CREST program. There was no set format to the discussions, and the responses teachers gave were not coded. However the discussions were transcribed and provide additional impressions. Finally, throughout the CREST program, as the evaluator, I was continually taking observational notes on participant participation. Due to my involvement in specific portions of the program and the inability to be present at all portions of the program, my observations are biased toward the program components in which I could participate. Therefore, my observations were not analyzed formally and are presented only as anecdotal information.

RESULTS

Program Surveys

Pre-program teacher surveys were completed by eleven teachers. Teacher responses to survey statements indicated they felt confident about integration of field research into their science curricula with respect to administrative support school resources, and value of field research (Table 2.3). Teachers reported being least confident in their administrations’ willingness to provide “ample time to plan field research program” ($\bar{x} = 3.7$, SE = 0.29). CREST teachers felt their schools had adequate resources, but they were concerned with “funds to purchase necessary field-research equipment and supplies” ($\bar{x} = 3.5$, SE = 0.41). They rated the value of field research high, with complete agreement on two statements: “my students would benefit from participation in field-research” and “I could learn a great deal from working with ecologists”.

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Table 2.3. CREST Teacher Response to Pre-program Survey Statements. Statements were rated on a Likert Scale of 1 (Strongly Disagree) to 5 (Strongly Agree).

<table>
<thead>
<tr>
<th>STATEMENT</th>
<th>Mean Rating (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADMINISTRATIVE SUPPORT</strong></td>
<td></td>
</tr>
<tr>
<td>My administration encourages innovative instructional practices.</td>
<td>4.6 (0.21)</td>
</tr>
<tr>
<td>My administration supports our science program with needed materials and equipment.</td>
<td>4.3 (0.31)</td>
</tr>
<tr>
<td>My administration would provide ample time to plan field research program.</td>
<td>3.7 (0.29)</td>
</tr>
<tr>
<td>My administration would support travel by my class to field-research sites off school grounds.</td>
<td>4.1 (0.38)</td>
</tr>
<tr>
<td><strong>SCHOOL RESOURCES</strong></td>
<td></td>
</tr>
<tr>
<td>My school has ample resources to conduct field-research.</td>
<td>4.1 (0.48)</td>
</tr>
<tr>
<td>My school has funds to purchase necessary field-research equipment and supplies.</td>
<td>3.5 (0.41)</td>
</tr>
<tr>
<td>My school has good access to quality computers.</td>
<td>4.3 (0.30)</td>
</tr>
<tr>
<td>My school is located in close proximity to potential field-research sites.</td>
<td>4.6 (0.23)</td>
</tr>
<tr>
<td>My community offers opportunities to engage in partnerships with scientists.</td>
<td>4.4 (0.21)</td>
</tr>
<tr>
<td><strong>VALUE OF FIELD RESEARCH</strong></td>
<td></td>
</tr>
<tr>
<td>My students would benefit from participation in field-research.</td>
<td>5.0 (0.00)</td>
</tr>
<tr>
<td>I feel confident in leading my students in field-research.</td>
<td>4.5 (0.21)</td>
</tr>
<tr>
<td>I feel that I can address standards through engaging my students in field-research.</td>
<td>4.5 (0.21)</td>
</tr>
<tr>
<td>I could learn a great deal from working with ecologists.</td>
<td>5.0 (0.00)</td>
</tr>
<tr>
<td>Ecologists could learn a great deal from working with me.</td>
<td>4.3 (0.15)</td>
</tr>
</tbody>
</table>

All eleven teachers agreed that field research could fit into their science curriculum, and stated goals related to learning new research techniques, integration into science curriculum, and playing the role of learner for their participation in the CREST program (Table 2.4). Regarding working with ecologists, teachers expected to gain knowledge of research techniques, ideas for integration, and ecological content knowledge. Teachers also suggested ecologists would benefit from the partnership by learning more about pedagogy. One teacher wrote, “I hope I can provide insight on how to reach, inspire, and motivate students of all ages.”
Post-program teacher surveys (Table 2.4) were completed by 10 teachers (one teacher left the program after the first week for reasons not related to the program). All the teachers reported that they had met the goals they set prior to the CREST program and that they would participate in a program similar to CREST in the future. Teachers reported that the research techniques they learned during the program were the most helpful in meeting their goals. One teacher wrote:

My main goal was to increase my awareness of opportunities for student projects that are real world and/or research based. I think CREST has done a wonderful job exposing us to opportunities. Ideas and methods of teaching will benefit our students and enrich us as teachers.

After the program, teachers still felt that time and school resources were the greatest challenges to teaching ecology in the upcoming school year. Ten teachers reported they had new ideas about their science curriculum, and one teacher also wrote about modifying an established project to fit field research into their science curriculum. With respect to working with ecologists, teachers felt getting to know the ecologists on a personal level was the greatest benefit of the partnership. For the ecologists' benefits, teachers responded that insight into pedagogy and enthusiasm were gains they provided for the ecologists.

Teachers agreed with post-program Likert scale survey statements (Table 2.6) concerning integrating field research into their science curricula and the value of field research to their students. In comparison to pre-program Likert scale survey statements pertaining to "value of field research", the data showed no significant change in teacher responses (Table 2.7).
Table 2.4. CREST Teacher Responses to Pre-program Survey Questions.

<table>
<thead>
<tr>
<th>Questions and Responses</th>
<th># of Teachers Reporting Each Answer (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you feel field research can fit into your science curriculum? Explain why or why not.</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>11</td>
</tr>
<tr>
<td>Desire to create new project</td>
<td>3</td>
</tr>
<tr>
<td>Expansion of ongoing projects</td>
<td>2</td>
</tr>
<tr>
<td>Way to address standards</td>
<td>2</td>
</tr>
<tr>
<td>Support of Administration</td>
<td>1</td>
</tr>
<tr>
<td>Part of their Job Description</td>
<td>1</td>
</tr>
<tr>
<td>Authentic to students</td>
<td>1</td>
</tr>
<tr>
<td>Network of support</td>
<td>1</td>
</tr>
<tr>
<td>When teaching ecology to your students, what are some of your greatest challenges?</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>4</td>
</tr>
<tr>
<td>School Resources</td>
<td>4</td>
</tr>
<tr>
<td>Addressing Standards</td>
<td>3</td>
</tr>
<tr>
<td>Explaining Content</td>
<td>2</td>
</tr>
<tr>
<td>Student Interest</td>
<td>2</td>
</tr>
<tr>
<td>State three goals you would like to accomplish through participation in the CREST program.</td>
<td></td>
</tr>
<tr>
<td>Learn New Research Techniques</td>
<td>6</td>
</tr>
<tr>
<td>Integration into Science Curriculum</td>
<td>6</td>
</tr>
<tr>
<td>Play role of learner</td>
<td>5</td>
</tr>
<tr>
<td>Expand Pedagogy</td>
<td>4</td>
</tr>
<tr>
<td>Increase Ecological Content Knowledge</td>
<td>4</td>
</tr>
<tr>
<td>Explore TSS Environment</td>
<td>3</td>
</tr>
<tr>
<td>Networking</td>
<td>2</td>
</tr>
<tr>
<td>Inspiration</td>
<td>2</td>
</tr>
<tr>
<td>Sense of Place Technique</td>
<td>1</td>
</tr>
<tr>
<td>Try it out</td>
<td>1</td>
</tr>
<tr>
<td>What do you think ecologists can gain from working with you?</td>
<td></td>
</tr>
<tr>
<td>Gain Pedagogy</td>
<td>7</td>
</tr>
<tr>
<td>Different Perspective</td>
<td>3</td>
</tr>
<tr>
<td>Enthusiasm</td>
<td>3</td>
</tr>
<tr>
<td>Value of teacher/students as researchers</td>
<td>2</td>
</tr>
<tr>
<td>Patience</td>
<td>1</td>
</tr>
<tr>
<td>What do you hope to gain from interacting with ecologists in the field?</td>
<td></td>
</tr>
<tr>
<td>Research Techniques</td>
<td>6</td>
</tr>
<tr>
<td>Ideas for integration</td>
<td>5</td>
</tr>
<tr>
<td>Ecological Content Knowledge</td>
<td>4</td>
</tr>
<tr>
<td>Network with Ecologists</td>
<td>2</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Questions and Responses</th>
<th># of Teachers Reporting Each Answer (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>When teaching ecology to your students, what do you foresee as the greatest challenges?</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>7</td>
</tr>
<tr>
<td>School Resources</td>
<td>6</td>
</tr>
<tr>
<td>Student Interest</td>
<td>3</td>
</tr>
<tr>
<td>Addressing Standards</td>
<td>2</td>
</tr>
<tr>
<td>What do you think the ecologist gained from working with you?</td>
<td></td>
</tr>
<tr>
<td>Pedagogy</td>
<td>6</td>
</tr>
<tr>
<td>Enthusiasm</td>
<td>5</td>
</tr>
<tr>
<td>New Perspective</td>
<td>2</td>
</tr>
<tr>
<td>Value of Teacher/Student as researcher</td>
<td>2</td>
</tr>
<tr>
<td>Metacognition</td>
<td>2</td>
</tr>
<tr>
<td>Did you obtain goals you set for the CREST Program? What aspects of the program helped and what aspects prevented attaining them?</td>
<td>10</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Helped</td>
<td></td>
</tr>
<tr>
<td>Research Techniques</td>
<td>5</td>
</tr>
<tr>
<td>Networking</td>
<td>2</td>
</tr>
<tr>
<td>Trying it out</td>
<td>2</td>
</tr>
<tr>
<td>Authentic experience</td>
<td>2</td>
</tr>
<tr>
<td>Working with ecologist</td>
<td>1</td>
</tr>
<tr>
<td>Allowed to play role of Learner</td>
<td>1</td>
</tr>
<tr>
<td>Time to Reflect</td>
<td>1</td>
</tr>
<tr>
<td>Prevented</td>
<td></td>
</tr>
<tr>
<td>Instructor Availability</td>
<td>1</td>
</tr>
<tr>
<td>Negative Interaction with other Teachers</td>
<td>1</td>
</tr>
<tr>
<td>Negative Interaction with Program Staff</td>
<td>1</td>
</tr>
<tr>
<td>How do you see field research fitting into your science curriculum?</td>
<td>10</td>
</tr>
<tr>
<td>New ideas</td>
<td></td>
</tr>
<tr>
<td>Modifying Established Projects</td>
<td>1</td>
</tr>
<tr>
<td>What was the greatest part about working with ecologists in the field?</td>
<td></td>
</tr>
<tr>
<td>Personal Traits of Ecologist</td>
<td>8</td>
</tr>
<tr>
<td>Authentic Work</td>
<td>3</td>
</tr>
<tr>
<td>Learning Techniques</td>
<td>2</td>
</tr>
<tr>
<td>Inspiration</td>
<td>1</td>
</tr>
<tr>
<td>Would you do a program similar to CREST in the future? Why or Why not?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
</tr>
<tr>
<td>Expanded Knowledge</td>
<td>5</td>
</tr>
<tr>
<td>Network of Teachers</td>
<td>3</td>
</tr>
<tr>
<td>Program Staff</td>
<td>1</td>
</tr>
<tr>
<td>Learned New Techniques</td>
<td>1</td>
</tr>
<tr>
<td>New Ideas for Integration</td>
<td>1</td>
</tr>
<tr>
<td>Liked Program Format</td>
<td>1</td>
</tr>
</tbody>
</table>
### Table 2.6. CREST Teacher Responses to Post-program Survey Statements.

*Statements were rated on a Likert Scale of 1 (Strongly Disagree) to 5 (Strongly Agree).*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>My school is located in close proximity to potential field-research sites.</td>
<td>4.7 (0.15)</td>
</tr>
<tr>
<td>My community offers opportunities to engage in partnerships with scientists.</td>
<td>4.2 (0.25)</td>
</tr>
<tr>
<td>My students would benefit from participation in field-research.</td>
<td>5.0 (0.00)</td>
</tr>
<tr>
<td>I feel confident in leading my students in field-research.</td>
<td>4.6 (0.16)</td>
</tr>
<tr>
<td>I feel confident that I can address standards through engaging my students in field-research.</td>
<td>4.6 (0.16)</td>
</tr>
<tr>
<td>I will continue to seek out opportunities to work with ecologists.</td>
<td>4.8 (0.13)</td>
</tr>
<tr>
<td>Ecologists could learn a great deal from working with me.</td>
<td>4.4 (0.16)</td>
</tr>
<tr>
<td>I feel confident about integrating field research into my science curriculum.</td>
<td>4.9 (0.10)</td>
</tr>
<tr>
<td>The information that my students collect during field research will be valuable to ecologists.</td>
<td>4.5 (0.16)</td>
</tr>
<tr>
<td>I would like to continue working with field research in my personal time.</td>
<td>4.7 (0.15)</td>
</tr>
</tbody>
</table>

### Table 2.7. Comparison of Pre-program and Post-program Teacher Survey Responses to “Value of Field Research” Statements. Statements were rated on a Likert Scale of 1 (Strongly Disagree) to 5 (Strongly Agree). P-value calculated with Wilcoxon signed-ranks value (*p<0.05, **p<0.01, ***p<0.001).*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Pre-program Mean (SE) N=11</th>
<th>Post-program Mean (SE) N=10</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. My students would benefit from participation in field-research.</td>
<td>5.0 (0.00)</td>
<td>5.0 (0.00)</td>
<td>0.36</td>
</tr>
<tr>
<td>2. I feel confident in leading my students in field-research.</td>
<td>4.5 (0.21)</td>
<td>4.6 (0.16)</td>
<td>0.88</td>
</tr>
<tr>
<td>3. I feel that I can address standards through engaging my students in field-research.</td>
<td>4.5 (0.21)</td>
<td>4.6 (0.16)</td>
<td>0.42</td>
</tr>
<tr>
<td>4. I could learn a great deal from working with ecologists.</td>
<td>5.0 (0.00)</td>
<td>4.8 (0.13)</td>
<td>0.44</td>
</tr>
<tr>
<td>5. Ecologists could learn a great deal from working with me.</td>
<td>4.3 (.15)</td>
<td>4.4 (0.16)</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Post-program ecologist surveys were completed by all four participating ecologists (Table 2.8). The ecologists felt that teachers gained insight into the research process, knowledge about teaching field research, and passion for field-work from the
partnership. Personally, ecologists gained techniques for presenting work to public, exploration of a possible career in education, maintaining a connection with education, and enthusiasm. Likert data suggested that ecologists valued working with educators and students, and that education was valuable in promoting ecological literacy. Ecologists remained neutral about the value of the data collected by high school students. Ecologists also reported feeling that they generally did not commit an adequate amount of time to working with students and/or teachers apart from this program.

Pre-program and post-program student survey data comparisons suggested significant changes in students' attitudes toward science and the environment (Table 2.10). In particular, significant positive changes were reported for: "I enjoy spending time outside during my spare time" (p = 0.031), "I have participated in actual scientific research" (p = 0.0034), and "Science forms the basis for solving environmental problems" (p = 0.0005). No significant changes were detected in student responses to short-answer questions (p > 0.05) between pre-program and post-program surveys (Table 2.11).

Table 2.8. CREST Ecologist Responses to Post-program Survey Statements. Statements were rated on a Likert Scale of 1 (Strongly Disagree) to 5 (Strongly Agree).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean (SE) (N = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have a lot to gain from working with educators.</td>
<td>4.3 (0.25)</td>
</tr>
<tr>
<td>Education is a key component to promoting ecological literacy.</td>
<td>5.0 (0.00)</td>
</tr>
<tr>
<td>I can assist high school science teachers in developing field research projects for students.</td>
<td>4.5 (.29)</td>
</tr>
<tr>
<td>Working directly with high school science students interests me.</td>
<td>4.25 (0.25)</td>
</tr>
<tr>
<td>Data collected by high school students is valid.</td>
<td>3.5 (0.50)</td>
</tr>
<tr>
<td>I commit and adequate amount of time to working with students and/or educators.</td>
<td>2.75 (0.48)</td>
</tr>
<tr>
<td>Question</td>
<td># of Ecologists Responding to Each Answer. (N=4)</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>Ecologist Responses to Survey Questions</strong></td>
<td></td>
</tr>
<tr>
<td>What prompted you to be involved with the CREST program?</td>
<td></td>
</tr>
<tr>
<td>Previous connection with program staff</td>
<td>3</td>
</tr>
<tr>
<td>Desire to be involved with community</td>
<td>1</td>
</tr>
<tr>
<td>Feel involved with education</td>
<td>1</td>
</tr>
<tr>
<td>What do you think you have to gain form working with high school science educators?</td>
<td></td>
</tr>
<tr>
<td>Techniques for presenting work to public</td>
<td>2</td>
</tr>
<tr>
<td>Explore possible career</td>
<td>1</td>
</tr>
<tr>
<td>Maintain connection with education</td>
<td>1</td>
</tr>
<tr>
<td>Enthusiasm</td>
<td>1</td>
</tr>
<tr>
<td>What do you think high school science teachers have to gain from working with you?</td>
<td></td>
</tr>
<tr>
<td>Insight into research process</td>
<td>3</td>
</tr>
<tr>
<td>Gain form my experience teaching field research</td>
<td>1</td>
</tr>
<tr>
<td>Passion</td>
<td>1</td>
</tr>
<tr>
<td><strong>Ecologist Response to Interview Questions</strong></td>
<td></td>
</tr>
<tr>
<td>Would you participate in a program similar to CREST in the future?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
</tr>
<tr>
<td>What would you change about the program?</td>
<td></td>
</tr>
<tr>
<td>More interaction with teachers prior to going into the field</td>
<td>2</td>
</tr>
<tr>
<td>Nothing</td>
<td>2</td>
</tr>
<tr>
<td>What parts would you make sure were kept in the program?</td>
<td></td>
</tr>
<tr>
<td>Low number of teacher to ecologist, no more than two teachers to each ecologist</td>
<td>1</td>
</tr>
<tr>
<td>Same teacher with ecologist throughout</td>
<td>1</td>
</tr>
<tr>
<td>Quality of teachers who came</td>
<td>1</td>
</tr>
<tr>
<td>Follow through with rest of program</td>
<td>1</td>
</tr>
<tr>
<td>What did you gain from working with the teacher?</td>
<td></td>
</tr>
<tr>
<td>Different perspective</td>
<td>3</td>
</tr>
<tr>
<td>Valuable help with data collection</td>
<td>2</td>
</tr>
<tr>
<td>Valuable discussions about education</td>
<td>1</td>
</tr>
<tr>
<td>What do you think the teachers gained from working with you?</td>
<td></td>
</tr>
<tr>
<td>Insight into research process</td>
<td>3</td>
</tr>
<tr>
<td>Feeling like colleagues</td>
<td>1</td>
</tr>
</tbody>
</table>
Figure 2.2. CREST Student Responses to Pre-program and Post-program. Survey responses were recorded on a Likert scale from 1 (strongly agree) to 5 (strongly disagree). Scores closer to 1 represent a more positive attitude towards science or the environment. Bars represent means (± standard error); the p-value was calculated with a Wilcoxon signed-ranks test. (*p<0.05, **p<0.01, ***p<0.001)

CREST Student Science and Environmental Attitude Survey

<table>
<thead>
<tr>
<th>Enjoy time outside</th>
<th>Participated in Actual</th>
<th>Feed wild animals</th>
<th>Write letter for environmental</th>
<th>Donate money to</th>
<th>Organize community</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (p&lt;0.05)</td>
<td>2 (p&lt;0.05)</td>
<td>3 (p&gt;0.05)</td>
<td>4 (p&gt;0.05)</td>
<td>5 (p&gt;0.05)</td>
<td>6 (p&gt;0.05)</td>
</tr>
</tbody>
</table>

Figure 2.3. CREST Student Responses to Pre-program and Post-program. Survey responses were recorded on a Likert scale from 1 (strongly agree) to 5 (strongly disagree). Scores closer to 1 represent a more positive attitude towards science or the environment. Bars represent means (± standard error); the p-value was calculated with a Wilcoxon signed-ranks test. (*p<0.05, **p<0.01, ***p<0.001)

CREST Student Science and Environmental Attitude Survey

<table>
<thead>
<tr>
<th>Enjoy time outside</th>
<th>Participated in Actual</th>
<th>Feed wild animals</th>
<th>Write letter for environmental</th>
<th>Donate money to</th>
<th>Organize community</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (p&lt;0.05)</td>
<td>2 (p&lt;0.05)</td>
<td>3 (p&gt;0.05)</td>
<td>4 (p&gt;0.05)</td>
<td>5 (p&gt;0.05)</td>
<td>6 (p&gt;0.05)</td>
</tr>
</tbody>
</table>
Table 2.10. CREST Student Responses to Pre-program and Post-program Survey

This survey was completed by CREST students prior to engaging with research groups and after completing their research projects. Responses were recorded on a Likert scale from 1 (strongly agree) to 5 (Strongly disagree). Scores closer to 1 represent a more positive attitude towards science or the environment. Means are given for each test (± standard error); p-value calculated with a Wilcoxon signed-ranks test. (*p<0.05, **p<0.01, ***p<0.001)

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-Test N=25</th>
<th>Post-Test N=23</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In enjoy spending time outside during my spare time</td>
<td>1.6 (0.18)</td>
<td>1.3 (0.15)</td>
<td>0.031*</td>
</tr>
<tr>
<td>2. I have participated in actual scientific research.</td>
<td>2.3 (0.22)</td>
<td>1.3 (0.12)</td>
<td>0.0034**</td>
</tr>
<tr>
<td>3. If a wild animal would eat from my hand, I would not try to feed it.</td>
<td>2.6 (0.29)</td>
<td>2.3 (0.27)</td>
<td>0.27</td>
</tr>
<tr>
<td>4. I would write a letter to my state’s congressional representative asking them to take action on an environmental issue.</td>
<td>2.2 (0.21)</td>
<td>2.1 (0.24)</td>
<td>0.42</td>
</tr>
<tr>
<td>5. I would donate money to an organization that protects or cleans up the environment.</td>
<td>2.1 (0.17)</td>
<td>1.8 (0.14)</td>
<td>0.076</td>
</tr>
<tr>
<td>6. I would organize a group in my community to work on an environmental issue.</td>
<td>2.2 (0.18)</td>
<td>2.3 (0.21)</td>
<td>0.71</td>
</tr>
<tr>
<td>7. Humans can affect the environment in positive ways.</td>
<td>1.6 (0.12)</td>
<td>1.3 (0.12)</td>
<td>0.11</td>
</tr>
<tr>
<td>8. Science forms the basis for solving environmental problems</td>
<td>1.7 (0.13)</td>
<td>1.2 (0.088)</td>
<td>0.0005**</td>
</tr>
<tr>
<td>9. Present generations are responsible for the quality of the environment experienced by future generations.</td>
<td>1.5 (0.19)</td>
<td>1.2 (0.081)</td>
<td>0.055</td>
</tr>
<tr>
<td>10. Humans have a responsibility to other animal species.</td>
<td>1.4 (0.15)</td>
<td>1.4 (0.15)</td>
<td>0.58</td>
</tr>
<tr>
<td>11. Humans have a responsibility to plants.</td>
<td>1.5 (0.15)</td>
<td>1.4 (0.14)</td>
<td>0.063</td>
</tr>
<tr>
<td>12. Humans have a responsibility to nonliving things (e.g. rivers, soil, air).</td>
<td>1.3 (0.11)</td>
<td>1.5 (0.16)</td>
<td>0.88</td>
</tr>
</tbody>
</table>
Table 2.11. Comparison of Pre-test and Post-test Student Scores.
Scores were determined by using a rubric to rate responses from 0 (no response) to 4 (full understanding). P-value calculated with Wilcoxon signed-ranks test.

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-test Mean (SE)</th>
<th>Post-test Mean (SE)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define ecology.</td>
<td>2.2 (0.22)</td>
<td>2.2 (0.25)</td>
<td>0.88</td>
</tr>
<tr>
<td>Describe how you would teach a class of third graders about connections between animals, plants, and their environment.</td>
<td>2.6 (0.20)</td>
<td>2.3 (0.17)</td>
<td>0.95</td>
</tr>
<tr>
<td>Make a decision on an environmental issue and provide evidence to support your decision.</td>
<td>2.4 (0.14)</td>
<td>2.0 (0.17)</td>
<td>0.99</td>
</tr>
<tr>
<td>Total</td>
<td>7.1 (0.45)</td>
<td>6.5 (0.44)</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Interviews

Teachers reported that they came to the CREST program for various reasons during the pre-program interviews (Table 2.12). Those reasons included chance to explore new pedagogy and spend time in the Tetons, new ideas for science curriculum, time to be a student and learn more about ecology, learn new research techniques, and an opportunity to expand ongoing research projects. During the post-program interviews, all teachers (n = 10) responded “yes” when asked if they were interested in participating in similar programs in the future. Teachers stated “program flow” (n = 5) and “techniques” (n = 3) as the top attributes of the CREST program during post-program interviews. The most frequent recommendation was to “increase the amount of student contact” (n=6).

Teachers reported integrating what they had learned during the CREST program in different ways. Five teachers reported they had integrated “sense of place techniques
to expand on-going projects.” Three teachers stated they had not used any of the techniques they had learned during the program. One teacher reported using a modified version of the project she had developed while participating in the CREST program.

 Ecologists all stated that they would participate in a program similar to CREST in the future (Table 2.8), and they liked the low ratio of teachers to ecologists, working with the same teacher throughout the program, the quality of the teachers, and the follow through with the rest of the program. When asked what they would change, two ecologists stated they would like to have more contact with the teachers. The other two ecologists replied they would change nothing about their involvement with the CREST program.

 Teacher Journals

 Journal prompts aided in understanding what the teachers were experiencing during the program (Table 2.1a&b). All of the teachers who completed the CREST (N = 10) responded to the same five journal prompts. For the first prompt, distributed at the end of the first day of the CREST, teachers were asked to write about how they were feeling as the program began. The overwhelming response was that they were looking forward to the networking that would take place over the next three weeks (n = 9). Exploring the Grand Teton National Park environment and working with ecologists and students were also sources of excitement for the teachers as they looked ahead to the coming weeks.

 In addition to asking teachers to reflect on their first two days of the program, the second prompt asked teachers to think about partnerships they could develop back at their schools. Seven teachers responded with ideas for creating science partnerships when they returned home after the CREST program. Comments included:
The partnership ideas are starting to 'pop' into my head... I've begun developing some partnerships and hope to expand those... Our program is completely based on partnerships... The main problem is keeping up with the partnerships...

Table 2.12. CREST Teacher Responses to Interview Questions

<table>
<thead>
<tr>
<th>Question</th>
<th># of teachers reporting response (N = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>From Pre-program Interview</strong></td>
<td></td>
</tr>
<tr>
<td>What attracted you to the CREST program?</td>
<td></td>
</tr>
<tr>
<td>Chance to explore new pedagogy</td>
<td>3</td>
</tr>
<tr>
<td>Chance to spend time in Tetons</td>
<td>2</td>
</tr>
<tr>
<td>Gain new ideas for science curriculum</td>
<td>2</td>
</tr>
<tr>
<td>Chance to be a student</td>
<td>2</td>
</tr>
<tr>
<td>Learn more about ecology</td>
<td>1</td>
</tr>
<tr>
<td>Learn new research techniques</td>
<td>1</td>
</tr>
<tr>
<td>Expand ongoing research projects</td>
<td>1</td>
</tr>
<tr>
<td><strong>From Post-program Interview</strong></td>
<td></td>
</tr>
<tr>
<td>Would you do a program similar to CREST in the future?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
</tr>
<tr>
<td>What would you change about the program?</td>
<td></td>
</tr>
<tr>
<td>Increase amount of student contact</td>
<td>6</td>
</tr>
<tr>
<td>Logistics</td>
<td>2</td>
</tr>
<tr>
<td>Recruitment</td>
<td>2</td>
</tr>
<tr>
<td>Activities on weekend</td>
<td>1</td>
</tr>
<tr>
<td>Continued contact</td>
<td>1</td>
</tr>
<tr>
<td>What parts of the program would you make sure we keep?</td>
<td></td>
</tr>
<tr>
<td>Course Flow</td>
<td>5</td>
</tr>
<tr>
<td>Techniques</td>
<td>3</td>
</tr>
<tr>
<td>Student component</td>
<td>1</td>
</tr>
<tr>
<td>Length</td>
<td>1</td>
</tr>
<tr>
<td>Time spent with researcher</td>
<td>1</td>
</tr>
<tr>
<td>Chance to be a student</td>
<td>1</td>
</tr>
<tr>
<td>Diversity of teaching backgrounds</td>
<td>1</td>
</tr>
<tr>
<td>How have you implemented what you learned during the CREST program?</td>
<td></td>
</tr>
<tr>
<td>Using sense of place techniques to expand ongoing projects</td>
<td>5</td>
</tr>
<tr>
<td>Not using any, but have plans that involve using techniques from CREST</td>
<td>3</td>
</tr>
<tr>
<td>Modified ongoing projects to be more student led</td>
<td>2</td>
</tr>
<tr>
<td>Used a modified version of project from the CREST program</td>
<td>1</td>
</tr>
</tbody>
</table>

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Table 2.13a. CREST Teacher Responses to Journal Prompts

<table>
<thead>
<tr>
<th>Question and Responses</th>
<th># of Teachers Reporting Response (N = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>What aspects of CREST are you excited about? What aspects of the program concern you?</td>
<td></td>
</tr>
<tr>
<td><strong>Excited</strong></td>
<td></td>
</tr>
<tr>
<td>Networking with other Teachers</td>
<td>9</td>
</tr>
<tr>
<td>Exploring Program Environment</td>
<td>8</td>
</tr>
<tr>
<td>Working with Students</td>
<td>4</td>
</tr>
<tr>
<td>Working with Ecologists</td>
<td>4</td>
</tr>
<tr>
<td>Learning new Ecological Content</td>
<td>1</td>
</tr>
<tr>
<td>Learning Research Techniques</td>
<td>1</td>
</tr>
<tr>
<td>Expanding Pedagogy</td>
<td>1</td>
</tr>
<tr>
<td><strong>Concerned</strong></td>
<td></td>
</tr>
<tr>
<td>Working with students</td>
<td>2</td>
</tr>
<tr>
<td>Personal Physical Fitness</td>
<td>1</td>
</tr>
<tr>
<td>Program Facilities</td>
<td>1</td>
</tr>
<tr>
<td>Are you beginning to think of some partnerships you can develop back home?</td>
<td></td>
</tr>
<tr>
<td>Stated partnership idea</td>
<td>7</td>
</tr>
<tr>
<td>Did not state partnership idea</td>
<td>3</td>
</tr>
<tr>
<td>What are some of the things you are hoping to gain from working with the ecologist?</td>
<td></td>
</tr>
<tr>
<td>Research Design</td>
<td>6</td>
</tr>
<tr>
<td>Research Techniques</td>
<td>5</td>
</tr>
<tr>
<td>Ecological Content Knowledge</td>
<td>5</td>
</tr>
<tr>
<td>Integration Ideas</td>
<td>1</td>
</tr>
<tr>
<td>What was the value of your time spent with the ecologist?</td>
<td></td>
</tr>
<tr>
<td>Learned new Research Techniques</td>
<td>5</td>
</tr>
<tr>
<td>Personal Traits of Ecologist</td>
<td>3</td>
</tr>
<tr>
<td>Ecological Content Knowledge</td>
<td>3</td>
</tr>
<tr>
<td>Chance to Reflect on Teaching</td>
<td>3</td>
</tr>
<tr>
<td>Inspiration</td>
<td>2</td>
</tr>
<tr>
<td>Project Design</td>
<td>2</td>
</tr>
<tr>
<td>Networking with Ecologist</td>
<td>1</td>
</tr>
<tr>
<td>Fun</td>
<td>2</td>
</tr>
<tr>
<td>Exploring Program Environment</td>
<td>1</td>
</tr>
<tr>
<td>Hands on Participation</td>
<td>1</td>
</tr>
<tr>
<td>How has The CREST program helped you better understand the process of ecological field research?</td>
<td></td>
</tr>
<tr>
<td>Allowed me to Struggle with Process</td>
<td>3</td>
</tr>
<tr>
<td>Time with Ecologist</td>
<td>2</td>
</tr>
<tr>
<td>Time to Reflect on Pedagogy</td>
<td>2</td>
</tr>
<tr>
<td>Refreshed old Knowledge</td>
<td>2</td>
</tr>
<tr>
<td>Sense of Place Techniques</td>
<td>1</td>
</tr>
<tr>
<td>Learning Research Techniques</td>
<td>1</td>
</tr>
<tr>
<td>Using Real Research Tools</td>
<td>1</td>
</tr>
<tr>
<td>Working with Data Analysis</td>
<td>1</td>
</tr>
</tbody>
</table>
The third and fourth journal prompts focused on teachers’ experiences working with the ecologists. Prior to going into the field, teachers wrote they hoped to gain research design ideas, research techniques, and ecological content knowledge. After spending time in the field, five teachers wrote that the greatest value of the experience with the ecologist was in learning research techniques. Teachers also wrote that the ecologists’ personal traits (n=3) and the ecological content knowledge they shared were important (n = 3). Examples of ecologist personal traits mentioned by teachers were passion and dedication toward their fieldwork. From these traits the teachers reported being inspired. Regarding their professional lives, three teachers wrote that the time in the field allowed them a time to reflect on their teaching. One teacher wrote, “I have realized the need to rethink my current approaches to teaching.”

The last journal prompt was distributed to teachers on the final day of the CREST program. Teachers were asked to reflect on the value of the CREST program and to think ahead toward integration of elements of their research experience into their science curricula. Teachers wrote that CREST had helped them to better understand the process of ecological field research by allowing them to struggle with the process, providing time
in the field with ecologists, refreshing old knowledge, and introducing new techniques. Reflection on practice was the most common response regarding teaching skills they had honed during the program (n=4). When teachers were asked to describe how they would integrate their experience into their science curriculum, teachers wrote they would share the experiences with their students and use the techniques for new and existing projects. One teacher commented that he would continue to network with the ecologist he had worked with. This teacher wrote:

The value of “doing” field research with the ecologist was high for me. I’ve made a connection with a field researcher who will be continuing his research and will present to my students. Most importantly I’ve been inspired and have made a new friend.

The format presented in this study was not able to address the study’s second question, “How were the benefits facilitated?” This portion of the study was designed to examine outcome or summative data. When the question is focused on the processes that occurred during the program, formative assessment techniques need to be applied. With this in mind, an evaluation method that takes a more holistic look at program relationships is needed.

DISCUSSION

The Teton CREST was successful as a teacher workshop to introduce teachers to the techniques of ecological field research. CREST participants gave the program high approval ratings on post-program surveys, and both teachers and ecologists stated they would like to be involved in a program similar to the CREST in the future. From an institutional standpoint, TSS was satisfied with the program’s success, and this provides impetus for continuation. But feedback from program participants cannot be the sole basis for determining the success of a program. Relying solely on this data has been the
shortcomings of many programs associated with science teacher professional
development and science reform (NRC, 1996a; Sawada, Piburn, & Judson, 2002; Udovic,
Morris, & Dickman, 2002).

To better understand what the participating students gained from the program I
looked at changes in attitudes towards the environment and science. All of the students
exhibited what I would judge to be “positive” environmental attitudes (see LaTrobe &
Acott, 2000) based on changes between pre and post-program surveys. Why weren’t
there more significant changes form pr- to post-surveys? I believe it is because students
came to the program with “positive” environmental attitude, moreover, the significant
changes that were reported occurred as a result of participating in ecological field
research, similar to what would have been expected from participation in a field based
research program (see Manzanal et al., 1999; Zelezny, 1999).

What was not expected was the decline in scores on the short-answer portion of
the survey. On two out of three questions, students scored significantly lower on the
post-test questions. Two factors may explain this drop in the scores. First, students did
not take the tests seriously. CREST student participants arrived at the program shortly
after completing their academic school year and may have viewed the CREST program
more as a retreat than a chance to perform academically. Another reason was rooted in
the nature of the questions. Students were exposed to different projects during their
week, and the content covered in those projects varied, yet the test questions were written
to explore a broad content base. Hence, the questions were not well aligned with the
CREST experience, and they emphasized “transfer” knowledge. With such broad
questions, too much effort was placed on transfer knowledge. According to Basile
(2000) transfer knowledge questions require “students to apply the knowledge and skills they learn in one context to other situations.” Although this was a valid expectation of students, the teachers in the program did not focus on promoting this type of learning.

Overall the changes in student attitudes and test scores could not be attributed directly to the program. The results reported from the students are best viewed as secondary outcomes of the CREST program (J. Heimlich, personal communication, October 11, 2001), because the primary audience of the program was teachers.

Program organizers expected that ecologists would benefit from partnerships with teachers. For example, Falk and Drayton (1997) observed that ecologists most often reported enthusiasm as the primary benefit from engaging in a partnership with high school science teachers. Participating CREST ecologists recognized the enthusiasm and the passion that teachers shared, but commented directly on the value of the teachers' perspective on education. This may be due to the fact that all the ecologists were graduate students and at a point in their education where they were still exploring career options. The CREST program offered them a direct connection to the educational world that they typically would not have experienced during their academic work. All of the CREST ecologists commented about the need to have more interaction with the teachers prior to going into the field. This was consistent with the recommendations that Caton et al. (2000) made regarding developing effective collaborations. This level of interaction was not scheduled in the CREST curriculum. Thus the participants did not receive the depth of benefits that participating in longer, more sustainable, partnerships afford.
The value of the CREST program to teachers in terms of reflection on practice and exposure to new techniques and ideas should not be overlooked. During a closing discussion, one of the teachers stated:

Somewhere along the line these three weeks, I thought to myself, none of the labs I do are worth anything. That is sort of phenomenal because they don’t. They do begin with a question, but it is a question that is typed on a sheet of paper... myself I have to do some revitalization.

And another wrote in her journal:

I have taught 32 years and I am amazed at all the skills I’ve acquired and honed during this experience.

Despite not having facilitated more substantive partnerships in the field, teachers still reported the value of time spent with the ecologist. Teachers developed new research techniques for uses in their projects, they gained stories to bring back to their students, and, as some reflected, they experienced a sense collegiality they could not have gained in their school environments. One teacher reflected:

Working with the scientists added an incredible dimension to the program. It was so powerful to listen to each group discuss the field research they were involved in. To see the challenges they face. The thinking, revising, and the fact that they [ecologists] don’t have all the answers was fun, exciting and most of all encouraging.

It was testimonies like these that triggered a look back at the original goal of the CREST program: of giving teachers the tools to integrate ecological field research into their science curriculum. Should integration have been the program’s ultimate goal? Given the challenges that teachers stated coming into the program (time and resources), integration may not have been possible without a much more aggressive intervention, including more intensive post-program follow-up and networking, as well as infusing new resources into the schools. This was not realistic within the program budgets. To
stick closer to the goal and only focusing on providing teachers with experience to integrate ecological field research in their science curriculum is a more reasonable goal for this type of program. Teachers left the CREST program energized with new ideas to integrate field research into their science curriculum. Six months later, post-program interviews revealed only 50% of the teachers who completed the CREST program had actually integrated some of the techniques into their science curricula, suggesting marginal success midway through the school year. Subsequent follow-up at the end of the school year would have helped us learn whether or not more teachers had brought elements of CREST into their curriculum.

Are programs similar to CREST doomed to be marginally successful until they are able to reach the goal of full integration in schools? The answer may well be yes if they are not sustained beyond the scope of the workshop. Despite their short-comings, programs like CREST are excellent beginnings to designing effective professional develop to address the components of ecological literacy. As one of the ecologists commented:

The CREST program is the right step toward bringing students, their teachers and researchers together. I think we all benefited from the experience.

The continuation of the CREST program beyond its first year will provide ample opportunity for growth. The need for longitudinal evaluation is going to be central to understanding and ultimate effectiveness of the CREST program.

The educational evaluator should not list goals only in terms of anticipated student behavior. To evaluate an educational program, we must examine what teaching, as well as what learning, is intended. – Stake (1977).

In previous analyses, the Teton CREST (Combining Research and Education in Science Teaching) program was judged to be marginally successful after the first offering, but also to be a program of high potential impact (see Chapter 2). That analysis solely focused on analyzing the program goal of integration of the CREST experiences into science curricula. Valuable summative data were collected that will be of use to program developers, and in comparison with other programs when assessing the larger questions of the value of these types of programs. What was not addressed in the previous analysis was the question, “How were participant gains facilitated?”

This chapter explores the use of an organizing framework to explore that facilitation. Through an analytical approach that focused more on formative data, emergent properties of the CREST program were discovered. These properties were used to build a model that explained how the CREST program facilitated participant gains. From this model, recommendations for programmatic changes to the CREST program will be made. Stake’s evaluation model was chosen for this phase of CREST program evaluation because it facilitates organization of diverse data. It was also chosen for its potential to provide full description of a program.

Evaluating Educational Programs

NRC’s (1996a & 1996b) professional development evaluation goals aim at full description of a program, meaning that the evaluation goals are not solely focused on
program outcomes, but include evaluating the processes that led to those outcomes. There are historical models to accomplish this goal. In 1967, Robert Stake (1967) wrote a critical paper on the state of evaluation in education entitled, “Towards a technology for the evaluation of educational programs.” Ten years later, based on the ideas from that original paper, Stake developed an evaluation model that addressed full program description, including the elements of program processes (Gall et al., 1999). Stake’s original ideas were developed when education was in a period of reform; a similar setting that science education is in today. Initially, Stake (1967) differentiated evaluation from research stating, “Evaluation is expository…it differs from educational research in its orientation to a specific program rather than to variables common to many programs.”

Stake’s early work has been identified by contemporary authorities for its ability to address specifically to the needs of the program stakeholders (Gall et al., 1999). Although evaluation seeks full description of local situations (Abma & Stake, 2001), systematic reform depends on these evaluation elements to piece together the whole educational puzzle (NRC, 1996a). Program evaluation has become an essential part in developing new partnership programs, by learning from successes and failures of other programs. Indeed, current funding for partnership programs often is contingent upon an evaluative component (NRC, 1996a). Evaluation comprises both summative and formative functions and therefore, it is valuable throughout a program’s life (Mayer & Fortner, 2001).

The overall goal of evaluation is to provide a picture that readers can relate to (Stake, 1991). The approach to evaluation is dynamic, in that the process must be flexible and adaptable to accommodate the dynamic nature of professional development.
programs (Mayer & Fortner, 2001). The research tradition chosen to design the evaluation should accommodate this dynamic nature. The dominant research traditions used with education evaluation are ethnographic, naturalistic, and phenomenological (Stake, 1991).

Phenomenology can be defined as how individuals subjectively experience reality (Gall et al., 1999). Thus, phenomenological study describes the effect of a program to several individuals and adds to the program evaluation by focusing on the learners’ experience (Creswell, 1998; Grady, 1998). With respect to CREST, phenomenology offers a chance to view the challenges that teachers and scientists face in partnerships (Wals, 2001). The research tradition of phenomenology moves away from the positivist-empirist approach to collecting data from a person’s environment (Robertson, 1994). Phenomenology, instead, taps into the consciousness of the individual (Creswell, 1998), and thus stepping away from the research tradition in which that most scientists are trained and practice professionally. Thus, when traditionally trained scientists attempt to implement program evaluation, the frequently encounter difficulties (NRC, 1996a):

Unlike scientific research, whose product is a peer-reviewed paper, the ‘product’ we are dealing with – and education program – involves human interactions and is not readily subject to peer review. Scientists therefore must be aware of the complexities inherent in analyzing educational programs.

**Stake’s Evaluation Model**

Ideally, the evaluation is a cohesive piece with each entity leading to the next (Stake, 1977). His evaluation model has been used as an organizing context for teacher professional development course evaluation (Wood, 2001), and is recognized for education program evaluation (Gall et al., 1999). The model features an organizing
matrix for full program description, including three types of data: antecedents, transactions, and outcomes (Table 3.1; Figure 3.1).

Antecedents are the resources and experience that stakeholders bring to the program (Stake, 1977; Wood, 2001). For example, the teacher's prior ecological field-research experience, or the ecologist's comfort level with students, are experiences participants bring to a program. This information often is referred to "background information" or "personal history."

Transactions are the exchanges occurring throughout the program. Relative to antecedents and outcomes, transactions are the "dynamic" data (Stake, 1977). For example, the discussions ecologists and teachers have in the field during the program, and networking and the community that develops during the program are transactions. It is important to note that the boundaries between transactions, antecedents, and outcomes are not distinct.

Outcomes were historically the research focus, because data related to outcomes were traditionally the most easily quantified. However, outcome results could be deceiving when reported out of the context from which were studied (Stake, 1977; NRC, 1996a). In addition, the reporting of professional development program outcomes often has been to the program's effect on education. Reporting data in such a manner was very beneficial to the body of literature on the value of professional development, but when looking at the data's value to formative program evaluation, many holes were observed. Thus, models accommodating a full program description are likely to be more effective in improving the program (Stake, 1977) because they are supported by a broader scope of the data.
<table>
<thead>
<tr>
<th>Stake’s Terminology</th>
<th>Common Terminology</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antecedent</td>
<td>Background</td>
<td>Pre-existing conditions that may influence program outcomes.</td>
</tr>
<tr>
<td>Transactions</td>
<td>Encounters</td>
<td>Interactions that participants are exposed to during the program.</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Results</td>
<td>Observed and/or measured effects of the program. Stake described as, “the consequences of educating.” Outcomes maybe either intended or unintended (Wood, 2001).</td>
</tr>
<tr>
<td>Congruence</td>
<td>Relationships</td>
<td>Relationships within antecedents, transactions, and outcomes. Used to compare the intents with observations, in order to provide base for judgments. Provides summative evaluation data.</td>
</tr>
<tr>
<td>Contingence</td>
<td>Relationships</td>
<td>Relationships between antecedents, transactions, and outcomes. Used to identify antecedents and transactions that affected outcomes. Provides formative evaluation data.</td>
</tr>
<tr>
<td>Descriptive Matrix</td>
<td>Methods and Results</td>
<td>Portion of evaluation matrix that includes intents and observations.</td>
</tr>
<tr>
<td>Judgmental Matrix</td>
<td>Discussion</td>
<td>Portion of evaluation matrix that includes standards and judgments.</td>
</tr>
<tr>
<td>Intents</td>
<td>Objectives</td>
<td>Planned for program environment and results.</td>
</tr>
<tr>
<td>Observations</td>
<td>Data</td>
<td>Examination of program intents using measurement devices decided by the evaluator.</td>
</tr>
<tr>
<td>Standards</td>
<td>Criteria</td>
<td>Base of comparison for observations matching intents.</td>
</tr>
<tr>
<td>Judgments</td>
<td>Discussion</td>
<td>Opinion of evaluator regarding value of program component.</td>
</tr>
<tr>
<td>Rationale</td>
<td>Goals</td>
<td>Impetus or purpose of program related to educational value.</td>
</tr>
</tbody>
</table>

Within and between the three program phases described by Stake (antecedent, transactions, and outcomes), exchanges will occur. Exchanges occurring within a level are called congruencies. For example, teacher and ecologist field discussions are
congruent transactions. Stake (1977) termed the exchanges between program levels contingencies. The ecologist visiting the teacher’s classroom, as a result of field discussions, is an example of a contingency. The organizing matrix of the evaluation also makes a distinction between descriptions and judgments. Descriptions in this model are the program “intents” and associated observations. Antecedents, transactions, and outcomes are all used to provide the descriptions. Based on the intents and associated observations, the evaluator will apply standards to the data that form the basis for their judgments (Wood, 2001; Stake, 1977).

**Teton CREST Evaluation Matrix**

*Program Antecedents*

The category of *Teacher Background* was intended to represent a diverse group of teachers from varying geographic regions, and with varying degrees of experience with ecological field research and involvement in scientist partnerships. Data were collected through pre-program surveys, teacher journals, and interviews. Teacher background data focused on four areas: 1) school resources, 2) field research value, 3) administrative support, and 4) demographics. These data were used to form a baseline profile for teachers, from which program effects could be determined.

*Program content* was expected to expand teachers’ prior knowledge related to natural history, ecology, and field research. The content was evaluated for how well it prepared teachers to participate in the program and reach the program goals; thus a major part of CREST content included pre-program preparation. The content also was intended to be easily translated to a teacher’s home environment. Teacher journals and evaluator observations explored the value of program content to teachers.
The Teton Science School (TSS) environment was expected to provide an environment that promoted CREST teacher learning. The analysis of the TSS environment included facilities, staff, surrounding areas, and also the interactions that teachers had with each of those entities. Learning communities that developed during the program were of special interest, because such communities had been noted as vitally important in other similar program environments (see Richmond & Kurth, 1999 and Barab & Hays, 2001).
Program Transactions

Interactions teachers encountered during CREST were expected to be a positive asset to the program. Interactions that teachers engaged in during the CREST program included: 1) teacher – teacher, 2) teacher – ecologist, 3) teacher – student, and 4) teacher – program. Throughout the program, teachers were expected to have the opportunity to be involved in networking, and following the program, a network to be established keeping teachers connected with ecologists, other teachers, and TSS.

Program flow was expected to reflect a logical progression of program content, which prepared teachers to design and facilitate their own field research project. Evaluator observations and post-program interviews assessed the teachers’ perceptions of CREST’s choreography. Teacher journals, evaluator observations, post-program surveys, and post-program interviews described the interactions and the perceived value of those interactions.

Program Outcomes

Attitude, as described by Manzanal, Barreiro, and Jimenez (1999) includes three components: cognitive, affective, and behavioral influence. The CREST program evaluated the various components of attitude for each participant, and it was expected that all participants would have a positive attitude toward their experience desire to participate in similar programs. Data from surveys, interviews and journals provided information about the CREST teachers’ attitudes towards the program (cognitive and affective), as well as their attitude towards integration (behavioral influence). Pre-test and post-test scores assessed CREST’s effect on student attitudes related to science and environment. Interviews and surveys explored ecologist attitudes toward their
participation in the CREST program. Data collected described the program’s effect on attitude (affective and behavioral influence) toward partnering with science teachers. Interviews and surveys also examined benefits that ecologists received. Analysis focused on program components that contributed and shaped participant attitudes.

*Integration* was a desired outcome of the CREST program, based on its goals. The expectation was that teachers would integrate the skills and methods learned during the CREST program during the following school year. Throughout the program, teachers were asked to reflect on how they would integrate their new skills into their science curricula. These reflections occurred through journal writings, group discussions, and interviews. Data analyses explored the teachers’ intent to integrate, actual integration, and the CREST components that teachers recognized as promoting integration.

Creation of *student research projects* that were led by CREST teachers was intended to give teachers a chance to “try it out” and also intended to offer an opportunity for a group of students to engage in ecological field research. CREST participants reactions to the value of these projects were analyzed, as well as what students learned in relation to general ecological content and process skills.

*Networking* was an intended outcome of the interactions that were purposely designed to occur during the CREST program, and to extend beyond the program into the following year. The intent was to create and establish a network was intended to be created that would keep teachers connected to TSS, as well as the other teachers and ecologists in the program.
Unexpected outcomes are described by Wood (2001) as, “major unanticipated effects of the program.” Data from CREST surveys, interviews, teacher journals, group discussions, and evaluator observations also described project outcomes that were not predicted. The unexpected outcomes were viewed as positive, neutral, or negative, depending on their impact on other program components and outcomes.

Congruencies

The matrix represented in Tables 3.2 – 3.4 summarizes results of congruency analysis for the CREST program. The supporting data for each matrix component was presented in chapter two of this thesis (see Tables 2.3 – 2.12). Comparison of the intents of each component with the associated standards and observations formed the basis for judgments I will present. Furthermore, the congruency analysis, coupled with a contingency analysis, forms the basis for program recommendations outlined the discussion.
<table>
<thead>
<tr>
<th>Description Matrix</th>
<th>Judgement Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teacher Background</strong></td>
<td></td>
</tr>
<tr>
<td>School Resources</td>
<td></td>
</tr>
<tr>
<td>To define a resource availability baseline. This will aid in analysis of transference.</td>
<td>Pre-program surveys reported that teachers “agreed” that their administration was supportive of ecological field research.</td>
</tr>
<tr>
<td></td>
<td>Pre-program survey responses should average higher than 3.0 for administration support. Pre-program interviews will provide supplemental information.</td>
</tr>
<tr>
<td></td>
<td>CREST teachers all felt their schools, or themselves, could provide adequate resources to support ecological field research in their science curriculum.</td>
</tr>
<tr>
<td>Field research value</td>
<td></td>
</tr>
<tr>
<td>To define a field research value baseline. This will aid in analysis of transference.</td>
<td>Pre-program surveys reported that teachers “agreed” that their administration was supportive of ecological field research.</td>
</tr>
<tr>
<td></td>
<td>Pre-program survey responses should average higher than 3.0 for administration support. Pre-program interviews will provide supplemental information.</td>
</tr>
<tr>
<td></td>
<td>All CREST teachers came to the program recognizing ecological field research as valuable to student learning.</td>
</tr>
<tr>
<td>Administrative Support</td>
<td></td>
</tr>
<tr>
<td>To define a support baseline. This will aid in analysis of transference.</td>
<td>Pre-program surveys reported that teachers “agreed” that their administration was supportive of ecological field research.</td>
</tr>
<tr>
<td></td>
<td>Pre-program survey responses should average higher than 3.0 for administration support. Pre-program interviews will provide supplemental information.</td>
</tr>
<tr>
<td></td>
<td>9 of the CREST teachers came from school’s where they felt the administration would support field research in their science curriculum. 2 felt their administration was not supportive, but commented they could integrate.</td>
</tr>
<tr>
<td>Experience &amp; Demographics</td>
<td></td>
</tr>
<tr>
<td>Backgrounds should represent a diverse group of teachers from varying geographical regions. Variation in teaching experience and experience with ecological field research and scientist partnerships is desired.</td>
<td>CREST teachers came from 5 different states, teaching in both formal and informal settings. Experience ranged from 0 to 30 years (mean = 14.7; SD = 3.14). Experience with ecological field research varied greatly with some already engaging students in long-term studies with multiple partners, and others reporting no experience. There were 3 males and 8 females. All CREST teachers were white.</td>
</tr>
<tr>
<td></td>
<td>Experience should cover a large range, and the standard deviation of the average experience should be large (at least half). The demographics of the teachers should match the 2002 national averages for high school science teachers reported by the National Center for Educational Statistics (NCES).</td>
</tr>
<tr>
<td></td>
<td>The teaching experience range is sufficiently large and the variance within that range is also sufficient. The variation in ecological field research experience is also sufficient. Percent males in program (27%) below national average (45%). Percent of whites in program (91%) higher than national average (NCES, 2002).</td>
</tr>
</tbody>
</table>

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### Table 3.2b: CREST Evaluation Matrix: Program Antecedents

<table>
<thead>
<tr>
<th>DESCRIPTION MATRIX</th>
<th>JUDGMENT MATRIX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTENTS</strong></td>
<td><strong>OBSERVATIONS</strong></td>
</tr>
<tr>
<td><strong>Program Content</strong></td>
<td>All teacher journal entries identify valuable program components. Journal entries of 7 teachers discussed pertinent applications of the field techniques to their own science curriculum and potential partnerships.</td>
</tr>
<tr>
<td><strong>Program Preparation</strong></td>
<td>Teacher responses to post-program evaluations are summarized in. Anecdotally, teachers reported feeling prepared for the program in their journals. No teachers reported concerns about program content.</td>
</tr>
<tr>
<td><strong>Teton Science School (TSS) Environment</strong></td>
<td>2 Teachers stated a reason for coming to the program was the environment of the program. Overall all teachers responded positively to post program survey questions related to program facilities and staff. Negative comments were on transportation coordination and communication.</td>
</tr>
</tbody>
</table>
### Table 3.3: CREST Evaluation Matrix: Program Transactions

<table>
<thead>
<tr>
<th>DESCRIPTION MATRIX</th>
<th>JUDGMENT MATRIX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTENTS</strong></td>
<td><strong>OBSERVATIONS</strong></td>
</tr>
<tr>
<td><strong>Program Flow</strong></td>
<td></td>
</tr>
<tr>
<td>Program flow should</td>
<td>Teachers commented</td>
</tr>
<tr>
<td>appear logical and</td>
<td>positively on the</td>
</tr>
<tr>
<td>build off of itself</td>
<td>flow of the CREST</td>
</tr>
<tr>
<td>throughout the program.</td>
<td>program.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interactions</strong></td>
<td></td>
</tr>
<tr>
<td>Each interaction that</td>
<td>Teachers reflected</td>
</tr>
<tr>
<td>teachers encounter in</td>
<td>positively on the</td>
</tr>
<tr>
<td>the program should be</td>
<td>experience with the</td>
</tr>
<tr>
<td>positive and be a</td>
<td>ecologist in journals.</td>
</tr>
<tr>
<td>positive part of the</td>
<td>Teachers noted the</td>
</tr>
<tr>
<td>program.</td>
<td>value of working with</td>
</tr>
<tr>
<td></td>
<td>the students as a</td>
</tr>
<tr>
<td></td>
<td>valid opportunity to</td>
</tr>
<tr>
<td></td>
<td>try out their new</td>
</tr>
<tr>
<td></td>
<td>skills. Experience</td>
</tr>
<tr>
<td></td>
<td>with program staff</td>
</tr>
<tr>
<td></td>
<td>was positive, but</td>
</tr>
<tr>
<td></td>
<td>some negative</td>
</tr>
<tr>
<td></td>
<td>experiences with</td>
</tr>
<tr>
<td></td>
<td>logistical issues</td>
</tr>
<tr>
<td></td>
<td>were noted. Overall</td>
</tr>
<tr>
<td></td>
<td>Positive experience</td>
</tr>
<tr>
<td></td>
<td>working with other</td>
</tr>
<tr>
<td></td>
<td>teachers was</td>
</tr>
<tr>
<td></td>
<td>portrayed. Post-program</td>
</tr>
<tr>
<td></td>
<td>survey responses</td>
</tr>
<tr>
<td></td>
<td>indicate desire to</td>
</tr>
<tr>
<td></td>
<td>continue to work with</td>
</tr>
<tr>
<td></td>
<td>ecologists (mean = 4.8;</td>
</tr>
<tr>
<td></td>
<td>SE = 0.13).</td>
</tr>
</tbody>
</table>

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## Chart 3.4a: CREST Evaluation Matrix: Program Outcomes

<table>
<thead>
<tr>
<th>DESCRIPTION MATRIX</th>
<th>JUDGMENT MATRIX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attitudes</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Student Attitudes</strong></td>
<td></td>
</tr>
<tr>
<td>Engagement in ecological field research impacts student attitudes toward science and the environment.</td>
<td>Students all reported positive science and environmental attitudes on the pre-test. 3 of 12 questions yielded a significant difference between pre and post program survey responses.</td>
</tr>
</tbody>
</table>

| **Teacher Attitudes** |                |
| Teachers feel confident leading students in ecological field research and that it will benefit them academically. Teachers enjoyed and valued the CREST program | All teachers reported they would do a program similar to CREST in the future. There were no significant changes in pre-program and post-program survey responses to "value of field research" statements. | Changes in pre and post program survey responses "value of field research" are significant. Teacher journaling post-program interviews, and evaluator observations support the survey results. | Teachers valued CREST for its ability to promote reflection on their personal pedagogy. Teachers came to the program recognizing the value of field research, therefore no significant change would be observed. |

| **Ecologist Attitudes** |                |
| Ecologists recognize the value of engaging in partnerships with science. | Ecologists “agree” on post-program survey to "gaining from working with educators" (mean = 4.3; SE = .25). 4 out of the 4 ecologist said they would participate in the CREST program again. | Post-program interviews and survey responses (average > 3.0) report that ecologist would continue to engage in partnerships with science teachers. | Ecologists felt the CREST program was “a step in the right direction.” The ecologists’ participation in the program did not constitute a true partnership, and more needs to be done programmatically to facilitate these partnerships. |

<p>| <strong>Integration</strong> |                |
| Teachers integrate elements learned from the CREST program into their science curriculum. | All teachers responded with ideas for integration. Post-program interviews revealed not all teachers were integrating new projects. Teachers who were integrating, were mainly expanding research projects that they had done in previous years | All teachers respond positively to “fitting research into your science curriculum” on post-program survey and related journal prompts. Post-program interviews reveal that teachers have integrated some of the tools they learned from the CREST program. | The main value, related to integration, was that it allowed experienced teachers to expand and revamp their ongoing research projects by using some of the techniques they experienced during the CREST program. |</p>
<table>
<thead>
<tr>
<th><strong>Table 3.4b:</strong> CREST Evaluation Matrix: Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DESCRIPTION MATRIX</strong></td>
</tr>
<tr>
<td><strong>STUDENT PROJECTS</strong></td>
</tr>
<tr>
<td><strong>INTENTS</strong></td>
</tr>
<tr>
<td>Teachers facilitate the project that they developed. Students experience ecological field research process.</td>
</tr>
<tr>
<td><strong>OBSERVATIONS</strong></td>
</tr>
<tr>
<td>Teachers did reflect on the experience positively during group discussions and interviews. Teachers commented on the lack of follow-up with students during post-program interviews. All students participated in their project presentations. Student responses to &quot;what they would change&quot; were centered on more time for projects, and the research topics.</td>
</tr>
<tr>
<td><strong>STANDARDS</strong></td>
</tr>
<tr>
<td>Teachers respond positively to this program component in journals, and on post-program surveys. Full student participation in project presentation.</td>
</tr>
<tr>
<td><strong>JUDGMENTS</strong></td>
</tr>
<tr>
<td>&quot;Trying it out&quot; was a valuable CREST program component for teachers, though not necessary to achieve program goal. The follow-up with students needs to be improved through a debriefing process. Students felt that the research was authentic, but wanted to play a larger role in project design.</td>
</tr>
<tr>
<td><strong>NETWORKING</strong></td>
</tr>
<tr>
<td><strong>INTENTS</strong></td>
</tr>
<tr>
<td>Throughout the program teachers have the opportunity to network. Following the program a network will be established to keep teachers connected with each other and TSS.</td>
</tr>
<tr>
<td><strong>OBSERVATIONS</strong></td>
</tr>
<tr>
<td>Journal responses state teachers are &quot;excited&quot; about opportunity to network. Evaluator observed sharing of ideas taking place during the program. Teachers describe networking as an aspect of program that helped them reach program goals and reason they would take similar program again. There was no opportunity for teachers to network post-program.</td>
</tr>
<tr>
<td><strong>STANDARDS</strong></td>
</tr>
<tr>
<td>Evaluator observations include sharing of ideas throughout the program. Teachers respond positively during post-program interviews about the amount of time allowed for networking. A system is in place that facilitates teacher networking after the program.</td>
</tr>
<tr>
<td><strong>JUDGMENTS</strong></td>
</tr>
<tr>
<td>During the CREST program teachers had adequate time to share ideas and were encouraged to do so. After the program no systems were in place to facilitate continued networking. A system needs to be developed so that teachers remain in contact with each other, as well as TSS.</td>
</tr>
<tr>
<td><strong>UNEXPECTED OUTCOMES</strong></td>
</tr>
<tr>
<td><strong>INTENTS</strong></td>
</tr>
<tr>
<td>Unexpected outcomes can be used to expand the evaluation beyond the program and relate it to the attributes of the sponsoring institution, the Teton Science School.</td>
</tr>
<tr>
<td><strong>OBSERVATIONS</strong></td>
</tr>
<tr>
<td>Positive outcomes: 1. Teachers often use the term &quot;sense of place&quot; in describing acquired skills techniques. 2. Teachers state collegial atmosphere of TSS is asset to CREST program. Negative: Teachers state lack of clear expectations.</td>
</tr>
<tr>
<td><strong>STANDARDS</strong></td>
</tr>
<tr>
<td>Positive outcomes outnumber the negative outcomes. Positive outcomes are aligned with TSS mission.</td>
</tr>
<tr>
<td><strong>JUDGMENTS</strong></td>
</tr>
<tr>
<td>Although the CREST program did not focus on &quot;sense of place&quot; techniques, it is engrained in all programs at TSS. Teachers felt they were treated as colleagues and program coordinators were learning alongside themselves. Only negatives of program were due to deviations from standard protocols.</td>
</tr>
</tbody>
</table>
CONTINGENCY LINEAGES

Having explored the congruencies, or the relationships within the CREST program components, the contingency, or relationships between CREST program components, analysis remains. The contingencies for the CREST program can be presented through eight lineages. Each lineage described the relationships between CREST program components and demonstrated how those relationships resulted in tangible outcomes (see Table 3.5). With respect to contingency analysis, Stake (1977) cautioned that data from a single program could not support contingency claims, therefore support for each lineage in this study will be in comparison with findings from related studies drawn from the literature.

**Lineage 1: Teacher Background → Integration**

Teacher background (antecedent) had a direct affect on integration (outcome). The CREST program lacked a component that act as a transaction in this lineage, thus exposing a hole in the structure of the CREST program. Finding minimal integration was consistent with the findings of Supovitz and Turner (2000), who correlated professional development integration with administrative support, resource availability, and the teachers’ attitudes toward reform. During post-program interviews, teachers reported limited use of CREST techniques in their science curriculum. One factor on pre and post test surveys, which falls under the category of administrative support, was the teachers concern for adequate time to integrate techniques into their curriculum. With this factor in mind, CREST improvements for the future must not only focus on establishing a program component to act as a transaction in this lineage, but also the importance of revising expectations and objectives to become more aligned with the
realities of the teachers’ working environments. The limited integration of CREST techniques cannot be solely explained on the teachers’ background (lack of time). This perceived barrier to implementation could be overcome with more program follow through on the part of TSS. If teachers were to leave the program with a concrete plan catered to their teaching environment, and complimented by adequate support throughout the following year, integration may be increased.

*Lineage 2: Teacher Background → Interactions → Networking*

Teacher background, specifically related to the value of field research, positively affected interactions, which ultimately had an effect on the networking outcome. CREST teachers came to the program with positive attitudes about field research. From the first day of the program teachers were interacting with each other about how important they felt field research was for themselves and their students. They came to the program with positive attitudes about field research and that created a bond within the group. This is consistent with the community development noted by both Barab and Hay (2001) and Richmond and Kurth (1999). Although both of those studies focused on middle school students engaged in science apprenticeships, they are pertinent if viewed in the light of community development by learners. Just as the students in these studies bonded around common learning experiences, so did the CREST teachers as they played the role of adult learners. The end result of this community development was the ample amount of networking that occurred during the program.

*Lineage 3: TSS Environment → Interactions → Networking*

Barab and Hay (2001) and Richmond and Kurth (1999) also reported a second community, which developed during in their respective programs, one centered on
participants connecting with the program environment and associated staff. This
community also developed within CREST. Teachers described the TSS atmosphere as
collegial and responded positively to questions related to program facilities and staff.
The positive interactions with the TSS environment were an impetus for networking that
occurred during the program, between CREST teachers and TSS staff. The networking
during the program was not limited to the TSS instructors directly associated with the
CREST program, but teachers often interacted with other TSS faculty.

Lineage 4: TSS Environment → Interactions → Unexpected outcomes → Integration

Those teachers that did report using CREST techniques tended to focus on the
techniques that fell in the category of “sense of place”. Examination of the mission and
philosophy of TSS (see Appendix 4), as well as the inclusion of “sense of place” as a
program component explains the integration of these techniques, but it was unexpected
that this would be the main form of integration. Eick and Reed (2002) supported the old
adage, “we teach how we are taught” in their study of pre-service teachers integrating
inquiry in the classroom. In this light, as program designers, we were naïve in our
expectations that “sense of place” would not have such a large impact. Naïve in the sense
that we did not expect the teachers who participated in CREST would be as accomplished
in integrating field research as they were. Future CREST program administrators need to
expect that teachers will come to the program with established techniques and are
attracted to the program for the ability to add techniques that would be consistent with the
mission and philosophy of TSS.
Lineage 5: TSS Environment \(\rightarrow\) Interactions \(\rightarrow\) Attitudes

The TSS environment facilitated teacher-teacher, teacher-ecologist, teacher-student, and teacher-program interactions. These program interactions had a positive effect on the participants’ attitudes. Both ecologists and teachers responded positively during interview questions regarding the nature of their interactions during fieldwork. The responses indicated an equal sharing of ideas and skills in the field. Many successful programs report similar positive outcomes in this realm. Feinsinger, Margutti, and Oviedo (1997) and Caton et al. (2000) both concluded that the success of partnership programs often relied on establishing equality in the scientist-teacher relationship.

Ma and Bateson (1999) also reported a significant correlation between attitudes toward science and attitudes toward the environment. The CREST program provided a setting for the students to participate in teacher-led research projects, which exposed students to both ecological content, as well as science process skills. The interactions that students and teachers had during this portion of the program helped shape positive experiences for CREST students as well as maintain positive attitudes about science and the environment. Based on Ma and Bateson’s correlation, this is what would have been expected, the student responses to attitude survey questions were indeed positive, as were there responses to participation in the research experience.

Lineage 6: Program Preparation \(\rightarrow\) Program Flow \(\rightarrow\) Attitudes

The teacher’s program preparation, facilitated by TSS staff, had an effect initially on program flow. One teacher reported being uncertain of program expectations at the beginning, which may have influenced the extent of her initial participation in the
program. This negative influence ultimately appeared in teachers' attitudes (outcome), the same teacher reported that the lack of explicit expectations was a negative attribute of the program. Although the other program components mitigated the initial negative impact of program preparation, future CREST instructors should present the program expectations in a clearer manner, prior to teachers arriving at TSS.

*Lineage 7: Program Content → Program Flow → Attitudes*

Wood (2001), following Stake's (1977) matrix design, concluded that both the curriculum (or program content) and program choreography (program flow) affected teacher attitudes. In general, CREST teacher attitudes were positive for both program content and program flow. Teachers reported the program content was appropriate and followed a logical progression preparing them to facilitate student projects.

*Lineage 8: Program Content → Program Flow → Student Projects*

The NRC (1996b) states, "Learning experiences for teachers of science must use inquiry, reflection, interpretation of research, modeling, and guided practice to build understanding and skill in science teaching." Woods (2001) also described the influence of an appropriate curriculum (program content) on program choreography (program flow). CREST teachers commented that program content was appropriate and was presented in a logical progression (program flow) that ultimately aided in developing their projects for students. Thus following the recommendations in the literature of appropriate curriculum and proper flow, CREST was able to influence the positive outcomes related to the student research experience. Based on this lineage, future CREST programs should consider using a similar approach to both program content and program flow.
Table 3.5: Lineage Descriptions

<table>
<thead>
<tr>
<th>Lineage</th>
<th>Component Links</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teacher Background → Integration</td>
<td>The antecedent (teacher background) directly affected the outcome (integration) without an intervening transaction.</td>
</tr>
<tr>
<td>2</td>
<td>Teacher Background → Interactions → Networking</td>
<td>Teacher background (value of field research) positively affected interactions, which ultimately had an affect on networking.</td>
</tr>
<tr>
<td>3</td>
<td>TSS Environment → Interactions → Networking</td>
<td>TSS environment positively affected interactions, which in turn promoted networking.</td>
</tr>
<tr>
<td>4</td>
<td>TSS Environment → Interactions → Unexpected outcomes → Integration</td>
<td>The TSS environment provided positive interactions, which gave teachers “sense of place” techniques. The extent to which these techniques were ultimately integrated was unexpected.</td>
</tr>
<tr>
<td>5</td>
<td>TSS Environment → Interactions → Attitudes</td>
<td>The TSS environment facilitated positive interactions, which attributed the positive attitudes reported program participants.</td>
</tr>
<tr>
<td>6</td>
<td>Program Preparation → Program Flow → Attitudes</td>
<td>Program preparation initially was reported negatively, but due to program flow its effect was negated and overall positive attitudes towards the program were reported by program participants.</td>
</tr>
<tr>
<td>7</td>
<td>Program Content → Program Flow → Attitudes</td>
<td>Program content was reported to have been presented in a logical progression, which resulted in positive teacher attitudes towards program.</td>
</tr>
<tr>
<td>8</td>
<td>Program Content → Program Flow → Student Projects</td>
<td>Program content was presented in a logical progression that was reported to aid teachers in development and facilitation of student projects.</td>
</tr>
</tbody>
</table>

RECOMMENDATIONS AND SUMMARY

CREST Program Recommendations

1. Initiate directed recruiting campaign. There was no contact between the CREST program directors and the teachers' school administrations. Because teacher background has a direct influence on integration (Supovitz & Turner, 2000), a directed
recruiting campaign, which included administrators might aid in recruiting those teachers who will benefit from this program. Directed recruitment may also target those teachers who will have an impact on their school and district curricula choices.

Ultimately the integration-limiting factor reported by teachers was time. The effect limited time has on integration may not solely be resolved by administrative support. Even though teachers report full support and resources are available at their schools, the time challenge may still remain a factor when the length of class periods are relatively short. Programs such as CREST need to explore how to integrate within the constraints of class periods as short as 48 minute (actual length of science class period reported by CREST teacher).

2. **TSS must increase program follow through.** Participants reported the networking (teacher-teacher, teacher-program, and teacher-ecologist) throughout the program was beneficial. Teachers exchanged ideas with each other, with the ecologists in the field, and with TSS staff. Unfortunately once the program ended, so did the networking. Web-based discussion groups would provide links to other teachers, ecologists, and program staff after the program ended. The question then is how to assure participation in their discussion groups beyond the three weeks of the program.

CREST teachers received graduate credit for their participation in the program. That credit could be expanded to be dependent up on post-program participation in discussion groups. Monthly journal reflections assigned and reported through the web-forum have been tried and by another similar program. A program sponsored by the National Science Foundation at the University of Montana, Teachers Investigating Ecology (MT-TIE) reports success in engaging teachers in the network by requiring
online journal entry submission (L. Blank, personal communication, November 3, 2002). This method appeared to work for the MT-TIES program, but the CREST program currently does not have the same yearlong approach. Therefore it would be hard for the CREST program to maintain the network, without substantially more teacher buy-in. One idea for establishing this buy in would be to periodically post information on website, which would be beneficial to the teachers. The teachers would then be encouraged to attend the discussion groups on their own accord. Another idea to enhance participation would be to “seed” discussions, by actively beginning discussion groups with direct questions to the participants. Either alternative would require a higher level of management by TSS staff, but would create a higher level of teacher buy-in, and thus a more sustainable network.

Addressing continued ecologist involvement is be more of a challenge. Caton et al. (2000) reported time and distance as the major barriers between post-program networking between scientists and educators. Increasing the emphasis on the partnership during the program may result in higher investment by the researcher and a desire to maintain contact. Similar methods of creating buy-in, as those suggested for the teachers, may also work to include ecologists in the network.

3. Increase integration into teachers' science curriculum. Apart from increasing the post-program involvement, there is another option that must be implemented to assist in integration. CREST teachers must leave the program with a concrete plan for integration that will cater to the unique setting of their home environment. This will involve several days devoted solely to working on realistic individual lesson plans at the end of the program. In order to aid in the process of developing new and modifying
existing curriculum, CREST teachers should come to the program with their previous year’s curriculum in hand. Designing a CREST schedule that includes individual consultation will assist in the creation of lesson plans.

Contingency analysis reported no transaction occurring between teacher background and its affect on integration. In order to implement a transaction that will facilitate integration, TSS staff will have to be involved with teachers beyond the program’s established three weeks. This interaction may be implemented in two varying forms, dependent upon program resources and teacher preference. First the interaction may occur at the teachers’ schools requiring CREST program staff to travel onsite. CREST staff and teachers then develop an integration plan in a one-on-one atmosphere based on the school environment.

One alternative to traveling to CREST teachers’ schools would involve continued workshops at TSS. The MT-TIE program used this model, whereby teachers participated in several workshops throughout the school year. MT-TIE program directors reported these workshops were integral to program success (L. Blank, personal communication, November 3, 2002). These interactions coupled with post-program network improvements and greater involvement from the CREST teachers’ administrators will directly address integration challenges reported by CREST teachers.

4. Assign one program staff to be responsible for all program logistics.

Professional development programs, especially those attempting to implement a partnership, are resource and time intensive (Mayer & Fortner, 2001). The majority of negative comments reported by teachers were directly related to program logistics, such as confusion over scheduling and transportation. The program model that TSS uses for
residential programs dictates one person in charge of all logistical concerns, so that others may focus on their portion of the program. Implementing this historically successful model into the CREST program will alleviate many of the stated logistical problems.

5. **Continue the evaluation process, transitioning from focus on formative to summative evaluation data.** Evaluation from program inception to adequate longitudinal outcomes is essential to validating this approach to professional development. The data collected for this evaluation focused on program components, on attitudes, program environment, and participant interactions. In the formative years of a program like CREST, formative evaluation data assures the experiences that participants have with the program is analyzed. In this manner, this evaluation acts as a voice for the teachers, ecologists, and students as CREST program designers consider future improvements.

The evaluation specific to CREST must be expanded to explore in more detail the outcomes for high school students. Other studies have found engaging students in authentic field research has improved student knowledge. For example, studies of note include Pankratz (2000), Manzanal et al. (1999), and Lisowski and Disinger (1991). These studies focused on short-term treatments for students and differ from the long-term integration aims of CREST. Imagine the increased effect on student knowledge gains when teachers are able to tie field research into their students’ everyday science curriculum.

6. **Actively facilitate ecologist-teacher interactions based on equality of roles.** Although both teachers and ecologists reported benefiting from the time they spent together in the field, their interactions did not resemble the equal partnerships described in the literature (Caton et al. 2000; Falk & Drayton, 1997; Feinsinger, Margutti, &
These studies describe partnerships that were based on deeper involvement, and the partners experienced richer opportunities for professional development and collaboration. CREST teachers and ecologists discussed research design, but together did not have the opportunity to discuss curriculum design. This was a missed opportunity for the teachers to play the expert role, thus promoting a richer partnership based deeper in equality.

Feinsinger et al. (1997) provide a model where partners work together to develop a plan for ecological inquiry in the schoolyard. The focus is on science process and the pedagogy needed to integrate that process. The result is two “experts” working collaboratively on the same project. For example, incorporating this model into the CREST program might require one day devoted to nurturing the partnership. A possible negative impact of increasing the time commitment of ecologists might be difficulty in recruiting their participation. Thus, this recommendation must be weighed against the program’s expanded aim of using partnerships to promote teacher and ecologist professional development. If the goal remains focused solely on teachers then this recommendation need not be implemented. But if the program expands its focus to include professional development of ecologists, then this recommendation must be implemented.

7. Emphasize shift to open-ended inquiry investigation during the design of teacher facilitated field investigation. Teachers reported the need for more student contact prior to starting field investigations, and the need to debrief with the students after the presentations. Students reported not feeling involved in the field investigation design as well as not having enough time for the field investigation. A shift in emphasis
from teachers designing the field investigation prior to students arriving, to an emphasis on involving students in investigation design would address student concerns. Providing time before engaging in the investigation for nurturing teacher-student interactions, and debriefing after the investigations address teacher concerns regarding too little time spent interacting with students prior to and after field investigations. Not only does this recommendation address some negative comments, but also it further promotes integration of sense of place techniques for education by allowing the teachers another chance to "try it out".

8. Do not include the student portion of the CREST program. This recommendation is based on two important findings: 1) the effect of the CREST program on the participating students was minimal and 2) more program time must be devoted to developing the teacher-ecologist partnership, as well as more time devoted to lesson plan design. The value of the CREST program for participating students was limited. This same level of value can be expected in future programs, as the primary audience of the CREST program will continue to be the teachers. In removing the student component, program time is then freed up to address the need for developing the teacher-ecologist partnership, as well as increasing time that can be devoted to assuring the teachers leave the CREST program with concrete lesson plans specific to their teaching environment.

Through program evaluation, I found that the CREST program as a workshop for science teachers was a success. It introduced them to techniques; it helped them reach their personal goals for participation; and provided a space to reflect on their practice. In reaching the program goal of integration into K-12 science curricula, the CREST
program had mixed results. Some teachers were able to integrate new techniques to their existing research projects, while others struggled to integrate new lessons. Although no direct correlation analyses was performed, it appeared that integration relied heavily upon teacher background, and furthermore, that CREST did not have a component to assist teachers in integration.

The Stake responsive evaluation tool allowed me to incorporate multiple kinds of data analyses to provided an overview of program components and their effect on each other. The CREST program model and recommendations flowed clearly from the evaluation matrix. I also believe it has value as a formative evaluation tool. After using this model to evaluate CREST, I concur with Wood (2001), who concluded, "...the Stake model provided a solid basis to support detailed recommendations and a confident judgment on the worthiness of the program." My only concern is that summative evaluation was lost in the process. These data were integrated, but difficult to highlight.

The Stake model provided an effective tool for making program improvement recommendations. These recommendations can provide the roadmap for confronting the challenges that still limit the extent to which the tools, techniques, and content of the CREST program are integrated into science curricula. The CREST program will change as a result of this evaluation and incorporate new components to better meet program goals.


Appendix 1

Transcriptions
Appendix 1.1A

Teacher Pre-program Interview
Location: TSS
Date: 6/10/01
Participants: ME (Matt Erickson) & T3

ME - What got you involved in this program?

T3 - Most of all I love this area. I thought anything more that I can learn about this area, I want to take the opportunity. There are things that will continually come up in the classroom. So the whole idea of learning how to conduct research. Once you have that background it makes it so much easier in the classroom to come up with an idea of something that is going on outside and how to investigate it. You have some basis to go on, a place to start.

When you get a group of teachers together from all over. You are gaining from all of there experiences, so you don’t have to go through each one of them. You learn from others and what they are doing. Once you have a tested idea, you are more likely to do it, then reading it from a book.

ME - How transferable do think this experience is going to be back home?

T3 - This is history it is not just science. There is millions of years of history here and we can relate that students. Let’s take a look at what is there, and what happened before. How can we make that integral relationship from what is happening here, to what is happening some place else. Using deduction. The more that you can get across that nothing is isolated and that everything is connected. It is not just taking what you [TSS] do and how can we use it. It is like this is what we teach. There is nothing that is disconnected on this planet.

Issues of space are present in both places. There is a consequence for taking up space. Decisions that they make effect others...

ME - Your own personal development?

T3 - Knowledge, content. Once you have the content, then you can use it in all of these other contexts. There is no end to that. There is no end to learning about the world around us. And science is the field to do that, because the Earth is so big. There is so much to learn about. The more you continue that process, the more you can make those connections for your students. I think content is very important. And some people might argue with that. Saying that you don’t need to know the name of that plant and how they make the connections are all you need to know. I like to know what things are. I like to listen to other teachers. But with research, you could study research methods, and it could be a whole different art form. How you approach it. And although we’ve done a little of it at my level, if you want the kids to get more out of it, you’ve got to know what you are doing pretty well, and the more experience you get, the better off you are going to be at that. If I learn your techniques if may be different, but it will be an addition to what I know. Here we are going to see 11 teachers using different
approaches. I am going to gain from what the other teachers bring and I don’t always get that.

ME – What about working with the ecologists?

T3 – Just another resource. They are so excited about it, this is their life. Learning from them first hand, books just don’t talk back. We are learning so we can teach responsibility. If we teach it in the classroom, we are hitting so many more people then reaching out to adults. The ecologists have to be excited enough to pass it on to the teachers, the teachers have to be excited enough to pass it on to the students. If the teachers don’t care the kids aren’t going to care. But if the teacher is enthused that is going to get passed on to the kids.

ME – Through field research can you still address those standards?

T3 – The more you know, the more apt you are to fit it in. I am at a point with my curriculum where it is pretty solid. I’ve worked with it pretty strongly. I feel so comfortable with it that I can branch out, that I can make those connections. I think you have to be at that point. Maybe not every teacher is there. Personally, I know where I am at I can find time to weave the two together, because I know where we are going with the objectives. I know them so well. But because of the pressure, I have been kept within the confines of teaching what I knew. The pressure is there. The administration is going to check the scores of my students and compare them with my colleagues. It is a whole different way of teaching. Much more accountable with those objectives. Part of what we teach is human impacts, the geology, earth science. I’m trying to mix the two. Plus it will make it much more interesting to me.

ME – Does a program like this make you more confident?

T3 – Definitely, we need that rejuvenation. It is the same book, the same lesson, the same time of year, we know it. When it comes to this it is much more important, than something that could be taught passively; what humans are doing to the earth.

ME – How do you feel you teachers would do with a program like this?

T3 – With our state program, new teachers need to start on their master’s degree right away. There is so much at once. That I don’t see throwing a whole lot at them is going to work. In our particular state, the demands are so high. It is too hard for them. It is not that they can’t do it, but the state has put so many demands on them, that they can only do so much within there career. They want a family, they want that part of their life. If they are going to a graduate program, that is where their energy is. They aren’t focused on coming up with a program. The ideal thing would be for individual districts to come together to come up with a research program that fits their curriculum. Then you don’t have to put in all the time to come up with an idea. That may be a way to help out those young teachers. If you can sell your district on it, it becomes for feasible.
ME – Feinsinger quote. As a teacher, what do you feel students need to be involved in public decision making?

T3 – Somehow it has to hit their heart. Somewhere down the line. I think the more formal your curriculum your is about hitting different things at different times about it. It can’t just be an isolated incidence. The more times you hit it in a k-12 education, it almost becomes its own subject within science. If that could be in place, it could make a difference. It just has to touch their hearts. Just like with adults. They need to know a little bit about the politics behind it. They need to know what say they have, what they can do. What senators or representatives do they need to write to. How can they really make a difference. Adults don’t even know that. You need to teach kids politically what is available, how they can make a difference. Even at the high school level teach them what is out there, let them know about programs for kids, such as this one [CREST/TSS]. Let them know what are the problems and how they can make a difference. They want to hear about the gore. We can’t just teach about the environment, we need to look at what we are doing here, how we are destroying the habitat.

ME – Do your students generally feel they can make a difference or do they feel powerless in certain situations?

T3 – They feel powerless and they don’t care. We have such a throw-away society. Our students are a little lazier than we were and we’re a little lazier than our parents were. We have to set an example. When I go to the grocery store I take my canvass bags with and I love to see a student there and see me doing that. If it is easier to be ecologically responsible, people will be.

ME – How often are you able to have discussions with your students like this?

T3 – It comes up every once in a while. They don’t ever bring it up. I don’t remember students ever bringing it up.
Appendix 1.1B

Pre-program Teacher Interview
Location: Traveling to TSS
Date: 6/10/01
Participants: ME (Matt Erickson), T6, T7, & T8

ME – What attracted you to a program that involves field research?

T7 – We focus on being outside, being from the [place of work]. This was the first year we completely developed a curriculum, and I am trying to find ways to keep that curriculum new and innovative and find ways that kids can have fun and learn about science outside.

T6– For years I have taught biology in the molecular way. I am sure that there are some people who say it should still go the molecular way. There are kinds of parameters outside that can be tested, measured, and conclusions drawn in such a broader spectrum for students to experience. Rather than that narrower molecular perspective, which certainly has its own points. I think I’m drawn to it, because it is a different way of teaching. I think it is difficult for kids to think they are even learning in the outdoors, because it can be so enjoyable. I like the new approach. I think that students who have gone with the outside, are going to be so much more respectful of it. Hopefully they will become the citizens of the future, and will be able to do more for the environment.

JM – I was drawn to it for three reasons. First, it is important to get students out and do hands on learning. To give them something concrete to work with, specific projects. So that they can learn that science is not just in a lab, and I isn’t hard, and it can be pretty meaningful. Secondly, I started at the [place of work] three weeks ago and my job is the [involved with research]. So I have a decent science background, and research background, but I am interested in learning other techniques and theories, specific ways of getting students [involved]. The logistics and all of that. How to get out and do research. The third reason was it’s a three week free trip to the Tetons.

ME – What can you personally gain from being involved in research?

T7 – New ideas, more creativity, more inspiration for keeping my teaching style dynamic. Exposure to a new ecosystem, which in terms of scientific knowledge is really nice to be able to be exposed to a lot of different areas. When you are teaching about ecology, if you can bring that back and find some similarities and differences.

T6 – I don’t think I’m new to research. In undergraduate school we had to do each year a research project, and then present it. My master’s thesis had to be done. I don’t know that I am so used to it, but I think you can always hone your skills. There are certain areas that you folks offer that I am weak in, birds and bird banding. I hope to gain some personal knowledge for myself. Then to find something that is practical that I can take back home. We may not see the same birds there, but at least I will have the technique and a little more expertise to develop something along that line. From what am seeing in
my students. They are very sharp students, but they have a very difficult time coming up with a hypothesis. Even having enough knowledge to go about testing it statistically and significantly, hopefully they will learn that also.

JM – For me a lot of it is sharpening your brain. Before I came to the [place of work] I was being more of an administrator. When I did teach, it was lower elementary. Not that you initially dumb-down, but your brain goes a little mushy. That is one thing that I will get personally out of it as well, specific techniques that I can bring back and use with students. Learning about a new area too.

ME – How do you see this fitting into what you are responsible for content wise, and can you hit those standards?

T6 – Absolutely, without going back and enumerating any standards, you have everything you could ever want in research. You’ve got biology, chemistry, physics. You’ve got English. You have all of the subject areas. Under those subject areas, the standards I’m sure are included under those subject areas.

JM – I think the biggest challenge is getting them out of the class long enough to do research. Don’t you think? The 48 minute little blocks.

T6 – I think the arboretums thing about extinction of experience. They have no experience. The other day I was out with seniors at the end of a whole year of environmental science and some student did not recommend a violet. Isn’t that something. Of course you could say to me, what were you doing all school year?

JM – What were you doing all school year, Pat?

T6 – I never would have thought, that she did not know the name of a violet. You do your best, and you think you are teaching what they know. Sometimes the most obvious things are the things that they don’t really know. I’m not sure that is a state standard problem. I truly think we are putting the standards and the testing in front of the people that we are trying so hard to educate.

JM – I think that a lot of that is tied into that we don’t teach teachers like professionals. We don’t test them to know their craft. I have run into some teachers that aren’t that great. I guess we need to find a way to weed them out. But to hog tie teachers that are effective and good is not good.

ME – I think the national standards are pretty good, how are your state standards?

T6 – I think they are very similar, I think they are built right off of the national ones. So I don’t think you are trying too much different there.
JM – I just think it is how we are going about measuring them. You can’t argue having standards for any profession really. Although what is the importance in education, really?

T6 – I don’t think what I object to is not the standards, but the time people have to put into documenting that what they are teaching has the standards in it. That is what I object to really.

JM – Like in the lesson plans?

T6 – Yes, or like hiring someone and saying you have to take all of our programs and document. But that happens a lot. They actually have to do this and it is so that the teachers don’t have to take the time to do it. Which is wonderful, but how many people do think actually sit down and really look at that.

ME – Ecological literacy, what do you feel are the tools that we need to give our students?

JM – Public speaking is one, if they are going to go to a town board meeting or something, they need to be comfortable doing that.

T7 – Critical thinking skills, because I think that the real specifics of different ecosystems and different issues within a given area. It varies, it is not the specific knowledge about ecology that they need to know. But the all the critical thinking skills; how to ask questions, how to figure out what the issues really are within an area.

PC – I think reading. Being able to read critically. Being able to interpret graphs. Knowing enough statistics to know whether the data they are looking at is really significant of not.

T7 – To be able to figure out what is propaganda.

JM – What is fact and what is fiction. Another thing to ask the ecologists is what can ecologists do to make it easier for the layperson. We have all run into scientists that are great scientists, but not very good at translating it to the nonscientific person. I think that right there might be part of the challenge. The goal is to encourage citizen involvement, it goes two ways. Elected officials have to be open to that.

T6 – I think I was going to say something similar. How do you bring about change? Do you stand on the outside and feel you can never do anything about it? Or do you write letters. Do you participate in cleanups? How do you get effective change started and continued? At the end of everything, someday they will be voting. Do they understand how and where to go for information?
ME - Do you think the students you have had feel empowered enough to make those decisions?

JM - I think they have to care first. They need the skills to act intelligently, and we hope in an ecologically friendly way. But if they are not connected to what ever the issue is, if they are connected to their personal lives that is really critical too.

T7 - I was thinking of [a student], the intern who was working with us. Right around the elections we got into some pretty interesting conversations. I think they are certainly capable of participating in that change.

T6 - They need to keep informed, they need to know what is going on. I used to keep a folder...I used to read to them the environmental articles of what was going on. They need education on not how to vote, but on what is going on with candidates.

ME - Do they feel that they can make difference?

T7 - High school kids are the most idealistic. They are coming out of high school thinking it is time to change the world. It is that time period that is a great age for making a difference.

T6 - I think in a class of 20, a student that realizes that if they persist they can make a difference. How many out of 20 or 25 really get that? I don't think all 20 feel that way. I think they are a little to involved in their here and now world. Also some of them are just trying to survive. Definitely some of them come out feeling that way, but not as many as we would like. [Student] had the thing you wish every student could have, he had the freedom to go over there and participate on a very informal basis and he was able to learn that way. And if probably the way every one would learn the best. But how many kids have that opportunity?

ME -- The ecologists said it was to show them that everything is connected.

JM - The question is how long does it take to connect them. I think often times centers like ours, you have the students two or three times a year, if you are lucky. Is that enough to connect them. Or should you work with one grade the entire year. That is an important question.

T7 - Our [place of work] only works with 12 schools, and we often let the school decide how they want to split it up. Along those same lines, it depends on the type of experience they are getting. I think this program here gives them and incredible experience to do something different. And maybe have an inspirational moment. That could impact them for their lifetime. It can vary.

JM - It can be different for each person. It would be interesting to look at what got us here. What hooked us into this?
T6 – We are trying to measure something that is very tough to measure. It is an attitude in somebody’s mind. That attitude may not kick in until they are twenty-five and nowhere around. Whereas if you are teaching them math they have to be able to solve an algebra problem, that is a tangible measurable thing.
Appendix 1.1C

Pre-program Teacher Interview
Location: Grand Teton National Park
Date: 6/10/01
Participants: ME (Matt Erickson) T1, T5, & T8

ME – What attracted you to this program?

T1 – Research, getting some ideas for outdoor research to work with kids. In my program I do inquiry-based activities. All of my labs are inquiry based. Analyzing their own data is what they have a tough time with. All of the standardized tests that is what they are given, a block of information that they have to analyze. I think if they get more practice doing that, they will be better for that. Plus they like that, they are pretty engrossed in that. They will work on those for days.

T8 – Part of it is the outdoor connection. I really like the outdoors and the idea of connecting that with the classroom. The idea developing inquiry topics, advancing my own knowledge and skills. Unlike these two, I am a new teacher. I’ve been a girl scout leader for a long time and a former CPA. I still feel like I am learning as much, and as fast as the kids are. One of the nice things about inquiry based learning is you don’t have to have all the answers.

T5 – I’m at a different place in my career. I’m looking ways for the product that we produce to have meaning and history. And be part of a long-term consequential research project. I am hoping that the scientists will be able to share with me where they go for expertise when they are stumped. We have thousands of field guides, but you never know how accurate you are. How do archive it, so that other scientists will be able to use it or other students. Because my kids love to communicate with other students or other scientists, who are doing the same thing. I hate technology, but I feel I have to learn how to use technology to launch a larger reach for my students to connect more to experts and other students who are passionate about the same thing. I want them to know. And if we are going to put all of that effort into knowing, then I want it to be useful to other people.

T8 – Our big thing is that everything is connected and effected by everything else. And why should we care. We keep going back to those two things, how is it connected and why should we care.

T1 – I think that is what is nice about this program. I just like to sit back and listen. So I can take as many notes as possible and little anecdotal stories that I can add to my units that will give it a little more flavor.

T5 – I feel really comfortable about the attitude part of their learning, and I’m getting more comfortable with their skills. But I don’t think you can ever have enough knowledge.
T8 - The more that they are telling us, some of the fact knowledge is not what we need to teach. The idea of how to think is what's more important, or how to seek. Even when an expert comes across an answer that is not what they are doing. Part of what they are doing is seeking additional knowledge.

T1 - People think I'm a master teacher, because I say to the kids, "well how can we figure it out." I really want to know, I usually don't know the answer.

T8 - I think sometimes scientists get so pigeon-holed and narrow-focused that they fall in that knowledge category and they don't have that other piece, which we may bring to them. The idea of getting there. Some of them might understand how they got there, but if they get really, really focused on their research. Their knowledge is so great in one area. Maybe we can bring to them the ability to look at it a little broader.

ME - What do you think the scientists can gain from you?

T5 - The people who have worked with my students, have been so impressed by the level of competence and the level of enthusiasm and their excitement about learning about things that they have to offer. I think it is kind of a boost. It adds significance and scope to their work.

T1 - Also I think they feel flattered. A lot of the times they are not recognized for the work that they do. It gives them an opportunity to be the star. The ones that I have had come into the classroom, they just love it. A lot of the times they try to dumby it down for the kids, but we say "no, we want it at the level that you are going to be speaking to your peers with." A lot of times they want to dumby it down, and they don't need to do that. Kids can figure it out, if not they are going to ask a question.

T5 - What else can we offer the scientists, the Tom Sawyer thing. We can offer them hands to help out.

ME - Ecological Literacy. What sort of things do you give to your students to make sure they are able to participate in discussions?

T8 - Our inquiry papers.

T5 - Our kids read periodicals. I stold this idea from an old NSTA magazine, then I elaborated it, having them ask questions and do additional research. I kids learn how to read scientific articles, and that is really a powerful tool.

T8 - It was interesting to me, because we talked about dumbying it down. I had my kids picking their articles. Then later I picked out a series of articles that I wanted them to have read. They were not easy reading at all. I gave them to the kids and said, "these are going to be a little difficult." They came back to me and said they were a little difficult. But what was interesting was that they wanted me to pick more articles for them. They said these were more interesting that the ones that we picked for ourselves. I thought was
really powerful, for they don’t always know what to pick and it is good to challenge their thinking and have them work at a higher level. Especially some of the brighter students.

T1 – Some of the projects that my students do is having them look at bias in the literature. Having them look at both points of view, so if I’m doing a position paper they have to collect evidence on both sides. I have them fill out a sheet for each article, with the author’s name. They also put what side they would be biased on.

T5 – I was really impressed with the Rocky School of expeditionary learning. Their two goals for science, what their children have to be really competent at. They have to be able to read a college level science article and critique it and evaluate it. They have to develop an independent research proposal and carry it out and present it. They feel those are the skills, the scientific literacy and the ability to put what side they would be biased on.

T5 – I was really impressed with the Rocky School of expeditionary learning. Their two goals for science, what their children have to be really competent at. They have to be able to read a college level science article and critique it and evaluate it. They have to develop an independent research proposal and carry it out and present it. They feel those are the skills, the scientific literacy and the ability to conduct experiments.

T1 – The state of Washington, in order for their students to graduate sometime during their schooling in the four years they have to develop of project.

T8 – In our district, one of the things we get a lot of feedback on, is that our students are asked their opinion on things. That they write reflective articles and journals. Even critiquing literature. They go away to college and come back and say it wasn’t as hard as they thought. They also say they are astounded at how other students come to college and when asked to give a response to an article, they say they haven’t ever been asked to do that.

T1 – Don’t you feel that is in response to the standardized testing that is going on?

T8 – We have been doing that for a long time.

T1 – Your district has, there are very few districts that do those types of activities and get the backing of the parents and the administration. What you have is special a unique situation.

T5 – You are right, but I do think the standard based education is helping other people have that same type of freedom. If we don’t get bogged down in the details of content.

T1 – I think that is where my freedom has been, in that I have always been able to do inquiry based. I have such a report with the parents and the kids. I think the administration wants those test scores.
T8 — I think those test scores come with that.

T1 — I believe that also, but I didn’t know that other districts mandate their grading scale.

ME — Can we hit the standards through field research?

T8 — Absolutely.

T5 — Eighty percent, of them.

ME — We can hit the standards, but can we hit the measurements of the standards?

T1 — Oh yes you can. I just got through teaching a group of teachers. One of the biggest complaints is that math teachers just don’t get it. One of the first things, is what do you want your kids to know. What are the outcomes? They have no clue. They don’t know what broad-based concept is in that standard. I think that is a lot of teacher education that still has to go on. Instead of figuring out what they want their kids to learn, they go that path and hope their kids learn that information.

T5 — The thing that we are struggling with. The way that we did it was we went to the pathways for the standards. Then we put all our favorite activities to accomplish those. Then we tried to come up with questions that would be fundamental, that the children would be trying to answer. And all year they answered those questions. What we don’t have, and what we feel the need to establish. If our kids are going to be assessed on these assessment programs. What we need to do is develop some journals, where the kids keep a set of questions, problems, and solutions that are used to review from. That read together the content that they are responsible for. So you don’t have to be locked into a sequence, but at some point you need to know that you have led up to one of these kinds of assessments.

Time becomes an issue; we can’t sacrifice the humanities for the science. We do sketching; we incorporate art into everything that we do. I think all of that is important. We just have to keep playing with time.

T1 — That is my ideal school. To do the middle school concept with high school. To blow the hours away. Teach major themes and integrate the English and the math as we go along. What makes you remember things, the desire to know, the need to know. We don’t teach that way.

T5 — That is TIME TURF and TERRITORY, that is our big issue, how to resolve those. It is not going to be a simple solution.
Appendix 1.1D

Pre-program Teacher Interview
Location: TSS
Date: 6/13/01
Participants: ME (Matt Erickson), T2, T9, & T11

ME – What attracted you to this program?

T9 – I heard about it through Doug. I have been coming to the program for quite a while. The research idea was real intriguing, because I am already doing some loose research projects with my students. I wanted to step it up a little bit, to help them develop their own research projects, to individualize. Especially for the stronger students.

T2 – I have had experience before with field research techniques, and a lot of educational theory. I have never had the chance to put the two together. Being a first year teacher, wanting to get going with something that I can build on. Field based education. I am getting a lot of ideas from networking with teachers. Also just loving to be with biologists, getting new insights.

T11 – I have a couple of reasons. I found out about this by accident. After bringing astudents here last summer. I fell in love with it last summer. For the past 19 years I have been at camp as soon as school ends until it begins again. So this is an opportunity for me to go away from the mode of organizing and teaching all the time, to being a student. I really needed to do that. My background is not in education. I got in to education kind of by accident. I really like it and enjoy it. But I sometimes have the feeling that I am trapped inside and would much rather be outside. I think a lot of our kids have lost the going outside and playing. I need to get my kids out, not only to do the research, but to go outside and play. Go outside and get dirty. They are really creative, but are limited in their worldly experience.

It is important to talk to other teachers to share some of the same problems and concerns. A lot of times you feel isolated. Then you talk to other people and you find out, that it is the same. And that there are some solutions or suggestions.

T9 – I feel pretty much apart of the lecture that we feel comfortable to question or participate.

ME – Ecological literacy. What skills do they need to participate?

T2 – I think it would be nice to not sway kids on political issues, not sway kids, but point out political issues and teach around them occasionally. To give them a broad knowledge base and to tell them that is what you are doing.

T9 – To let them know that they are part of the process and that they can participate. We have a lot of open town meetings, and nobody goes. Kids can be part of that, and their opinions have weight. Developing the knowledge base is critical, so that they feel
confident enough to express an opinion on an issue. The idea of long-term is very important to me. Negative impacts can have a long-term effect and positive work that you do now can have a long-term positive impact.

T11 - One thing I want my students to do is to be better observers of everything. They always accuse me of walking slowly and picking up everything. To try to model that. They don’t look very closely. I think that society today forces them to rush. My students are so heavily booked in their schedule. Just to look more closely at things and to listen. They never get a chance to sit down and talk about things that aren’t part of the curriculum. I’ve been trying to slow down.

T2 - If it drives you nuts, you gotta work on it, that is my philosophy.

T9 - On ecological issues too, I just forgot what I was going to say, oh, you are either part of the problem or you are part of the solution. You can’t be a non-participant. If you choose to not participate, then you are part of the problem. So an attempt to dispel that apathy. People that are apathetic aren’t usually bad, they are just uninformed not taking the opportunity to be apart of it. I want them to know that they can be apart of it. That they can step forward and do something. What their opinions are and what work they do, has value.

ME - What is the value of doing field research?

T9 - The value of field research is that it is real, instead of doing a textbook lab, they know that they are doing a real thing. They know that they are sending their information to agency or researcher so that they feel it is important. Because they feel it is important, they do better jobs. It is real. Kids know a phony in a second.

T2 - The value besides its real. Also it is a great way to heighten their observational skills. It is pretty hard to develop observational skills in a classroom and fluorescent lights.

T9 - And it is fun.

T11 - I think some of things they do remember. The littlest things. Even in class lab settings. I want you design an experiment. You have shown them what is available, but you let them set it up. That has more value when they design their experiments. Then they look around and see six different ways of showing the same thing.

ME - Addressing standards through field research?

T9 - There is a lot of concern with standards. I heard Bill Nye the science guy speak for standards. He said as long as you teach well and teach real. Kids will already know the material. If you do a good job, kids are going to learn. I think field research is a great way to address lots of the standards of systems and habits of the mind.
T11 - The Ohio standards are so amorphous. If kids feel confident in what they have learned and have some good reading skills and some good research skills. Then when they take those standardized tests. And I do feel it is important to practice some of those things. If they have lots of time to read and reflect. A lot of those questions are not knowledge based. Read this and tell me what it means. When they do the research and they generate the data, and they make their own graphs. Then I don't thing they are as intimidating to them when they get to those standardized tests. I have a real bias against standardized testing. I really don't like it. In some cases you have to teach to the style of the test to help the kids.

T2 – Think that the field research to address the standards is real doable. That is not the problem. It is whether the field research can prepare the student to take the standardized test. That is the real issue. I agree, that if you can spend a quarter of you time to have students to learn science, scientific method, observational skills, sampling techniques, and have them develop their experiments from those techniques. Then reinforce it with info, info, info. Biology is so information intensive, vocabulary, processes. There has to be a balance in there. Where a little bit of field research goes along way towards the standardized tests.

T9 – Some standards are obviously important. I've always found that it is interesting that most professional educators aren't big fans of standards, but most politicians are. Everybody wants schools to be accountable. Kids aren't standardized.

T11 – The more chances kids have to experience things in science, I think they are going to feel better taking a test. They are going to feel more confident. Even if it is foreign to them.

T2 - They are going to internalize some knowledge.

T9 – The true tests in life are can you do your job, can you have the impact that you want to have. Field research you are doing the job.

T2 – You either do it or you don't you can see it if you have done it or not.
Appendix 1.1E

Pre-program Teacher Interview
Location: TSS
Date: 6.12.01
Participants: ME (Matt Erickson) & T4
ME – Describing master’s project

T4 – I can already tell you it is going to be very effective. Listening to the speaker last night, he was just fantastic. He just motivated me, and got me excited, got me thinking about things I’m missing. You do forget about your own background.

ME – Now your background is in biology?

T4 – No I do physics. I don’t know very much biology, but I am seeing applications for physics. Like when we were out on that moraine yesterday. I can see the differences in solar energy on different aspects. Back where we live it is hilly, although you don’t see it quite so dramatically like you do here. I can think of things to do. It just makes sense for life skills. They used to have more of an apprentice approach. We have lost that. This to me is coming back to that approach.

ME – What attracted to you this program?

T4 – I got a note from you and checked it out on the internet. A couple of student aides checked it out for me. They checked it out and said you would absolutely love this. For me to try something new, to get out of my comfort zone. See something new is really important. In my teaching I don’t like when kids say, “why would I ever use this, or why would I ever want to know this?” So I try to come up with things that have practical uses. I thought that if I came out here I am going to learn some more things that I can pull into the classroom. Every subject is interrelated. What I am learning here, the research skills are research skills we can use in physics or any other kind of science, that is just across the board. The other reason is, it is just a beautiful area, and what a wonderful opportunity. I think education is so important. If there is an opportunity you should take it, you should always be enhancing yourself. I’m very pleased to be here. Whatever you adult learning is, you can still pull from that into the classroom. Now that I here it is pretty cool to interact with the other teachers. Already, we are forming this little network. We are planning on exchanging emails and exchanging ideas. So often in a public school you are so busy. You don’t get time for that.

ME – Time, Turf, Territory?

T4 – As you talked about last night there is some bureaucracy and things that you have to get accomplished. It would be neat have an all project based class, but you have to be so careful to this standard and that standard. That can be hard.
I am in a situation too, where I have left my old school and my new school they do team teaching. I’ll be teaching with a gentleman, who has had probably a hundred years experience, and he is very set in his ways. So I was thinking that this may be difficult to change him. He has these lab write-ups. You do this, and then they write it in. It is an approach that teaches students not to learn. Or an approach that would turn them off to science. I don’t now if I can change him, but I can try to change things a little bit. I have four years teaching experience, and I’ve gotten into that inquiry mode. I give my students a project, and not exactly tell them how to do it. For instance in physics, I just got done doing a big long unit on mechanics. I said we are going to have a junk-yard war, you need to build a “Rube Goldberg” machine. I had them make a big poster of the mechanics of their machine. The kids, they just took so much more ownership, they got to make the things the way they wanted. They showed me they understood each of those concepts, and to hear them talking about it was really cool. And I think the kids get so much more out of it, then, “oh, what goes in this box.”

I think that is your approach. I don’t think you need to study a bunch of research and stuff, it just makes sense that people would learn better with this approach.

ME -- Do you spend less time preparing for assessment, because assessment is part of the project?

T4 – Assessment is part of the project, which makes it easy, although it can be somewhat qualitative to break. It can be a little more subjective. But it is that real learning, rather than that regurgitating what you have told them.

ME – Ecological literacy – What skills to try to give your students, so that they are able to go and participate in those decision processes?

T4 – I don’t think I spend as much time on that as I could. I need to focus more on that. I think kids have the idea and many adults do too, that this is a government bureaucracy, we have our greenpeace folks over here and they are miles apart and both of them are extremist. Why my voice doesn’t matter. Sharing stories encouraged me, if we can show the impact of one person. For instance what Rockefeller did for the park. Make it a person by name. I think that makes it a little more personal for them.

ME – Do you think being out here you are creating your own stories?

T4 – Oh sure.
Appendix 1.2A

Post-program Teacher Interview
Location: Phone Interview
Date: 11/27/01
Participants: ME (Matt Erickson) & T8

ME: So how is the semester going?

T8: Oh it has been going great, we are doing a lot, we have a lot of stuff going on. In terms of. We are taking a lot of field trips so we are doing a lot of fieldwork. We are going to the zoo and doing work at the zoo, we have been to the pond the prairie. We have been to camp where we did river and forest studies and caves. Mostly the kids went into the cave and we talked about what critters did they see. We hoped they would do some abiotic testing, but they didn’t get a chance to. We compared different ecosystems. Looking at what the abiotics of, what is different between the pond, the prairie, the river, the forest, and those type of things. Then what kind of biotic information do we see at them. They have to figure out and do drawings on species, we have had the art teacher up to help with drawing of different species. Doing what we call species accounts.

ME: Sounds like you are doing a lot.

T8: We are doing a lot. I’m focused just on sixth graders, I am not doing the High School stuff. So I am doing the sixth grade stuff. I am making a lot of connections between literacy and social studies, which is officially what I teach. Because we have a room that is set up, last year I taught science, this year they put we in social studies. We have a room that is set up with a moveable wall. So we teach however we want. We have four periods that we teach, and we can structure it any way we want. Tomorrow we will go to the zoo for the day. We negotiated with the Spanish department to teach the students for 45 minutes, four days a week, and we’ll take them the extra period on the fifth day. That way we can go and leave for field trips at 9:30 and we can go for field trips from 9:30-2:15. We don’t always go on Friday, we go whichever day of the week. A lot of people don’t go on Monday, because they say it is too hard for the kids to remember. We go on Monday. (Cut off) We move the days around. We guaranteed them (Spanish department) one day a week and they let us pick the day. We really have a small class this year, we are really lucky. Last year we had 38 in the same class, this year we have 34 between the two of us, so it is like 17 a piece. We have one student who is fully handicapped, but is fully integrated into our class. Then we have one student who is profoundly deaf, she is doing very well, she is incredible. Then we have a few other goobers, that you have all the time. We have a great group of kids. The assistant principal said that our kids have a sense of learning community.

ME: Time seems to have been a challenge for you, but you seem to have overcome that fairly well. Have there been any other challenges as far as taking kids out and doing field research?
T8: It is all at how you look at it. We never have any challenges, because we just do it. We tell them that if the weather is bad, you dress for it. So we go rain or shine. Tomorrow we will go to either the botanical garden or the zoo, depending if the weather is really bad we will go to the zoo, because we can work indoors. We will be doing behavioral stuff. If it is nice we will go to the botanical gardens and do some tree stuff. We really have an ideal situation. Our district has three buses, and as long as no one is using them we can schedule them. The anniversary of Lewis and Clark is coming up, and one of the teachers at school is Merriweather Lewis in the recreation. We went to the history museum and participated in the Rivers Exhibit. Our whole thing for social studies is western expansion and manifest destiny. We are really able to tie in work on rivers and streams and ecosystems to looking at those subjects. So it is pretty exciting.

ME: Can you think of anything specifically from CREST that has helped you out?

T8: Oh yeah, I think that working, A, with the students and learning that you can figure out things for yourself. I wasn’t as experienced as my colleague. Using that field guide, I still talk about loving those walks that we took up the mountain. Doing that kind of diligence and working through that kind of stuff. I think it teaches you how to do that, whether it is science, lit, or social studies. The scientific methods, we are still using that, the transects that we did (during CREST), that stuff. I hadn’t done any transect stuff before.

The drawing, some of the painting, you can do things as part of science. I think that adds a new dimension for students. You have some that say I can’t draw, but others, that is the one thing that they do well. Today we were doing expansion maps, the students were drawing on their maps. We extend their thinking through these activities.

ME: Has your experience with the researcher, effected your semester?

T8: Yeah, I think the patience of it all. When we took the kids to the prairie, this was the second year I have done it, but this year I felt so much more confident. Even if I didn’t know the plants, looking at the plants and talking about some of the things on the plants. Some of the petals, the sepals, and the stuff we figured out as we worked through it.

ME: How do you think it is affecting the students?

T8: Our students are so incredibly engaged. Not a hundred percent of them. Our kids come in after school. They come in early in the morning. Sandi is good at getting the kids to hand in quality work. That is something that I am learning from her. The idea of how do you get kids to hand in quality work.

The other thing that I did when I got back, that you might be interested in. I took a class through [local university], they are writing an ecology curriculum. A- I am not very happy with it, personally right now. I have to look at the latest edition. They are focusing on the detrivore community. I certainly spoke up and made comments based on the things that we had done in the summer (during CREST) in that process, and I was one of the teachers doing that.
ME: What sort of things about it?

T8: Things like needing big ideas. Needing to know what kind of questions, and to allow kids to come up with questions. It seemed to me that things were too programmed. And yet I understand that there is this balance between when you are dealing with, especially when you are dealing with middle school and grade school. When you are dealing with teachers who don't know anything and with teachers who know everything, like Sandi does. How do you support the students who aren't willing to put forth the effort, and get them out there and get them doing real science and real thinking. I think that kind of thing came out.

ME: Are you hitting the standards by doing this?

T8: Oh yeah, I am not even worried about doing that. In the thing for [local university], they are going to connect them up to standards. Part of what I see, for what we are doing the kids really have to think. They are good basic science. The kinds of questions we are asking them, they are having to struggle and to think about how they would go about answering them. Even that, as we talk about history and finding primary source documents. You are asking more questions and how are you going to go about answering them. To me that's all connected and the standards seem to fall into place when you are doing that kind of thinking and working with your kids. Teaching them how to write. One of the big pieces with the tests here in [state], is that they have to know how to write or they won't know how to write. In the school district where I taught before, their science scores were abominable, part of it was that the kids couldn't write [State] has constructive response and open-ended questions. They have all three of those on the test. If you can't write, you are going to fail, because you have to be able to communicate your ideas, it is so important to be able to communicate your own ideas.

ME: Have you been doing some journaling things with them?

T8: Oh yeah, one of the things we do is have a journal for each of the core classes. So there is a math journal, a lit journal, science journal, and a social study journal. (Sandi says, "tell Matt we have a flag tied around all of our pencils"). The format of the journals are all the same. They all have to have a title, they all have to have a table of contents. History Alive uses a really neat journal, which has a left hand and right hand side of the page. On the left hand side take data and facts and on the right hand side you either illustrate it or diagram what you have learned. That is straight out of history alive, I am really pleased with that. In their Science and Math, they just basically take notes, we just grade them to see if they have done them. Not to see what's in them, we don't grade the quality necessarily of what they have put in it. But we do use it for a lot of different things, so it shows if they are not taking good notes. They have a notebook, for science as well. If we give them extra handouts that we give them for other than in their journal. Like when we go into the field, every kid has their own clipboard. We don't take our journals into the field, because we have found that it just works better not to get them wet and lost. Every field trip that we have, has a plan and a central questions for what we are trying to do. Based on what are the goals and the essential questions that we are trying to
answer on this trip. Then we will have additional details and questions. We are big into journals.

ME: Besides their learning, how is it affecting their attitude towards the environment, towards ecology?

T8: Hopefully they gain some appreciation; we do this for a whole year. I think they gain some appreciation. We use some videos that really help. Actually [another teacher] worked on some new videos on prairies and ponds. In addition we have them read articles and they do media reports, where they are supposed to be coming up with questions. I certainly hope that it is making a difference.

ME: What I am getting at is the whole ecological literacy; do you think they are becoming citizens and being involved?

T8: Oh, yes. They will a whole lot more than 90% of anybody. At the end of the year, they do a zoo project, where they have to create a zoo exhibit. It has to be of an ecosystem. We give them the biome. We have some of the WOW curriculum. The WWF has the endangered ecosystems of the world. They get one of those and have to design and exhibit for the zoo that tells about that and how do they care for the animals. We are going to Jekyl Island in May and we will be doing coastal ecology at that point. Last year I took my kids to the Cincinatti Zoo, which is a great trip, but I am looking so much more forward to Jekyl Island. The kids will be so much more out with the real elements.

The other big thing that we hit hard were distinguishing characteristics and dichotomous keys. How do you know a creature, an animal, how do you know anything. So it sort of transcends all of the curriculum.

ME: Relative to last year, do you feel you are doing a bit more of this?

T8: Oh yeah. I am with [another teacher] for one thing, let’s be honest.

ME: Were you with her last year?

T8: No I was not with her last year. We were both sixth grade teachers, but we weren’t on the same team together last year. We were supposed to be on the same team this year, but principal asked if we would team together. We are really having fun.

ME: Would you do this again?

T8: Oh yeah, absolutely.

ME: (explaining the future of CREST)

T8: There are so many teachers that are afraid of science and math. Elementary teachers, that are not hooked on science.
I look at where I was before, it was a school that really has a need for this. It is in a district that is really struggling. The phenomenal thing is that they haven’t been able to hold science teachers for one thing. They have a prairie right next to their school, and we had the prairie burned. I knew that the prairie needed to be burned. Two of the teachers that stayed worked on curriculum for the following year, in which we were going to use the prairie. They were doing some field trips. They were having some problems with buses, but they didn’t need to take a bus. They had a prairie a pond, and a forest right next to the school. You know what they did, they mowed it. They had got this whole thing going through [local university], and I guess whoever it was retired or something. You could have had a 1000 kids who could have used that. You need someone who is going to drive it and knows what they are doing. That is one reason why I think it is really important. And at that point, I didn’t know nearly, what I know now.

ME – Would you do this again if you had the opportunity?

T8 – Oh yeah!

ME – What things would change and what things would you keep the same?

T8 – I’ve been talking to people so much about it. I liked the three weeks and the facts that we got to do all three pieces. I still want to do the water stuff, that is one of things I want to do with the kids. I think that the water is an important issue. I liked living at the FRS. Some people thought it was a stretch, but I really liked it. One of the things with the kids, I would like to spend some down time with the kids. Perhaps, rotating teachers through an evening at the FRS, when kids are there. It is a matter of getting to know the kids. I don’t mind being with the kids, we were a bit segregated. I wouldn’t have minded eating with the kids, or being with the kids a little bit more. It seemed like we were busy the whole time, and it wasn’t like we needed something else to do. Meet with them not only in a working situation.

I think the other interesting thing was observing how the Teton Science School, how the PREE handled the kids is interesting. I think that may be true for people who haven’t been out with kids a lot. One of the teachers commented on how they may not be comfortable taking kids out. I have a real strong background in Girl Scouts, so taking kids out isn’t something I think a whole lot about. But not everyone has done that. Some people as see it as more trouble than it is worth. That is why I think in seeing how things are set up, and being with the kids is important.
Appendix 1.2B

Post-program Teacher Interview
Location: Phone interview
Date: 11/29/01
Participants: ME (Matt Erickson) & T6

ME: What has been going on this fall, as far as projects that you have been doing with the students? Last time I talked to you, you were talking about an after school club, did that ever get going?

T6: No I never got that going. I was over at the nature center, because I wanted to run it at the nature center. Actually we did have a few meetings on the topic, and there was a gal who must have been working part-time at [local university]. She was interested in helping us with the programs at the nature center. They may not have had the money. Then we sort of got lost. We got stopped. It is funny that you should ask that, cause I was just over there Monday or Tuesday and we met about going winter camping. With them being involved with us. I would still like to have an after school group, and it would have to be after school. I just haven’t gotten around to it.

ME: Is the challenge still the time?

T6: Yeah I think it is number one my time and it is also the kids time. As much as you may think it is inner city and most of them don’t do anything, most of them are involved up over their heads in all kinds of things. As far as three of the students that we took out there (TSS), believe it or not, we never see them. I don’t see them at all. They are involved in Chemistry and are involved in other things. Where as I may have depended on them to be a nucleus, I can’t even find them to do that with.

ME: Have you been doing any field research with your class?

T6: You would be proud of me. Every time we go outside, we collect data and then we bring it in. We try to process the data. I wouldn’t say that this is brilliant new stuff. What we have done is collected insects in the prairie. What we are going to do is use that as a data base to build off of. We have been doing phenology. Are you proud of me?

ME: I am very proud.

T6: We are just doing basic stuff, elementary stuff. We are doing temperature, maximum and minimum and we are doing precipitation. We have a little weather station outside. We are collecting data once a week. I would send the kids out once a day, but that is problematic. We are charting it on the board, then at holidays we collect the data points. We have this nice thing going for our phenology. We also did field insects. We did aquatic insects. We are studying soil right now, and we will be studying soil insects. I got the AP statistics teacher, I can’t remember his name. I got him to one work with us to take our water quality data and finding out statistical tests that we can use over ten
years of data. Then actually the people that we work with for testing water have a conference in the spring. Every school has to bring something. What we were going to do was get that into a power-point. What we do with the data and show the other schools what we do.

We journal. Once a week we journal. What I’ve done is what you did. I supply the journal topic. Then they take it down. They can spend a little bit of class time responding to it, but then they can home and write in it.

ME: You have been doing the water quality for ten years?

T6: Yeah, we have been doing that for a long time.

ME: Are some of the things you are doing new this year, maybe because of your involvement with CREST?

T6: I think the way I handle my data has changed since I participated in that program. What I tend to do is look at it more for research. Since I have no base line data on some of those things. Everything that I seem to look at these days, I say oh wow this is base line data. And we need to start to get some sort of database and do other research on these things then we will have something to compare things to.

We even went out an measured slope the other day. Oh boy, this is real research. We measured slopes the other day, from the park, going down to the river. I thought can even use that to look at erosion. Right? We are starting to go off the chart here. We went out and picked our purple loosestrife and brought them back into the classroom. We will do our purple loosestrife beetles. That is cool, kids like that.

ME: Did you get out this fall and do sampling before the release?

T6: What we did last fall, not this one, was we went out and collected six plants and brought them back to the classroom. Kept them in the classroom. They died over the winter. We collected the seeds and grew the plants. Then we inoculated each one of those with about 10 beetles. Then the girl called who was taking care of the plants, and she said, “I think they’re ruined”. So I picked them up, and I swear within 2 or 3 days there were a thousand beetles. Then we took them down to the river and let them out on the purple loosestrife there. Then we took pictures. The best way to document is through pictures. So we did all that with [local ecologist] and doing transect work. Then we back out to look at the plots again and brought them in. We’ve gone there three times, we have had a very warm fall here. So we will keep that going.

I haven’t done any studying of the transects. Remember when we did that and walked along with the shrubs and all of that?

ME: When we were out in the Gros Ventre?

T6: Yeah, yeah, I definitely want to do that. In fact just the other day I ran into some of the data from that. But I don’t think I can do that now until spring or so.
ME: You were working with Court on the bird study. Any of that have an influence on this past fall, working with the researcher?

T6: Let me see, this is directly related to birds. I had a few people interested in birds and working with [local ecologist]. They wanted to work with birds and band them. No I haven’t done anything more with that, other than being really aware of how much is needed for a data base.

ME: Anything from the CREST program that you are seeing you used this fall?

T6: No I don’t think so. Well you know what we did a lot of sense of place this past school year.

ME: Is that something new, or just putting a name to it?

T6: Well no, some of it came from the arboretum work that we did. I kind of sort of rearranged it a little bit. We were looking at maps, kind of like we (CREST) did. We went out to the place and looked at maps, and how the geology kind of shapes the biology type stuff. I think I was more conscience of that.

Did you talk to everyone?

ME -- Would you do this again?

T6 -- Absolutely, I would do it again. I found it very beneficial. Personally I learned a lot.

ME -- What sort of things would you want to see changed?

T6 -- To be very honest with you nothing much, but a few little logistics. The nitty gritty. The transportation with the kids was one of them.
Appendix 1.2C

Post-program Teacher Interview  
Location: Phone Interview 
Date: 11/29/01  
Participants: ME (Matt Erickson) & TIC

ME: Did you get any of the field research that you were planning this fall going?

TIC: Well it is going slowly. I need to meet with Ken. The whole concept was to attract college people to do research here. I met with this guy from the University of Wisconsin field station. He was pretty direct. He said you outta give it up and you should just do the research yourself. You are not going to get too many professors, who are going to want to get involved in research. This is his opinion, at least at that university, he is probably correct. At least until we get some interesting things going. He said, "at least until you get some money." That was [local university]. I haven't really tried [other university], because it isn't really convenient. Looks like for the spring we will have two interns from some of the smaller colleges, who require internships. If we get people who's undergrad shows interest in field work. It is just getting on the list and spreading by word of mouth.

We are initiating some projects this spring. We will begin bird banding. I don't think it can be part of MAPS, because our site is too small. They don't want you to manipulate the habitat. For us, we are working to enhance and restore. We will probably do a migration study in the fall. If we can find some money, we will try and hire some people. It takes time. That and we will start up some basic surveys, reptile and amphibian survey and a plant survey. We are making progress. I hooked up with a community college that teaches survey. They will use the nature area and survey the project. We will get some good maps out of that. Hopefully we set out a research grid, set out some metal spikes in the ground.

ME: Have you been able to involve any of the students in any of this stuff?

TIC: Once we get this thing started. I've been trying to work with [local teacher] on getting her students involved, but their periods are 48 minutes. You can't do a whole lot once you get them outside. We are still figuring out how best to do it, and we will probably end up working it out through our outdoor leadership program. Possibly an after school thing. The other thing I am trying to work on is doing and independent study, so they are doing some projects. Ideally we would like to arrange for some college credit. A lot of these kids leave for the universities in the afternoon. So to answer your question, it is minimal, but things should pick up.

ME: Do they do any Co-op classes?

TIC: At the high school classes, not that I am aware of. It would have to be after school. What we really need is a teacher who is really into it. [Local teacher] is really into it, but she is so busy.
ME: Has there been anything in planning for this that you would look back on and say, my participation in CREST helped me out?

TIO: I would say the methodology, the basic research refresher was helpful. I did propose some summer courses for teachers. I plan on pirating some of the CREST material. I put in a proposal for a three day, one credit class. Trying to attract primarily high school teachers interested in research. For us it is building the infrastructure. Then we are expecting to build interest. I am discovering the red tape and bureaucracy at the high school level as well as the college. It is going to take some time to establish the credit and that kind of stuff to make it attractive.

Some other projects we are looking at initiating would be small mammal survey in the park. But we have to worry about, if the traps are going to get stolen. Another when is there is an organization that works with rivers. They have a person working with them who is pursuing a project on corridor biology curriculum. She is writing a grant to the EPA, for a digital camera to position along the corridor of the river and involve high school students. They would do the surveys. In addition to that it is a tracking survey, setting up tracking stations.

ME: That work with the researcher, have you pulled anything with that experience?

TIO: Not really, just glad I’m not doing that kind of work. It would come in handy with the GPS. Once we have done the basic work with the surveyors, we are going to be converting that data to a GIS format. I have a contact at [local university] who is a GIS specialist. Then as we move toward summer and start these research projects, we will be using GPS as far as locating some stuff. Whether it is locating trees or vegetation transects. Down the road we might look into doing some telemetry. Again not right now, but down the road. There is grant money out there for stuff.

ME: Do you still feel that you can aid teachers in hitting the standards doing all of this stuff?

TIO: I think so. Like I said, through our teacher-training course. Once we are able to demonstrate simple experiments and projects. Be able to do that during our teacher training. Then as we get our research projects going, [colleague] and I will be working together. [Colleague] will be able to get more involved. I think with our setup it will be more of the classes that come here doing the projects here versus after school. I would be how well the others are able to integrate this.

ME: Have you changed any approaches to ecological literacy?

TIO: I am thinking of the students that we brought out. I am not teaching classes day to day. My contact will be through these research projects. As we get them involved in. I thought of another one. We did some tagging of Monarch butterflies in the fall. We had
a couple of kids that were hanging around involved with that. As we get them involved with the hands-on projects, I think it will definitely have an impact on their literacy. We are not measuring it. We have a potential, "oh wow" factor, as we have people look differently at their city environment. I think as we move forward we will have a real impact.

ME: Would you do it again?

T10: Yeah, sure. We will be staying in touch with the science school. I feel things are moving much more slowly then I would like. I really like getting out with the researchers.

ME – Anything you would like to see changed?

T10 – I think the roles of the PREE students, was a bit of a confusing thing on my end. I don’t know how they were prepped to work with teachers. Some personalities clashed. Obviously you can’t talk to a twenty year veteran like you can to other peers. Finding a way to have the teachers and students interact more. I kind of felt this, that teachers are kind of held above students. Get privileged housing. To me it kind of hampered how did the projects.
Appendix 1.2D

Post-program Teacher Interview
Location: Phone Interview
Date: 12/05/01
Participants: ME (Matt Erickson) & T7

ME: What has been going on, as far as any field research you are involving your students in?

T7: We came back from the Tetons, [colleague] has been organizing field research. So the kids I work with, we went with him to go do monarch tagging and that sort of thing. More specifically for the programs I was running, we had four summer camps in a row. Weeklong day camps. We set up the camp so that at the beginning of the week, we had team building activities. By the end of the first day they had to come up with a couple of questions that they wanted to explore by the end of the week. What I was hoping was that some good research questions would come up. A few did, but a lot of this was just about what kind of animal is this. But there were a couple of experiments where the kids came up with a design for comparing insect habitats. That was really fun and it was fourth and fifth grade kids. The older group built solar ovens. They took a look at a commercial solar oven that we have, and Amber and I went out and grabbed anything that looked like it might be something that they could use in the solar oven. We used a bunch of recycled things and went and got some reflective things from the hardware store. The kids came up with their own design. It was kind of field research, you had to use the sun. That was the experiment that the older kids had to come up with. They had to come up with their own design. That was 7th and 8th graders.

We had that program set up before we went to the Tetons, but what I would say that your program [CREST] did it gave me a good base, a good foundation on how to structure the program, once we got kids here. We had the idea, but doing the program out there laid out a nice structure for us. We modified it, made it a bit smaller, because we also took them kayaking and rock climbing.

ME: When you are talking structure are you talking a management type thing?

T7: Less management, and more. Well the first day they came up with a question, the second day how they were going to explore those questions. We kind of skipped the hypothesis, well no we didn’t. We kind of did with the solar oven. I guess not really. The hypothesis was is it going to cook food or not. In terms of what processes to go through whether it was building a solar oven, or going out and catching bugs. Leading up to that idea, it was more thoroughly thought through based on how you ran the program at CREST. Originally I was thinking that they would come up with these questions and then throughout the week, we would find answers to them. Instead we put those extra steps in there to get them a little bit more involved.

ME: Is there anything out CREST that has been specifically useful?
T7: Yes, in so many different ways. In so many little ways and a couple ways. One of the big ways is preparing for next summer. Next summer we are trying to double our programs, and use what we did at with the kids at CREST as our basis, our foundation. For our program back to the Tetons. And hopefully for our program out to the Maine Maritime Academy.

ME: You will focus this around a whole week of research?

T7: One of the things we learned from your program, and it wasn’t necessarily a direct what you wanted us to come away with. I thought having the students go to the Tetons with questions in mind already would be kind of take place of the teachers coming up with the questions. That hole between needing to have some kind of structure for the kids for the time that they were there and having them involved in the process of determining what they were going to study. That my group struggled with. It was a good struggle, because I came away thinking the kids should have been involved from the very start. Those first discussions about what we would like to study. We are still going to have the same structure with a week camp here then nine days traveling, but during that camp they are not just doing team building, outdoor skills, and mentoring kids, which was our focus last year. But also be dedicating an hour to each day of camp to forming a good question and a hypothesis. Given information that they would have about both areas ahead of time. So that they come out there ready to do their own research project, so that the kids are more highly involved in that first step of the process. So that you avoid all of the debate about questions. That we went through for days as teachers. So we are changing our outdoor leadership program, because of our experience at CREST, and we are also trying to double it. It was so successful. That was probably the biggest, because we are taking that program now, and expanding it. One other thing, there have been so many reaches. I just put together a grant to support the outdoor leadership program. So that we can expand it to twice its size. It is a three year grant for $35,000/year. Hopefully that will cover the cost of travel and lodging. A staff person could really focus that one activity throughout the year. So that every month you have an activity where the kids are doing some exploration somewhere. Whether it is spelunking in some caves, or snowshoeing at the Kettle Moraines. So that they are still keeping those questions and explorations throughout the year. Smaller things are. [CREST student] has been a spokes person for the center (UEC). Because of her experience out there (TSS). There is a quote from her mom on a city bus. Right before we came out to the Tetons, her whole family had been made homeless. There was a quote about the salvation army from her mom. Both of them have come and talked to funders, about who we are, and what the program is about. That is kind of community building experience. Everything that goes on with Jim. He and I work as a team on some of this stuff. He has had some pretty good ideas. He has realized that his best focus is really to focus on integrating field research into the curriculum of the schools that we are working with. That should be expanding the program that we offer to our schools.

ME: Has it increased in any of the programs that you are personally involved with?
T7: It has, like when [colleague] was doing the monarch tagging. When the monarchs were all migrating every time we went out with a class, no matter what the class was, even if it was second graders or even kindergarteners, we take a net out with us. And give them a chance to put a tag on a monarch. We would bring a data sheet with us and explain what the project was. In terms of designing curriculum. Basically the teachers tell us what they want to study. We are not at the point where we are working with middle school and high school students and doing intense research yet. With the exception of the kids who went on the trip. The students that came out. [Student] is going to be working on a project with [colleague]. The pigeon project out of Cornell. What you have heard from [colleague]. He depends on me to match him up with kids when he is ready to do something.

ME: Has anything come out of the time you spent with the researcher?

T7: We are having our quilters quilt us a density board. This is the whole curriculum that is developing. When we start to do restoration in our park, we want to be recording data all along the way. The idea that I have for the school program, that is still in the idea phase. Every school gets a plot of land that they adopt, that they do readings on to look for trends as we do some restoration ecology. One school will go out and take the baseline for what the park looks like now. They’ll use the density board, and do some bird surveys, some insect surveys. And mammals, we are going to do some mammal monitoring with an inferred camera. I see that directly as part of our school program.

ME: How is this effecting the students?

T7: They were thrilled, first of all to see a butterfly, second of all to catch it, third to be allowed to put a sticker on it and to find out why we were doing it. We would explain to them why we would do it. Explain the migration, it is one of those wow factors. That was really neat.

ME: I like that fact that they know why they were doing it.

Are you seeing some of the things your doing reaching the standards?

T7: Sure, when it comes to standards, they are tickled pink. I think that there is potential for more. Certainly, what we have done so far with the butterflies, there all kinds of standards that are being met. You are collecting data, there is math involved, critical thinking, there is reading.

ME: How does it affect their ecological literacy, their willingness to be involved?

T7: I think so, one thing that is a luxury for us is that we focus on the neighborhood. What we have seen is a trend of students coming back on weekends. There are a couple of kids that when we were tagging butterflies, they were here everyday after school. They were here on weekends they brought their cousins and brothers and sisters. That was really neat, and that is kind of the only way to measure that. The more that you have
kids coming back and exploring in the park. The more time they are here and with a
mentor they are learning.

ME: Would you do the project again?

T7: Yep, I would.

ME: What would change or keep?

T7: The only thing that I can think of would be the same things I said about our program.
Which would be to get those kids out there sooner and get them involved in the whole
process. Maybe the first three days we got some of the structure and then we started
struggling with the question. I think you could add another week to the program (joking).
Really that was the biggest frustration for me we were so limited for time. That we were
trying to come up with we were facilitators of research. That is really what I considered
us instead of teachers. So that we could do our own struggling with the questions. On
that first day we kind of sold them on what our project was. And it would have been nice
instead of saying that here is our project and come be part of our group. Would be to
break up the kids and have them come up with a list of questions and group them
according to what they are interested in. I guess that is the major thing that I would
change, have the students involved earlier. I guess it is two things. One is have the kids
involved earlier and the second is how the groups were picked I think was a little
awkward.

What you did well with the teachers was to have us go through the process of the
questions so that we would be able to have the kids go there. Do that with the teachers
first so that they know the process then have us do that process with the kids. But you
would definitely need more time.

I think for anybody, when you are doing a teacher training, when you are trying to teach
them about some sort of curriculum or some sort of thing that they are adding to their
curriculum to make it hands on, to give them that experiment. It seems much more
effective, a better way.

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Appendix 1.2E

Post-program Teacher Interview
Location: Phone Interview
Date: 11.29.01
Participants: ME (Matt Erickson) & T9

ME – What has been going on?

T9 – My first unit of science is environmental science, so we have this little outdoor classroom and we go out there. We do a biomonitoring index check out what is out there. We planted a bunch of trees, so they measured the height and do that kind of thing Collect data. Mostly it is data collection. Start to develop that sense of place type idea. That all of the interesting things in the world aren’t in Brazil. There are some pretty interesting things here too.
We did a water quality testing and sampling. We talked about the importance of water and did a little unit on water. And we collected data. It was an interesting year, because we have seven or eight years of data to compare it to. This was such a drought year. The stream was pretty small when we went to test it. The insect diversity was pretty much the same, but the numbers were changed quite a bit. They speculated on why that was so.
In terms of being outside that is what we have done. We have this little pond here in [home town] and I went out with seventh grade. We basically worked on developing a sense of place there too. They all picked out a specials spot and kind of developed the idea of a phenological study a little bit. We have been there twice and we need to get them back there. It just froze over.
I have my Teton Science group all picked out and we are getting ready. We had a lesson today. We go each week on Thursday s for about 40 minutes. We do different things but they are all outside. Haven’t had a chance to get a hold of [partner ecologist] yet.

ME – Are you doing anything different with the bio-monitoring this year?

T9 – It is a little different, because part of it depends on who you take out. Part of it is voluntary. I take my class out during school. I have 3 sections and I take all three sections out. That is when we do most of the data collection. But we always do a tree planting or some sort of improvement thing. This year we planted some more trees. So that was a little different then previous years, because it was voluntary and the group of kids that came, before they came with the whole class we picked out some trees that we were going to plant and then the volunteer group got to pick where to plant them. Before we planted them we talked about what would be good in terms of placement. What would help them best survive and what would also be pleasing aesthetically. IN the past our outdoor classroom is a little regimented. The trees are in rows and little squares. Not a real good layout at all. I don’t know if that is a result of CREST, where we used a lot more natural design or if it is just because I thought about what we were going to do a little bit more. Probably.
We were thinking about birds a little bit more. When we planted them and picked them out we tried to pick all species that would produce some kind of berry that would help the birds. I know in the back of my mind I was thinking a lot about what [partner ecologist] and I had discussed. Cover is reduced, range is reduced, food is reduced, and that is what is making hard for the sage grouse to survive. All of those factors combining. Anything that we can do to bring it back. The area we have is not suitable for sage grouse, but any species.

ME – Addressing the standards, still confident?

T9 – Yeah, most of the standards, well most if not a big percentage of them can be either completely met or at least someway addressed through field research or some sort of field based science. I don’t have a copy of my standards right here with me. There are standards for the level that I teach. There are standards in Earth Science and some standards in environmental kinds of science. There is lots of standards in measurement. Things like that where you can go out and do measurement and cover that standard, even though that may not be your main goal. Your main goal may not be to develop that measurement skill, but you address that standard. And writing in language arts there are standards you can meet. We have standards for oral presentation or written work. Not in my class, but in some classes they do Wyoming history, so they can hit those standards also.

ME – Wasn’t one of your comments that you would like to see more journaling?

T9 – I just like it. I need to do more of that with my class. That is one of the things that if you force yourself to do. My Teton Science group is going to get that, but my regular class lapsing to other things, now we’re in atomic theory. I don’t know if we’ll do a whole lot of journaling on atomic theory. There is a place for it aside from what you teach. I have been talking to them quite a bit, and showing them my journal. We’ve talked about journals of Galileo and journals of Lewis and Clark, and how important journals are from a scientific standpoint. But also that it is a way to express your creativity. We have talked about what phonological studies are and how you collect data on a place over time. We have talked about it, we just haven’t been able to do any of it.

ME – Ecological literacy is involvement in field research making them more conscientious citizens. Are you seeing that in your students?

T9 – Yes we do, when ever we go anywhere. It is amazing to watch at how they can be surprised by things. Some things that are very simple. Like with a beaver at the pond. They trap it and the whole thing is over. It chews up the trees pond and we talk about, is that a good thing, a bad thing, or is that just a thing. How do they feel about that. A lot of the kids think it should be left there and left alone. One of the things that happened was that there was muskrat at the pond, and somebody shot it. A lot of the kids were kind of disturbed by that. It was a good thing to see, because of the destruction. The muskrat was shot just because somebody wanted to shoot it. The beaver when it was taken it was taken for a reason. So they didn’t necessarily like it, but they could live with
it. Not that they wouldn't have been, if we hadn't been over there, but I think they felt a lot more ownership, because they consider that pond a little bit there place.

ME – Any general thoughts about how CREST has affected your teaching this year?

T9 – I am, I have always been into it a little bit, so for me it wasn’t a radical shift. I want to get going more with phonological type journaling, so that they notice change over time. That is a good way to lead into evolution actually. Just the idea that they develop that sense that they belong to this place. That every place is special. I’ve always wanted them to develop that idea, that they don’t have to go to the Himalayas to be in nice mountains, that you don’t have to go to Brazil to be in nice forests. The idea that they need to protect their own places and develop appreciation for their own place in order to better understand all places.

ME – About CREST anything that you would like to see kept, anything that you would like to see changed?

T9 – I like that there was a variety of folks, that Jim was not a pure teacher. I thought it was nice that people from different centers and different grade levels. Sometimes that I think teachers of younger grades have a lot to offer that teachers of older grades are somewhat arrogant about. More into the pedagogy than the strict knowledge base. I think that often times we miss the boat especially at upper levels. Part of it is that I think we get standards beat down our throats. The younger grades take field trips all the time. They don’t always do something that is [unable to understand tape], but they understand that there is a real need and purpose for that. Sometimes when you get further up into the higher grades, it is harder to take a field trip, because you have a hard time getting kids, because they can’t miss a band practice or miss a language arts lesson. So it does become more difficult. Sometimes I think upper division teachers could learn from elementary teachers, if they could past that idea of I’m smarter than you.

ME – Would you suggest inviting some elementary teachers?

T9 – Sure, especially some that do the journeys curriculum. That would be good. The teaching of kids, even-though that was difficult and I know people had a hard time with that. That was good. Jim and I struggled with our group. We had some kids that we’re real smart, but they didn’t want to do anything. That was good for me to try to find out a way to motivate them. And I wasn’t sure if I was completely successful. I’ve taught for along time and I should know this, but sometimes you teach and you feel like your not being very effective. But you are. We didn’t know those kids very well, so it was hard to tell if you were connecting. There was some built in awkwardness. You had kids from two different places never had those teachers before. Could have done some mixer type of things, so they could get a better feel for the teachers. Having a little bit better introduction about what we were going to do.

ME – the flow?
T9 – I especially liked the time I spent with the researcher. Enough time, but I could have spent way more time, but I think it was enough.

ME – would you do it again, recommend it to others

T9 – I would. I would, especially people that I think need a push to get going. You wouldn’t want to send some kind of dud that was going to whine about everything. I now like Dave, he benefited a lot from it. He is brand new. He just needs some ideas and more things to do. Somebody like that. Somebody who has never been in to a lot of field based things, so they could find out that there is a lot of cool things to do. That is not that scary to go out there and that kids can handle it, and it is okay to get your feet dirty.

ME – I’ve been getting some feedback that this wouldn’t be the best program for teachers early in their career, because there is so much going on.

T9 – a little of that is true, but what I also think is true, is that if you don’t start doing things, you don’t ever do them. I don’t think if use the world as a classroom from the get-go, I don’t think that you ever would. Our high school, no one takes field trips. They don’t go anywhere in anything. It is difficult to pop the kids you need out of other classes. If you are going to do a field trip, you have to do it in your 50 minute block. Where can you go in 50 minutes. Obviously it flies better in some disciplines. It would be fun to have an artist there.
I know a lot of people were from far away, but a little outreach, where you do something with their students.
Appendix 1.2F

Post-program Teacher Interview
Location: Phone interview
Date: 1/15/02
Participants: ME (Matt Erickson) & T1

ME: Have you been using any field research this past fall?

T1: I have converted totally over to the log book. I was kind of doing that before, but I've made the kids buy sketchbooks this year. I am putting everything in the log book. All of my experiments are inquiry, so they are writing them up. That is all in the log book, they are tracking the data. I did one activity, I still haven't got out to the new school site, we have had some problems there. I did take them to the zoo to do an animal behavior study. They sort of did the same thing that we did with the buffalo watching behavior. They had to write that up.

ME: I know you have been doing this for years, has anything been different this year as a result of your participation in the CREST program?

T1: Well, I don't know that anything is different, but they moan and groan harder. Because they have to think. We are not into a rout memory-type program. The retention, I gave an open-ended final, and this was the first year that I have seen better results than I have in the past. It is really consistent, because I am making them maintain a log. I haven't statistically looked back at it, but at a glance that is what I was seeing.

ME: More journaling?

T1: Oh yeah, a lot more journaling. Like on the zoo project, just on the writing alone, we spent two weeks of them turning them in and me correcting them. What they had to do was take the results that they had accumulated from that data and they had to write a grant to some agency for the research. We spent a lot of time on that project with grammatical skills and stuff like that.

ME: Were those actual grants?

T1: No they weren't actual grants, I can't remember where I got this from. It was like a problem based thing, without a real end to it, but I set it up in a real life format. So they could apply to different agencies for x amount of dollars they had to write the budgets. Explain what they were going to spend the money on. Figure out their expenses.

ME: Can you think of any specific things from CREST that you have used this past semester any of the field techniques, relaying your experience with the researcher?

T1: One of the things, when we observed the bison, using some of those techniques. I didn't go into using a chi-test or any of that. The kids math skills are declining, it is
tough just to get through a lot of stuff and that would have been way beyond them. So I didn’t even go there. But using that technique, and we practiced it before we went to the zoo. On how to collect the data. We did it random. They could pick out three times during the day that they were going to collect data for a half an hour. They understand that research isn’t that fun it can be tedious and boring. So that was good. I think even reinforcing the logbooks I bought. I bought colored pencils, watercolors and pens for them to really do their journaling like it should be done.

ME: You mentioned that journaling has helped with retention.

T1: Yeah I think so. I’ve been doing journaling at different times over the past ten years. Certain projects I have had grants, where I bought the journals, and doing it for a project for six weeks or so. I think adding the colors and stuff, not letting them get away from it, and grading the journals. I go through and I give the outline of what I am looking for. They know they are going to have to be doing this on a regular basis.

ME: Do you think that working in the journals has increased their appreciation of nature?

T1: That is kind of hard to tell, these kids are kind of squirrelly. Just the appreciation, took parents out with me, and even they noticed that the kids were like, oh my god they have to do this all the time. Yeah, that’s the way we do it. So I think they are becoming a lot more aware of issues then they had before. I did my cryptosporidium with them, that made them aware that it could be in their water systems too, you don’t have to go into the woods to catch this. That problem has a real impact on them, I’ve ran that problem for two years now, I’m going to give a presentation in San Diego on it.

I’m getting away from paper (tests) and making them write everything. I think that makes a real big difference. Their English skills are so poor that I have spend a lot of time trying to hone in on them, and I have put those issues off.

ME: Are you seeing anymore action out of students, are they prompted to act?

T1: I would say yes, but I mean over all of those kids that I have taught there are those kids that it impacts more than others. Then there is always the strange kid that is super aware and gets excited about it. I think generally about environmental issues that they were not aware of and cost and things like that. That is not that easy to clean up something.

ME: Thinking about the flow of the CREST program, what are some things that you would keep, and what are some things that you would like to see changed?

T1: You should definitely keep the student component, because I have worked with other programs with (out) that. Once you got to the teacher training, it is never reinforced until you get a chance to play it out. If you don’t try it out, then they (teachers) usually won’t try it out. That is at least from my experience. I think that the student teacher
component at the end is always good, because then you have a greater chance of teachers
taking advantage in their home district.

ME: Then, what would you change about the program?

T1: Can we come back?

ME: (explaining summer research assistantship)

T1: We had to choose, and there were so many different things to choose from. A lot of
us haven’t gotten out to do those things. I got to go see the bird banding, but I didn’t go
get to see the other things. I don’t know in that time frame, how you could work that. I
have done Woodrow Wilson fellowships and things like that, but this is a much better
program, because you are actually out in the field. I know Woodrow Wilson is out in the
field, but they don’t have a student component. When I worked up at the science
academy, the last few years we had a student component. After we trained teachers for
a week, we had another week for the teachers to actually try it out on kids. This seems to
work the best. Greater success with teachers transferring that knowledge back to the
classroom. Versus programs, where we have spent two weeks with the teachers, and then
send them back and said, “ok try it”.

ME: Well that is the model we came up with and seemed to work the best.

T1: That is probably the best one, and I don’t see many programs throughout the United
States utilizing that model. I don’t know why. You just get some interesting characters.
It can be just a big bugaboo. You have to get the money to pay the teachers. And it is
two weeks, and I think that is the other issue. You can get motivated teachers who want
to change things. They will spend two three weeks, or whatever it takes. But most
teachers, you are lucky to capture them (for) a week. And it is real hard to do anything.
Even with our program, we ran that two weeks and that was skimming a lot of things off.
Bare-bones training the teachers and throwing them in with the kids. That is the thing,
you will get the teachers who want to be there.

ME: You thought the three weeks was OK for the length wise?

T1: Oh yeah, the teachers who want to go to that program, that want to make changes in
their district. They are going to spend that amount of time, easily. We spent four weeks
at another program, that was a long time at a hundred degrees, and no air conditioning.

ME: (question not recorded)

T1: We always kind of did the log thing, but kind of haphazard, but now I have made
that a major criteria. The kids have to write everything.
Appendix 1.2G

Post-program Teacher Interview
Location: Phone Interview
Date: 1.17.02
Participants: ME (Matt Erickson) & T3

ME – Time with the researcher.

T3 – We were outside one time and counted the airplanes flying. And we got into a
discussion about how this might affect somebody’s study, if they were trying to count
birds or count animals. It ties right along with how airplanes effect bird populations. So
from what I’ve learned I’m incorporating it in, but I can’t say I am doing a whole lesson
or a whole unit. Most of my kids know what I did last summer.
I know of my birds around here then I did before, I’m more in-tune.

ME – Relative to previous years of teaching are there other things that you have brought
in?

T3 – Not that I can think of offhand. We are so locked in. After March when we are
done with testing, we can get back to doing things. Like we could do some compass
work. We have a special grant for gifted and talented. We have the money for a sub so
that we can take these kids out one day a month. I would like to do some field research
with these kids.

ME – What did you think of the flow of the program?

T3 – I thought the whole thing was set up beautifully, from the start to the end. At the
end it would have been nice to work through the process again with the kids. With our
time I don’t know if that would have been possible. I think maybe that second time to
have the kids come up with more of an idea of what to investigate. That would have been
nice to see what the kids came up with.
I thought it was well set up, as far as the teachers learning the techniques, and really
working with us. It would have been nice to work with more than one. Spend maybe a
couple of days with the ecologist and move to another.

ME – More closure with the kids?

T3 – yeah.
Appendix 1.2H

Post-program Teacher Interview
Location: Phone Interview
Date: 12.9.01
Participants: ME (Matt Erickson) & T11

ME: What have you done this past fall, with regards to field ecology?

T11: Part of it is wetlands, and part of it is wooded. They are not going to be able to build, but it is close enough to school, that it would be a great place to do some studies. You could walk right from the classroom. There is actually an old farmhouse that we have been talking to about not to tear down. It could be a place to store nets and all kinds of stuff that you don't have room for at school. We want it for an outdoor ed building. I don't know if that is going to happen or not, but that is something that we have been talking about. We went out and walked the property to see what the possibilities could be, and it could be a really neat place for kids to go out. Even if they were going out just to do the things you (Matt Erickson) were doing. Just go out every couple of days and go take pictures or look and see how things are changing. I think that is just going to be an ideal setup. It is close enough that they can just leave the classroom, run outside, and come back in. That is still a year away. I don't know if I am going to stay at the school I am at no. That will depend on if they are going to divide up our department. But I would still have access to the property. We do have some area. My school is in an area that used to be mostly farmland. It is growing very quickly. The school population, since I have been there, has gone from about 1100 to 2300. Which is way too big for the school, but that is just an indication about all the growth that has been going on. We do have an area that is pretty good with a pond, wooded area, and a wildflower field. We went out the third week in September, we started looking at seeds. We are beginning a Biology project on plants. We did dispersal, we looked at all the different way that seeds are dispersed. We talked about that. They collected a bunch of seeds that they brought back in the classroom. They developed a key, not knowing what they were at all, which is kind of fun to do. They presented that to the class. I wanted to do some journaling, I really enjoyed doing that this summer. So I got some good ideas from looking at a couple of books. Things that you had at the school (TSS). Kids did quite a bit of drawing and little tidbits of writing about the soil. A lot of these kids, even though they are in a rural area, they are big time city kids. They don't go outside and play, they don't do anything like that. Recently I have been really busy doing inside stuff, because I am doing yeast genetics with the [local university], we have a partnership with them.

ME: Are there other things from CREST that you are using?

T11: One thing that I am doing right now. I had used excel before, but I had worked with that quite a bit, with the bird stuff and also when we did our analysis with the kids (CREST). Some of the analysis, chi-square, I didn't know that was available with Excel. We just got a new global wireless ibook lab. My kids are doing fruit-flies right now and
using excel. I use a lot of those things that we talked about in class to help them set up their data tables. That has worked out really well. The best thing for me, was that it was something that was so different for me. That when I got back to school, I just felt so excited about going outside and doing stuff. Doing anything new. I have a whole list of things that I would like to do, obviously I haven’t done all of them. My second semester class should have a lot of opportunities to do some more research type projects. I have three sections of an honors Biology. They are either higher level sophomores or juniors that are really interested in Biology. I won’t have to worry about them running in the street or throwing rocks at each other. Second semester I would like to do some more, and have them design the project. One of the things we would like to do as they build the new school. We requested that instead of putting in all of the same trees, to put in a variety of trees. We could have like an arboretum, we could do tree identification. I would like the kids to do some research on our soil type and climate, and what would be some good trees to select. That would be landscaping, but it would also be available for students to use. I have a kid who is really into orienteering. We want to put in a permanent orienteering course, but have it be biology orienteering, where each station has something that the kids have to look at, or draw, or do. We already have it mapped out, we have timbers cut. We are going to sink some timbers down, and put a plate on it that has some symbols on it. That way you could change the course for however you wanted it, but the mowers could go over it. I am excited to do that with him.

ME: Doing that seed study, what are some of things you think the students got out of it?

T11: I think one of the biggest things was, I like the kids to have to do a lot of drawing, because it forces them to look very closely at things. Ordinarily I can put out a tray of seeds and the kids will take a look at it and go ok, and that is it. Having them collect them, and having them give them a name. I gave them a bunch of Latin word parts, and they had to make up a scientific name. They had to explain why they picked that name, and they had to talk about dispersal. One of the things was just looking very closely and being able to say, yeah this is kind of cool. They weren’t the first to discover this, but their seed was very different then all of the other seeds found. I didn’t think it was, I just did it at the spur of the moment, let’s go out and look. There was a lot of things that were going to seed. It ended up being a much better project then I had thought. Next time I do it I have some more ideas. I think they have a better sense of looking at things very closely. Taking things apart, and spending literally an hour looking at one seed. That is a long time. You had to draw it from different angles, you have to measure it, you have to mass it. They were doing tons of stuff with it. Did they float, what happens when you throw them in the air? They were doing all of those mini-experiments. I think looking very closely, a lot of kids today are in such a rush. They want to be the first ones finished.

ME: What did you take away from your experience with the researcher?

T11: First of all a real appreciation for birds. I wasn’t really interested in birds. In college I was interested in mammology and did a lot of things with mammals, but not
with birds. I really want to do more. I was talking to one the teachers from our junior high, her husband runs one of our metro parks. I need to find out if there is an opportunity here, even just to observe. Just to get to do some identification, but also to do some handling. I showed the class those slides. They loved the blowing on the bird, looking at the feathers. They were just entranced, and had lots of questions. I think just a greater appreciation for birds. I always end up doing things early in the morning. I really enjoyed doing that. Getting up early and getting things setup. The people I worked with were so patient. I asked lots of questions and they were always very good at answering the questions and letting me try things, handling the birds. Doing a lot of the stuff, that for them was probably routine, but for me it was real exciting.

ME: What about the program did you think worked particularly well, what sort of things would you change?

T11: I really liked doing a few things inside, then getting outside. But doing a little bit of each. I really liked the first day, doing the tour of geology. That was very interesting, that is a great introduction.
One big thing that I would like to change. The part with the students was so good. My group was fun to work with and very motivated and I think they did a tremendous amount of work in the time that we had, but then they were gone. We did our presentation I would like to have had a little time afterwards go sit down and talk about what they thought and where they could go with this. Were there things they would change. Kind of a debriefing period with them. I know that was hard with the schedule, but I felt like they were just gone. I didn’t even really get to say good-bye to some of them.
Eventhough it was just for a couple of days, I really got to know them. I got to know their personalities, what they enjoyed doing.
I enjoyed having the few evenings we had activities on the weekend. I think if you did it again. I would suggest. I was just lucky, I hooked up with people who had a car. I would either say to people, think about getting together and renting a car together. It was kind of hard to plan and think about what you wanted to do for those couple of days. I would have been happy to lay on the couch or be by the creek. I don’t know just thinking about the weekends.

ME: Even suggest having some sort of trip planned?

T11: You could do that, but leaving it optional. I know some people went home. Maybe do it like the science convention things. Have people check interest. I think you guys were run ragged too. You need time off on the weekend, not to have to haul people around. It was kind of neat exploring.

ME: Would you do it again?

T11: Oh yeah, in a heartbeat. I had a great time. It sure was nice to step outside and see those mountains, a different view of life. Like I said, it was just nice to get away. Not do school stuff, not work at the camp I’ve worked at for 19 years. I have fun doing that, it was just really good to do something different. It was nice to be a student.
ME: Do you still field research can be a way to address the standards?

T11: I definitely think they are. The big problems that we talked about, the availability, the limited time, limited resources. Now that I think about the resources, there are a lot of things that you don’t need a lot of stuff for. You just need to be a little creative. I have some research partnerships with universities, so I do get to take my kids places. My principal has kind of bent the rules. Some people are kind of mad at us, because we get to do things and they don’t. But I see that changing. When we divide up the school and things aren’t quite as tight. Even an in-school field trip, we arranged an in-school field trip last year. We had kids miss there regular classes, but we did a live open heart surgery. It took five class periods. It took place on the school grounds, so to get an extended period of time, we can probably arrange that. With the number of classes that we have, you are talking about lots of teachers and lots of kids. Just logistics for something like that is something you have to work on. I try to do something as a pilot, to see if it works, then to say to someone else, hey it works. I think field stuff is the most interesting, it is probably something most kids won’t have a chance to do. It will get them to think more about the sciences and going on in school. We have a lot of kids that are in the medical fields right now, but I think we would have more kids interested in the field sciences, if we could give them those experiences.

ME: How do you feel about their ethics towards conservation?

T11: They have had that drilled into them. In our district from kindergarten. We have three small parks. These kids have been in some projects, at least thinking about that stuff. I’m not sure how much they practice it. I’m not sure a lot of them especially at the high school level think about that a lot. We could do a much better job with that. The opportunities are there. But I think people are in too much of a hurry. If it means saving something or conserving something, it won’t be worth it in terms of time. We planted some seeds and the maintenance department mowed them down. I think that is just a consequence of being so large right now, lack of communication. They can say all the words, they can talk the good talk, I am just not sure they are practicing what they are talking.
Appendix 1.21

Post-program Teacher Interview
Location: Phone Interview
Date: 1.31.02
Participants: ME (Matt Erickson) & T5

T5 – My students are having to build a computer so that it is fast enough to process all of our data, so it doesn’t crash all of the schools computers. For the all-taxa survey. We are going to have a test run. The software exists, we had to come up with a way we could use the software. We want the data to be accurate, so we had to come up with our own protocols. We are trying to get the whole community involved. All of those projects I sent to you are done before and after school. Claude doesn’t want me to say this, but I may move to gifted and talented next year. I just can’t seem to get the project done in a regular classroom. Our kids are just leaving now, and it is 5:00.

ME – you have been doing this for years right?

T5 – Not like this. This is totally different. This is hypothesis testing, this is forming a collaborative partnership that we didn’t have before. All using the same protocol and being a part of a wider research group. We have joined with one of our less advantaged schools, and one of our prep schools and another prep school and we are all doing simultaneous water testing all on the same day four times a year. It is a national project. That is new for me. I have done water quality stuff with my kids, looking at the same place. The hypothesis the kids are testing is that there is a decrease in the quality of water as it moves closer to the city. Right now we aren’t getting evidence to indicate that, but we have only done two trials. That project is new, with the hypothesis testing. I just taught my first scientific methods class to my fifth graders. We did hypothesis testing even on my pathetic little lab that we were doing. I used the relationship, on relationship; I am doing a good job. I learned a lot from y’all.

ME – Some of the skills you pulled from CREST.

T5 – Well the big thing is the scientific nature, the hypothesis testing. Then I got excited about ARCview, as a result of Court’s project. I am using that in both water monitoring projects and the all-taxa project. That is new for me, because I hate technology.

ME – Do you hold the same views as [colleague] about standards not being a problem?

T5 – NO! It easier to do that in English and social studies, but in science it is very specific. But it does match a lot of our standards. My problem is all of our students are outdoor science people and we are inside doing laws of motion. I think we do about 50% of it in the field, but I think to do it right you need to do more than 50%. Think we are fooling ourselves, we say that we don’t care about testing, but we are very proud of the
fact that we are first in the state. When science scores dropped, I wasn’t on the top ten list.

ME – Ecoliteracy

T5 – I think our kids are passionate about it. I think that we all talk a good game, but to do really good work. I have been going to a class in teaching citizenry, but I think I am going to stop going to it, because it does not address real issues. In order to be effective it has to take on an expeditionary or a journeys model, where it has to be real work for a significant period of time. It is a lot of work. Those are the big things, the passion in my particular person, [ecologist partner] and his use of the software. I bought a GPS and use it like we did out in the field. My projects just keep growing. We are trying to inventory this for future research use. I am designing this so it can help someone to answer a real research question. Therefore we have to make the information as scientific as possible.

ME – Flow of the program

T5 – I don’t think I would have changed anything. I would have liked to stay longer. I would have liked to work longer with my ecologist, actually have learned a skill. I think when you started was terrific. What you guys need to do is attract young teachers. Who have like 20 years left to teach, who are going to make a difference across the board science teaching. What you are doing is so amazing that you want to get converts. I was thinking about why I teach the way I do. 25 years ago I had so instrumental teachers in graduate school in the early 70’s. I changed my entire pedagogy. You need to reach those teachers early in their teaching careers. You guys need to go to NSTA. That is where you will get those teachers. It was a wonderful program, and I do think you need to reach the right people, because it could make a significant difference to science teaching, which will then change the way people feel about the world.
Appendix 1.3A - Journal Prompts

Journal prompt 6/11/01

Welcome to the CREST program. How are you feeling as the program starts? What aspects of CREST are you excited about and looking forward to? What aspects of the program concern you?

Journal prompt 6/12/01

Ahhh, a beautiful day for some field research. Did the techniques and methods used in the field today make sense? How could you use these techniques and methods back home with your students? Are you beginning to think of some partnerships you can develop back home?

Journal prompt 6/13/01

Tomorrow you will be heading out in the field with a local ecologist. What are some of the things you are hoping to get out of the time spent with the ecologist? What questions are running through your head, that you would like to ask the ecologist? How do you foresee involvement in this specific field project contributing to what you take, from CREST, back to the classroom?

Journal prompt 6/20/01

Tell me; I forget
Show me; I remember
Let me do; and I know
- Chinese proverb

In regards to your time spent in the field with the ecologist, what was the value of “doing” for you?

Journal prompt 6/29/02

“Acquiring scientific knowledge about how the world works does not necessarily lead to an understanding of how science itself works, and neither does knowledge of the philosophy and sociology of science alone lead to a scientific understanding of the world. The challenge for educators is to weave these different aspects of science together so that they reinforce one another.” - Benchmarks for Science Literacy

1. How has the CREST program helped you to better understand the process of science, and more specifically ecological field research?

2. What research and teaching skills have you acquired or honed during participation in CREST?

3. How can you “weave” your CREST experience into your science curriculum?
Appendix 1.3B

Teacher Journal
#1T

6/11/01
I'm excited about the start of the program! Meeting new people and networking is very exciting learning about what other teachers are doing in the classrooms. I'm looking forward to working outdoors! Learning about everything in the area, listening to real history and stories. Concerns – getting out of the top bunk without breaking something!

6/12/01
Yes techniques did make sense. I'm familiar with transect sample I currently do with the IDNR. It was nice to see a different sampling method. We sample 100m sections within a 100 m sq. area and we sample 5 lines. I think the technique used yesterday seemed to work much better! You could sample an area much more quickly. Plus using the GPS's in this fashion is much more meaningful for the students. I plan on restoring a wetland area behind our new high school allowing the students to develop monitoring projects that could be kept upon opening! We will have the baseline and then over time see the impact of the new school and increased housing development on this area. I already have partnerships established with the IDNR, city council for the Greenway. However, one new partnership might be with local Soil Conservation office runs an experimental farm about 1 mile away from the new school site. I have done water sampling and frog sampling there in the past.

6/13/01
I hope to be able to learn how Matt set up the research variables involved, Methods use to collect data, how often samplings are taken, etc. I hope to learn how to set up long term monitoring projects. We are building a new school and the back lot is a wetland/prairie. The first year will be collecting baseline data the future collections will hopefully show the impact on building the new school and accompanying housing on the wetland!

6/20/01
The value of doing is “everything”! It allowed us to ask questions, and collaborate like a team. Decisions identifying the flowers were inclusive. [The ecologist] attempted to keep me focused when I seemed to be straying from the task. At times I wanted to wander and look at my surrounding above ankle height. I'm a workaholic... If I have a job or task I have a need to complete the task then play (goal oriented). Working doing the transects for veg. sampling was fun. Using the 3 different sites provided more questions to study and the opportunity to view the spectacular scenes of the Tetons.

6/29/01
1. The CREST program has totally opened my eyes to ecological field research. I run a lot of open-ended questions and labs in my class. However I think I have really pigeon holed the students in reducing the amount of variables to make their
data more reliable. Now I realize the importance of the big picture even in analyzing data. It was extremely difficult for me when working with [partner ecologist] on the flower project. I wanted to control everything with the research. After four days in the field asking questions, I finally concluded that it was OK to have many variables, that I could not control. It gave me an understanding.

2. I think it was valuable time to work with the students and to develop a research project. It also reinforced the big question ideas that we often forget in the rush to cover the curriculum. In an attempt to derail a possible disaster the final day.. I pulled Mike a side out of students earshot and strongly suggested to back off – let the students work through the problem and we stand back and act as mentors or resource people. Its a hard thing to do for many teachers in the go of the stage. When students need help they will ask!

3. Truthfully I was not excited about the bison project! But now! I plan to run a bison problem in the fall with my students and having the connection to Teton Science School will make the problem more real. I plan to use the data form the summer for the students to analyze. Future research projects will center on the new school site and the students... experiences than a multiple choice test will ever give them.. Its placed in long term memory! Something that can’t be taken away.
6/20/01
The active participation with an ecologist makes the experience personal, instead of passively learning from someone else's experiences, one learns from his own. He accepts ownership for the activity and ultimately for the outcome. Essentially one takes responsibility for the experience which automatically engages higher levels of thinking that in watching a demonstration or by reading.
In addition, interaction with an ecologist provokes questions whereas one can obtain more information. One can realize that we are all ecologists, with or without a formal education with in a particular area of study. One's perspective becomes part of the experience. Since we all see the world through "different eyes", one may be able to offer the ecologist a different prospective that may (or may not) change the experience.
Information is more apt to be remembered long term that in short term memory. And since the experience becomes part of the participant, the skills obtained are utilized in other related or non-related areas of one's life. Knowledge is appreciated more when experienced.

6/29/01
Before participating in the CREST program, I knew very little about the field of research. Given the experience of working with someone engaged in a "long-term" study has allowed me to appreciate the persistence, dedication, and commitment of the researcher. I have begun to understand the importance of research as an integral part of the decision making process that shapes our world today. I realized how the scientific process is already ingrained in the way we live, make decisions, and reflects how we interact with one another. Therefore, using the scientific method is a natural process for us already. I believe it is the awareness of the use of this process that can make it practical, useful, as well informational gathering – which is what education is all about. The CREST program has acted as a microscope in my understanding of ecological research. As humans, we are part of the earth, not separate from it. Ecological research allows us the window to see how we are taking care of "that part of us". It shows us what we can't see at a glance. It teaches us how to look at our surroundings that which we take for granted.
As teachers, we give what we are to our students. Making our students aware of the use of the scientific method in their every day lives teaches them to look, observe, and learn. Furthermore, in the interpretation of research, students practice using higher level thinking skills which ultimately leads to better decision making.
I have learned a new philosophy of teaching during the CREST experience. More importantly, I have realized the need to rethink my current approaches to teaching. I have experienced great success in inquiry-based teaching; but not at this depth or length. I know my 6th grade students are quite capable of bigger projects, higher levels of thinking, and participation in research projects such as the ones we were exposed to. I
have benefited greatly by observing those around me, and by utilizing a different philosophy.
I am anxious to develop units of study based on research. The first thing I will do is
develop one research project to accomplish this coming year. I feel I can work through
the logistics, I have administrative support. I plan to share this experience with the right
administrators. I will link up with a particular teacher I know that will collaborate with
me.

6/11/01
With the onset of this research project, I feel fortunate to:
1. be apart of this program
2. meet such a diverse group of the nicest staff, teachers, and students
3. be at one of the most beautiful areas of the country
My heart is enjoying this!
I am excited about participating in this first year program, and also having the
opportunity to help a graduate student (Matt) with his coursework.
I feel this program is very organized, well throughout, and practical.
I am excited about interacting with the ecologist as well as experiencing this work with
students. I am looking forward to observing their excitement, involvement, and
perspective of the importance of understanding ecological relationships. I'd like to know
if these students understand the implications of human impact on the environment, as
well as their role in protecting and preserving its habitats. Learning more about the world
around us is always something to get excited about. Researching a particular area will
certainly show us what we didn't see before. It will help us appreciate the effects of time
and change.
Whenever I'm "out in the field". I always learn more about myself. In observing nature,
I learn about patience, perseverance, acceptance, forgiveness, etc. I observe how animals
and pants honor life and try to apply those lessons to mine.
Lastly, I'm looking forward to passing what I learn on to students, that's what "teaching"
is all about – helping students understand more about our world.
Currently, there are no aspects of the program that concern me.

6/12/01
Awakened by raindrops, and still it was a beautiful day for some research.
The techniques and methods we used today were not altogether unfamiliar to me and did
make sense.
I could use all of these skills with my students:
• compass reading
• map reading skills
• UTM grid reading
• Usage of GPS
• Measuring skills
• Meter and tenths of meter
• Accurately recording data
• Slope (what is it & how is it measured)
• Directions

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Vegetation types
I would preface the research with a lesson on satellite images, a lesson (I already have) on pixels, and making the connection between the images and how they are used by scientists. Then I would introduce the importance of the research and the level of accuracy expected.
I know people I can connect with or reconnect with in [homestate] Ohio:
1. Environment Education Council
2. Wilderness Center
3. Environmental Education Center
4. Resource Agency
5. Local Ecologist
6. Nature Conservancy

6/13/01
for [partner ecologist]:
What prompted you to pursue this project? How long have you been working on it? How did you select the sites for your research? What is your background? How many sites do you study? How are the sites alike and different? Does the study continue throughout the winter? Will someone continue with the research when you are finished with your part of it?
I’m not sure what I’ll take back to the classroom. I intend to be knowledgeable about the types of research occurring in the this part of the country. I hope to be more knowledgeable about birds and their songs.
I hope this will help me provoke students to develop their own research based on inquiry, and understand the complexity of one project based on the fact that everything in nature is connected.

6/14/01 & 6/15/01
Two terrific days of research!
Researcher: [partner ecologist]
“Students”: myself and Beth Fetterley
objective:
to compare the impacts of different browse intensities of elk (rather wild ungulates) on land birds in upland aspen communities and habitat parameters within these communities.
Thursday: We conducted habitat studies on various aspen sites. [partner ecologist] introduced us to his research. His inquiry today was based on the decrease of aspen trees on the outside parameters of the sites. As [partner ecologist] walked the parameter of the sites, [partner teacher] and I counted the number of downed trees to 30 meters. With the use of the GPS, we were able to see the shape of the sites.
Friday – [partner teacher] and I met [partner ecologist] at his sites at Granite Canyon. We visited 3 sites and [partner ecologist] recorded the birds present mostly by their sound. Data was collected for 20 minutes. Disturbances such as elk, airplanes, hikers, etc. were recorded.
[continues to describe procedures]
Appendix 1.3D

Teacher Journal
#T4

6/11/01
I feel both nervous and excited. This is my first time at a “camp” and am somewhat shy. I’m excited to learn about the area. I hope to gain a more “in-depth” understanding of the area and how to use research (field) as an educational tool. What excites me the most is listening to other people’s ideas. Collaboration is so important and often missed in a busy school.

6/12/01
The techniques of measuring made a lot of sense. Using a random angle and then trisecting it were good – it’s amazing this diversity that we measured near each line. I didn’t think there would be that much diversity, obviously increasing data points increases understanding and this is something we try to do with student data.

6/20/01
- A feeling of what a researcher really does (time, reason, passion, etc.) Patience – the incredible patience that [partner ecologist] showed was amazing. To sit and wait for hours an maybe results / maybe not. Also, it was interesting to see how creative and clever [partner ecologist] was to figure out procedures / methods of accomplishing his task. I’m so impressed with the tremendous creation God has made. The mountains sing of His glory! The mountains are so visually imposing and strikingly silent. They are a place to ponder your thoughts, relax and enjoy their beauty. God, I thank you for such a beautiful place.

6/29/01
1. Although I already knew that scientific education is a means of teaching students how to think, CREST reinforced this idea. Also, while cookbook labs can serve a purpose, they must not take the place of inquiry based activities. CREST has also shown me that I need to slow down and study my own backyard (A sense of place). I’m encouraged to take my students outside to explore Physics concepts in nature.
2. It was great working with the students and giving them opportunities to design their investigations. Working with them gave me a Sense of how much they enjoyed working with a teacher and not under the teacher. I think the apprentice / partner type of model of teaching works and makes more sense. TSS does a great job of getting the students interested in research, nature and environmentalism. Rather than learning 3 or 4 facts (i.e. this bird is a raven, this plants name is sage) the students are leaving with an interest in exploring the why’s and how’s of the natural world. This is a concept that I try to teach and feel that CREST has reinforced.
3. Working with the researchers (Crow) has really had an enormous impact on me. I was impressed with their dedication, creativity, and passion for their work. That encourages
me to bring more passion into my teaching. Even though we were unsuccessful at catching birds at times, we still learned so much about their behavior by sitting still and observing. Hopefully I can get students to see that the process of learning and studying a phenomenon is just as important as an “end result”.

Science is an evolving body of knowledge. We cannot know it all, but by studying/researching kids can make connections. (i.e. a rain/water unit shouldn’t merely stand alone but be connected to other studies that depend on water such as vegetation and wildlife)

CREST has done a great job helping me to “see” the world around me, helped me to make connections and given me the resources and practice time needed to experiment with kids.

Well done CREST!!

I appreciate all you have given me and promise to give it to the students.

CREST has helped me realize just how out of touch I was with nature and didn’t even know it.

After being here for some time I truly hear the birds, smell the flowers, see the animals and truly appreciate the awesome creation that we live in.

I feel a real sense of peace being here and call to explore an investigate more of our natural surroundings.

I expect many students have also lost touch with nature or never are aware. Hopefully I can encourage them to explore their environment and have an appreciation for how special it is and what it means to us.

Project:
- statistics – too complicated for students, not enough experience, not enough data to do statistical analysis
  - students should have been more involved with planning project
Appendix 1.3E

Teacher Journal

#T5

6/11/01
I am energized and excited as the program begins. The sensory overload of the TSS site combines with the intellectual overload of the project. I am eager to hear about the research projects that are underway. Building community, networks of ideas and people are the lifeblood of any teacher. The first day is ending my mind swirls with moraines, outwash flats, alluvial plains, oxbows, skillet glaciers, potholes, topo maps, maps of geology. I am now officially on sensory overload. Wildlife, botany, geology begets biology — whew! I am concerned that there are so many project ideas I will have difficulty choosing one. I’m also worried that I may not be physically up to the challenges I set myself. But mostly I feel a sense of connection to this place — aspens, ground squirrels, chirping like birds, unique, jagged mountains rising above. The sage covered plains and the program — CREST Doug’s first intro. Hooked me and the hike reinforced all I love about ecology.

6/12/01
The techniques and methods we used in the field and in the classroom make perfect sense. I am impressed with the integration of maps, technology (GPS), tools (wayfinder, compass) to determine slope, with field guide and clear procedures. The questions I address with my students:
How do you understand an ecosystem?
How do you collect evidence to understand relationships in a system?
What is evidence?
How do you figure things out?
Why should you care? Are all well supported by what we did today. Plus I had a great time (except for the hurling thing)
I saw some ways to modify lab / field lecture times and techniques.

6/13/01
First, let me state how difficult it was for me to choose one project. Each ecologist seemed to have chosen a project I’d want to know more about:
Questions running through my head include:
Will I be able to transfer some of what I learn directly to my aboretum group
What it actually “feels” like to rise at 500am and work in the field? Will there be coffee?
Silly things like, “will I hurt the bird will he/she hurt me?
What path led you to this field? This project?
What are your biggest frustrations trying to collect data?
I chose the project I did (reluctantly) for the reason that I have great hopes that I can modify and replicate in my town.
Comparing the structure (I need a better grasp on that choice of word) of the bird community between developed / undeveloped areas would be something of great interest and applicability to [hometown].

One of the reasons I love field studies is that there is a possibility of real work for students (and you get to play outdoors) I was hoping to expand our tree survey to smoothing involving birds next year 2001-2002. Realistically 2002. I'm hoping that I'll gather tools, technologies, comfort level, basic knowledge. I'm hoping that I'll get better at bird ID and see what the "experts" do.

6/30/01
Consilience by E.O. Wilson discusses how the complex nature of knowing and understanding nature best occurs when many perspectives, disciplines, or pedagogies join together to answer difficult questions. He proposes that every scientist ask, "How does the humanities help me understand science?" and all citizens to ask how science helps you understand politics, economics, poetry, art, etc. Most problems or questions we are asked to address in the real world are better suited to the methods study of field ecology.

They involve:
1. multiple variables
2. much "mucking about: just to ask the right "testable" question
3. the evidence often runs counter to our intuition
4. they require tedium and sweat as well as unanticipated beauty
5. they require a "network" of skills, knowledge and attitudes often leading to people and places not anticipated
6. and often only lead (after much effort) to the "null hypothesis"

I think ecological field research is also an excellent segue to teaching.
In teaching we hope to ask kids to look closely, question, test, explore, predict, synthesize, analyze, and more. All these are addressed in the process of science used in field ecology.

I have taught 32 years and I am amazed at all the skills I’ve acquired and honed during this experience. Some of those skills include:
1. Statistical analysis of data. I have a much clearer understanding of the tools of analysis. I am comfortable with the technology that makes the analysis so much easier.
2. tools / techniques. All the tools – new and old – GPS, clinometer, canopy cover, new water quality testing, technology, have improved my comfort level with the tools and techniques of field research but even more – the systems with which the ecologists (Court, Doug, Kristine, Susanna) used multiple tools – including field guides (Pyle) and keep up with them was an excellent model for me. The structured chaos at the bird banding tables when there were 15 birds in bags, multiple data tables, tools (gram mass, ruler) passing back and forth, questions flying, people collaborating to answer and record – yet not forgetting the excitement of the “newbies” kids and adults about the birds – All serve in improve my management of complex tasks in the field. I was especially impressed with how good “habits” – where to put tools, the care you took in

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asking and answering questions was never short changed in the frenzy of the moment. I intend to purchase equipment and implement practices I learned here.

3. I can “wean” so much of the CREST experience into my teaching. Some ideas that come to mind immediately are:
   a. Real field research modeled on what we just finished with the students. Rigorous open-ended, student generated projects.
   b. The organizational aspects of TSS. Someone told me the best classes have all the nurturing and belonging of a great kindergarten classroom and all the intellectual rigor of an intense post-graduate seminar. I have felt both of these here. The kindly communism of the “silver fridge” and communal gear, the patient questions and concerns of the PREE and instructors with the intellectual challenge of the tools, statistics, the “can”, logistics and all of my “time-sensitive” learning of things that I needed to understand.
Appendix 1.3F

Teacher Journal
#6T

6/11/01
My answer is simple - I am looking forward to an exciting three weeks. I have no fears or problems with what I believe is expected of me. I believe the CREST faculty is very professional and has much to offer me and my science program.
I'm always excited to learn new ideas and information. My background is not ecology...so I have a lot to learn. I enjoy learning new techniques and procedures. Meeting new people and making new connections is always a plus.
Perhaps, the item I am not excited about is the opportunity of my students will have plus the others coming. I can't wait to see and hear their reactions. (If I have one concern about the program... it is the students reactions)
I am writing this after Monday's activities. Wow!! I learned so much about geology, botany and birds, mammals, etc. If every day is like this I will be swamped.
*special ideas:
Geology shapes botany and ecology of an area!
Topo maps and their use
Use of history of an area to shape today (glaciers, history of Teton National Park)
Vocab: moraines, potholes, faults, riparian, alluvial fan
The flora would be two numerous to list but: sage, bitterbrush, lodgepole pine, Douglas fir, etc.
Wildlife - Outstanding - elk, pronghorn bucks - etc., etc. birds, waterfowl.
So, in closing - Thanks for a great stay...especially Matt's airplane pickup!! And his kindness and concern. Looking forward to tomorrow
*[sense of place presenter] presentation - info was not new to me and I wasn't sure where he was going!

6/12/01
Good morning!!! Beautiful day!!! Cool, rainy, no sun but my favorite kind of weather. The techniques we used today were clearly presented. I felt that the explanation Doug gave in the early AM concerning topo map and the UTM way pointer were great. I would feel very confident in doing a lesson just as he presented the materials to us.
The bus trip was wonderful. Many teachers were doing a lot of talking... I just wanted to experience the beauty of WY. The stop to ID ducks was a real treat. I'm very lacking when it comes to bird and waterfowl identification so it was great to be with Jim who knows so much.
On to Gros Ventre Valley!! To work on the sage grouse habitat. Wow!! Learned a lot - use of GPS, good review of compass, three new sampling protocols, collecting data!! Once again, this is one of those very useable protocols to take back home. I won't be knee deep in sage but the use of transect and the other tests will be invaluable. I would like to have copies of those the data sheets. Could I?
I don't know if this is journal material but the trip and dinner at Domans was great! Helped to be realaxed! Thanks TSS!
The three teachers presenters were excellent, inspirational and lovely people. I felt all of
the activities they described could be used at my school. I will go into detail:
Brit – biodiversity of the 3 ecozones in our park would be very do-able I will do this.
Amy – I like the way Amy laid out exactly how her project flowed. This I will do!!
Sammy – great presentation – to adopt Sammy’s project will take some thought but I
believe I could use the idea in our large area, west side of building for plots of soil –
prepared differently for prairie plantings – I think this would work very well.
Overall – excellent day – very usable materials.
I have partnerships: DNR, NIP, UEC, UW-Madison Arboretum
The main problem is keeping up with the partnerships.

6/13/01
I will be working with [partner ecologist]...the effects of development and undeveloped
areas on bird populations. I’m pleased with my placement but not the hour we begin
(joke)!!
I hope to learn:
1. birding techniques: setting up nets, taking birds out of nets, banding
2. anatomy/physiology/behavior of birds
3. IDing birds
4. more about development around Jackson Hole
5. issues surrounding this development
Since, Jim is a real bird expert, I think he will direct most of the bird research at UEC.
But, I’m very interested in learning so I’m off on an adventure.
Questions for the ecologist:
What made you chose this topic?
What kinds of birds and numbers of birds have you found?
Does your project have a possible conclusion?
How will you bank your data? Present your data?
Have you noticed interesting or noteworthy behavior patterns?
What is going on in the research sites / Jackson Hole?
How do you like your project?
Where are you going from here?

What can I take from CREST to the classroom from this field project? Students can do
the same research with a little changing of research sites. We will need to borrow or buy
nets...We should be able to recreate this...I hope.
This evening activity with was very interesting, fun and a little scary...definitely
challenging. Very glad [presenter] didn’t lecture us on standards. I don’t like (strongly
don’t like) standards but [presenter’s] game made the topic more interesting, the “game”
was outstanding, one I could possibly use.

6/20/01
As I expressed today, I felt very good about the work I did with [partner ecologist] on his
project. I feel that I learned a lot – the scope of the research project introduced to
Jackson Hole development problems and there impact. I also learned so much in term of
birds: both the technique of audio and visual ID. Veg site, once again showed me
techniques and a protocol I could use in the classroom. I know (as I have said before) this is a very do-able project and as I said today I will use parts of this:

1. establish a small research group (not during school time)
2. introduce research method
3. establish 2 or 3 projects
4. work with students to carry out these projects
5. write ups
6. communicate

6/21/01
The first day of summer, what a wonderful place to spend it. The weather has modulated and is beautiful. I wonder if there will be more snow (NO)!

Doug:
I thought the hypothesis testing and statistical analysis was great. I had stats in undergrad and grad. School so my mind is fuzzy on the materials. You gave a great review thanks! I’m very glad [partner teacher] is on my “Teaching Research” project. I think we can work well together…the topic of animal behavior is a favorite of mine. The “patrons event” was good. It was great to participate in something that my benefit TSS. I found your guests interesting and very interested in the school. I especially liked [particular guest]?! Hey, the food out-of-sitght. [Presenters’] presentation very informative and timely. Thanks.

6/29/01

Crest program has helped me to better understand the science process by pushing me to rethink reevaluate my use of the science process in my classroom. I think?? I know the science process of observations, hypothesis, design, test and collect data, analyze data, drawing conclusions, further studies, errors, present. My new insight form the program is to actually use this in my classroom. Most of my labs are “cookbook” and “fit into 48 minutes, this has to change and in the process of changing…I’m going to be met with opposition…but isn’t change always that way! Spending more time on topics so students can develop “the science process” will take more time therefore as much material will not be covered. It will be a challenge … but I’m ready!

Perhaps, the “skill” (if that is the correct word) that was “honed” for me was – Statistics! I have had 2 courses in stats – successful to B’s in both but the review was great. Ideas such as: hypothesis, null hypothesis, alternative hypothesis, and the 4 or 5 specific stat tests. And then to see how the data was placed on a spread sheet and the statistical test was run with no problem (ha ha). And then to analysis the stat value in terms of null and alternative. And final to put the analysis into the big picture or the so what. I believe the final idea that was “ecological significance” is more important that the “statistical significance” (if I can use that word). What is the impact on the big picture??
*Also, I will always remember that “ecology is shaped by geology” [driven]
I will “weave” my CREST into my teaching in 3 ways: (Please feel free to check with me to see how I’m doing)!!

1. revisit my labs. – I’m not sure how I will do this but there will be no more cookbook – I’ll make investigations student and hypothesis driven.

2. I would like to begin a “Research group at my school. I know this will have to be an after school activity and outside of school time but I’m willing to do it.

3. (I certainly got this idea from [fellow CREST teacher]!) I would like to begin an Exploratory Learning group. Once again this will be weekends vacations or after school. I’ll start small (5-10 students). We will plan together where to go, how to get there, cost, etc. I think when [students] get home and spread the word...I
Appendix 1.3G

Teacher Journal
#7T

6/11/01
I'm feeling a exhilaration / tired from a full day of traveling and excited by the sweet smell of the fresh mountain air and sage. I am excited to swap ideas with science teachers who share my interests, I'm excited to learn about a new ecosystem and I am excited to push myself to come up with new creative curriculum ideas. I also look forward to spending the week with the staff in particular with [CREST instructor], about whom I've heard wonderful things. I am a little concerned about logistics for our students coming late – e.g. When things are scheduled I am also concerned after the first field day about domineering personalities within our group of teachers. Everyone here is for the same reason so I think we will make a strong team, however because of the tendencies of teachers to talk a lot, I hope that we are all encouraged to have some quiet observation moments.

6/12/01
A wonderful day. Balance between information, travel, exploration was perfect.
I greatly enjoyed Doug's methods of reading the land. Providing some basic information, then asking us to read the land and figure out what happened biologically and geologically. The alluvial fan is a new geologic phenomenon to me, and I feel like I have a pretty clear understanding to how it works. The description of how a moraine is formed is the best I've heard. We also were exposed to some of the basic ecology of the area – not only identification of species, but information about their life cycles and significant interactions.
Steve Archibald was disappointing. Not only is it a philosophy that I was familiar with, there were very few practical suggestions. It seems to work great for him because Steve is creating his own school. For high school teachers, it just isn't practiced as a teaching method. Because place based learning is not a new idea, I didn't learn anything new and I've incorporated it into my lifestyle already. Steve, however, is a dynamic person – and it is always good to see someone who is so enthusiastic.
Today's techniques made sense. At home, we need to map out our park. We would love to use GPS to do some tracking and mapping. Our program at the [place of work] is completely based on partnerships, and the new of role of the research liaison is to nurture partnerships and develop more.

6/13/01
Expectations: I am hoping to increase my knowledge base of birds bird vocalization and vegetation. I also am hoping to receive a strong example of a research method that we may be able to incorporate at [local park]. We have white-tailed deer in our park, and [home state] is experiencing a population boom of white-tailed deer. I would like to see our students study the impact these animals have on local habitats, when people force them into limited green spaces. Questions for the researcher [partner ecologist]: How did
he get involved in field research? What are his own professional goals? I also plan to ask him quite a bit about bird ID.

6/18/01
Reflections on the Program: So far, I’m very impressed with the professional development opportunities and the quality of instruction we have been receiving throughout the week. Eric Anderson is a phenomenal teacher and a pleasure to work with. The only thing I’m nervous about is what the plans are for the kids. It seems a little disorganized — although I know that this is the first time running the program, so some flexibility and changes are to be expected. I have confidence in the TSS staff so I’m not too worried. I’m hoping to figure out tonight the logistics for a visit to a ranch.

6/21/01
Participating in ongoing research projects for 4 days was very valuable. Here is why:
1. The researcher is an incredible resource with great ideas, meticulous and well-planned research techniques.
2. We had the chance to practice field research before we were expected to teach it. Almost a necessity, especially in order to do a good project with the students.
3. The time frame reflects something similar to what we will be doing with the students.
4. It was fun

The most important part of the program the ecology studies, course content and instructors have been fantastic. The logistical side of running a program is almost completely lacking. In figuring out whether to visit the [a]. ranch I was given a very big run-around. Really, just the logistical part seems to have problems. With so many people in charge, there have been some communication gaps. For example, last night there was no van shuttle to the FRS, nor was there on this morning. We were told there would be a shuttle every morning at 7:15 and that we would be able to get a ride sometime at the end of the day. I love walking, so that’s what I did. But, this morning, I was late because I was expecting a ride, and I was up in plenty of time to get to be TSS but wanted so I could get some reading homework accomplished. Whether or not there is a van shuttle is not an issue, but if there isn’t going to be one it should be communicated. I sure hope that TSS have it together by the time the kids get here. I have spent the past 2 months at work praising TSS for their opportunities and strong programs, and so far the opportunities have bee there, but my confidence in the way TSS has planned for the program logistics is lacking [was any of this bullshit really part of the program, we bent over backwards for these folks who didn’t have a clue of what they needed or wanted to do].

Recent classes: I am thrilled that we are studying statistics. I am frizzy on the topic, and I think it is very important to showing validity of research. Educational/ or school based research already has the reputation of not being valid, so each tool we have to dispel that idea is a step in the right direction.

6/23/01
Well, my confidence in TSS programs is increased. Once again, Doug and Matt get the Kudos. I still fell as though some logistics need to be better planned for next time, but I am excited about our project.
Reflections on CREST:

1. The CREST program has better helped me understand the processes of science in the following ways: Spending 4 days with a researcher gave me insight into the thought processes that one must go through to design a meaningful project, to narrow down a testable study, and to determine the impact of that research on land and wildlife management as well as on other potential and current research projects. I was introduced to field research techniques that are accurate ways to sample populations in the field. For example, ocular tubes and density boards are very simple tools that easily can be used with students. The frustration of being limited by time constraints has provided me with the means to prioritize the processes involved with research. In example, for student it is essential that they keep the "Big Picture" in mind, was if it means that there is less time to collect data.

2. Research/Teaching skills: Access to and training using field research equipment. Teaching philosophy. Although I come to CREST with a philosophy of education that meshes well with their place-based methods, this philosophy was put to the test. Because of time, we chose a question for the students ahead of their arrival. The challenge the, was to encourage the students to manipulate the question and make it their own. Another challenge was that the teacher I worked with said that she believed in inquiry style education, as I do. However, her approach was very different from mine. This led to great philosophical discussion an debate: TSS CREST helped establish the benefits and value of using research to teach scientific process and analytical thought. At each step we were encouraged to ponder the Why of Science? Why of research? The value of presenting. The CREST program took emphasis of data collection for the sake of data collection and put it on the connections between science and real world decision making.

3. I have the advantage of working at an ecology center where our goal is to have repeated contact with students over a longer period of time.

Note: The absolute highlight of the program were the students presentations. We were all proud to see students live up to and exceed expectations. It was great to end on such a high note. Again, Bravo to Matt and Doug for a job well done! I hope to come back.
Appendix 1.3H

Teacher Journal
#8T

6/11/01
As we begin this program I feel bliss to be here anxious to get my grades in, overwhelmed by the expertise in the room and ready to get started. I am enthusiastic and anxious to get walking and looking. Looking at flowers, plants and fauna – watching how they change and what they do. There is so much to absorb, where do we start, how do we organize it all. How do we teach our students how to collect and organize data.

6/12/01
I loved doing the transect – going into the mountains gave us the feel of truly being in the field. I am accustomed to using tubs to carry equipment and I was interested in how Doug laid out the supplies and checked them back in. While I had previously done inventories of circles. I found the transect methods gave me ideas about how to keep all the students busy and productive. I have also been concerned this past year because my students sometimes collected lousy data. While they improved over the course of the year I sometimes found they were sloppier than I wanted, so I am looking for ways and forms that will help me train them in maintaining quality data. If they do collect good data it will be hard to get to good analysis. So I continue to work on refining how to teach data collection. What to collect, how to collect it and how to help students understand its importance. The why do we care piece seems so important to me.

6/13/01
Water testing – I am drawn to thinking just how important water is. How now the concern is for the grouse and others whose lives are so finely balanced and without it they will and do perish – and how in my area we take it for granted. I have thought about it before because my Russian son, once talked about how they had to let their water settle in jars and sometimes boil it. Looking towards working with and on a field study. I am especially interested in how we gather and record data I have found that my students need more instruction and that because they are sixth graders – they really have not yet grasped the necessity for precision. So I must continually help them establish – what data we will collect and how we will collect it. I am also looking forward to actually doing wildflower identification. I feel that if I become more proficient I will be able to better respond to my students. It is not about knowing each and every flower, but rather figuring how to make use of the field guides and gaining a handle on the distinguishing characteristics. I think that can only happen with practice. I see the connections and use of phenology. I think students will quickly grasp its importance and I think that I might be able to fit it into Lewis and Clark and other field journals written in the 19th century. The questions keep coming.
6/15/01
I can see that as I feel more confident I can do more and I know that my students feel the same. As they understand how their world works they too begin to care and want to know more – to thirst maybe we all need to learn to recognize thirst and direct we do with it.

6/21/01
Working with the scientists added an incredible dimension to the program. It was so powerful to listen to each group discuss the field research they were involved in. To see the challenges they face. Then thinking, revising, and the fact that they don’t have all the answers is so fun, exciting and most of all encouraging.

6/29/01
I think a key word here is process. I have not always been a “process” person. I was impatient and believe it or not wanted the job done – just do it. Time and experience gave me some appreciation for process. The CREST program has given me more experience in the “Science Process”. We have been both learners and mentors or facilitators in the process. We participated in the process by working with our scientists. We felt the highs and lows of field research. As the ethnology book said – it is not a vacation. In both my work with Matt and the students I saw that nothing is as simple as it looks. Truly confronting what I have grappled with in the classroom.
Appendix 1.31

Teacher Journal
#9T

6/11/01
I have mixed feelings as the CREST program begins. I’m excited to have the opportunity to be near the Tetons, work at the Science School and meet some new folks- I ma also a little down about being away from my family. I’m sure a few phone calls and post cards will keep me going for the duration of the program. Working with the researchers on their fieldwork should be both interesting and exciting. I’m also looking forward to working with high school students from an urban area in this setting. I’m looking forward to developing a research project that I’ll be able to use with my students and to teaming with other teachers and scientists in the [hometown] area. I’m currently working with a local rancher on a CRM with my students. Research projects that can be integrated with this site and also with our school outdoor classroom area will be very intriguing to me. I want my students to develop a better connection with our own place. I’m looking forward to learning more about sense of place. I’m not particularly concerned with any aspects of the program. I hope I’m a helpful and contributing member of our group.

6/12/01
Today’s grouse research techniques and research methods were straightforward. I’m sure I can use these types of methods with my students or adapt techniques to make it possible. I’m looking forward to expanding our biomonitoring projects and expanding into more research style projects. I’ve begun developing some partnerships and hope to expand those. We have an outdoor classroom that is available to us for biomonitoring and research. We also have access to a site on a local ranch in our area. These areas should allow us to do both biomonitoring and research. Along with the local landowners, I’m hoping to establish working partnerships with SCS, a local horticulturist and [state university] exp. station in [hometown].

6/13/01
While in the field with [partner ecologist] I hope to learn field research techniques and protocols and details of his grouse study. I’m curious about his specific research question and his proposed answer. I plan to ask about his methodology, data collecting, problem with the research techniques and frustrations he is encountering. I hope to gain some ideas that will help me develop a research project to use in the [home area]. Techniques and Practical concerns that will help me work with my students and avoid potential problems. I plan to do continued biomonitoring, but also want to add specific research projects that may include bird surveys or wildlife monitoring. I plan already to incorporate daily journaling phenology to develop student observation skills an attachment to our own place.
6/20/01
The value of “doing” field research with the ecologist was high for me. I leaned about sage grouse in informal conversations (very educational and enjoyable) and by doing this increased my knowledge about grouse and many other areas. It also afforded me the opportunity to practice several scientific methods and work with telemetry equipment. I’ve made a connection with a field researcher who will be continuing his research and will present to my students. Most importantly I’ve been inspired and have made a new friend.

6/29/01
1. The CREST program has helped me better understand the importance of focusing my teaching more on the process of science rather than some product of either science or technology. Students need the opportunity to explore their world by getting their fingers dirty. This program has also helped me see more clearly how field research can be used to excite and engage learners in both the process and content of science. We all live and interact with the natural world. Helping students develop an understanding and appreciation for ecology will help them better understand their place in the world and develop their own self worth by showing them methods they can use to have an impact.

2. The idea of phenological studies is a skill that I’m excited to share with my students. It seems to be so simple yet powerful. Change over time and an appreciation for sense of place can be developed so easily and in such a relaxing style. I’ve also gained skills in vegetative and insect sampling and identification.

3. I am going to weave my CREST experience into my science curriculum by incorporating a simple phenological study into my weekly science teaching. I also will be using vegetative sampling techniques in the work we do in our outdoor classroom.

This has been a challenging experience for me. At the end I find myself energized and renewed in my passions for teaching and ecology. I am going to continue to strive to become better at the art of teaching by incorporating the science methods, processes and content of CREST into my curriculum.
Appendix 1.3J

Teacher Journal
#10T

6/11/01
I am feeling a mixture of excitement and anticipation. Excited to be studying in depth the Teton ecosystem and to be meeting working with the TSS staff and other CREST teachers. Also, I am a little nervous about how the whole research project aspect of the program will work out.
The most exciting part I think will be the time spent in the field with the researchers. It will be pretty cool to “rub elbows” with them, gaining insight into how they approach their work and their thought on research as an educational tool. In addition, I am very curious to see how the [hometown] students react to this experience. Finally, I am thrilled to learn more about the project you (Matt) are working on. The project is directly relevant to my job as research liaison at the [place of work].
The only thing that concerns me at the moment is how well the students are going to respond to the research projects. Part of that is how well they will work together as a group and, secondly how well they will respond to myself and the other teacher. Our students are pretty shy and quiet and it may be a struggle to get them rolling. The other concern is with the applicability of research in the average classroom setting. I think what the teachers call research is very different from what the... [unfinished]

6/12/01
An awesome day in the field collecting data! The sage grouse area was spectacular and we had a good time. The techniques were all ones I had done many years ago. A great refresher and is helping my brain get geared up for thinking research. I did get a little lost during the explanation of the UTM coordinates but with a little book work, I should have no trouble. I also need to talk to Doug about how best to lay out a research grid for our 15 acre park.
The partnership ideas are starting to “pop” into my head. The [home state] Wisconsin Dept. of Natural Resources (DNR) is the natural first step. We just need to begin making the connections with the right people. But, before we commit to any projects, the Center needs to organize a group of students to work with. Riverside high school is right next door but it is very tough to get the kids out of class for projects. We need to look into either our after school group or possibly a course for college credit.

6/13/01
Tomorrow is the big day for going out with the field ecologist. I hope to get some insight into how a field ecologist approaches problems and their research. I am curious to hear some of [partner ecologist]’s theories on the large increase in the number of Ravens in the valley. Also, I am always interested in how researchers select their topics, and how they are going to use the information when they are finished.
One of the reasons I was attracted to this project was the radio telemetry technology aspect. If possible, I hope to learn enough about it so that we could use it in [home town park]. I’m not sure what we would tracks other than raccoons which would be too
dangerous to do with students. The other skill that I hope to take back is the use of a GPS unit. It was good to lean the background with the ways but I hope to become more proficient. It could really help use map different projects in the park.

6/20/01
By “doing” what a field ecologist did for 4 days, I got an excellent, first hand idea of what it is like to be a field ecologist. Many hours of inactivity required patience, long hikes through sage and up hills required problem solving abilities, and high tech equipment required the use of the intellectual side of the brain. Also, through talking to Crow, I got a glimpse into the thought processes of a researcher. The design and planning that goes into a research project is much more involved than I had imagined. I did lean and practice some new skills over the 4 days. These included how to use GPS units and one...[unfinished]

6/29/01
Over the last 3 weeks, I have both refreshed my knowledge of ecology and ecological research and gained a new deeper understanding of the research process. It has been 15 years since my undergraduate study of biology/ecology and it has fooled in my memory. The CREST program reinvigorated my love of learning about the ecological world. Also, through this program I have a new appreciation for the research process. It is not easy and, often, it is full of many challenges along the way. By spending a significant amount of time in the field with a researcher, I gained valuable insight into some of the resource of field research. I have leaned that ecological, field research is a creative and dynamic process. It is not the set, methodical process that I first believed. The techniques questions and strategies employed by research are so varied are the ecological systems and subjects studied.
I have gained a terrific framework and background for the value of field research in education. My techniques have been pulled out of the dark recesses of my brain and polished through practice with the group and the students. My teaching skills have been encircled greatly through leaning and teaching with other teachers. In addition to just gaining ideas through sharing with the rest of the teachers. I have become a better “team teacher”. Having to teach with another teacher gave me more practice working with another teacher. It also taught me something valuable about myself in that setting. I leaned that I tend to let the other person take the lead and play a support role, even when I have a lot to contribute to the instruction. In the future, I would like to explore that dynamic some more and learn how I can more of an equal part of the team and stay less in the background.
By not working in a traditional classroom setting, I have the flexibility to incorporate a lot of what I have learned into my teaching. My job, as the research liaison is to encourage and facilitate research in our park. Also, we plan to use it as a learning tool for learners of all ages. Thanks to the last 3 weeks of experience and exchanging ideas with other teachers, I have several research project ideas. They include a purple loosestrife project, initiating a bird banding project and several others.
Appendix 1.3K

Teacher Journal

#11T

6/11/01
I am slowly reconvening from the end of our school year. The knowledge that I could participate in this program got me through the last few weeks. I feel like I have been the “broken record”, telling everyone I know about this trip. I am most excited about having the chance to experience TSS and the area for the second time. Meeting new friends, hearing new stories, collecting new ideas is important for me this summer. I feel like this is an opportunity for me to switch gears and change my summer time. What concerns me most is that I won’t want to go home! It is amazing to me that at dinner tonight people were already talking about the “next time” or extensions of this program. It is great to feel so good and excited about new things, new people, and new experiences.

6/12/01
I really enjoyed the weather today…cool…windy. Neat stuff to see on the drive! The field methods were interesting/fun. I would like to use these methods to survey our lab area at school. We are building a new high school with a potential field study area. It would be great to have students involved in developing study sites. We do a lot of high school to elementary science outreach. This would be an ideal joint project. I don’t know if I will be teaching at the new school but I will have other teacher contacts…possibly the two high schools could get together and work on projects.

6/13/01
I am hoping my first day will be a time to learn a lot about bird anatomy, how to set nets and how to handle birds correctly. I had so many questions running through my head last night that I didn’t sleep.: What is the design of the study? How long has this study been active? How is the data used? What specific questions are you hoping to answer? We have some monitoring programs in Ohio, I would like to find out more about these programs. I know very little about birds and really would like to learn more and be able to share with my kids.

6/20/01
In working with the “bird nerds” I realized the value in repeated observation. I leaned a variety of techniques by watching different people. However it was only after having the opportunity to handle the birds and remove them from the nest that I could appreciate the difficulty of the task. The feel of soft feathers and warm little bodies gave me a connectiveness that reminded me of birds that I have had as pets. I worked with macaw parrots in high school but they were large, heavy birds. It is amazing how hardy the tiny birds really are. I felt the urge to talk to the birds I was handling and watch their eyes. They often appeared to be very trusting and relaxed. If I were their size I think I would...
be terrified. The process of setting up opening, and closing the mist nets reminded me of
the importance of developing techniques or habits that are efficient. Taking care of
equipment and materials makes any job easier and more productive.
Getting up early gave me an appreciation for the life of a field biologist. I very much
enjoyed the routine and the interaction with the researchers. I worked with great people
who were patient with me and my multitude of questions. The other studies sounded
interesting, but for me bird banding was the best!

6/29/01

1. The CREST program has given me a chance to revisit much of the true science
work that I love. Field research has always been of interest to me but recently I
have concentrated on genetics research with my students. Lab work is fun,
interesting, and exciting, but it just doesn’t touch my heart and soul like
fieldwork. Being outside feeling the sun on my neck and the breeze through my
hair makes me think more deeply about my place on the planet and my
responsibilities to encourage young people to venture beyond the four classroom
walls. The understanding of science comes with the experience of climbing
through vegetation touching a bird, or smelling sage (which reminds me of my
grandmother’s thanksgiving dressing from the turkey). When looking at the “big
picture” ecological field research presents the sometimes overwhelming
responsibility to see all and relate all. Controlled lab research goes out the
window – literally.

2. As I have mentioned and written about before, working with the MAPS program
has been inspiring for me. I actually feel like I know something about birds.
After days of watching, listening and practicing I can’t believe how excited I was
to take a bird out of the mist net and work through the data sheets. I will always
remember the look in the eyes of the American robin, when I put on my first
band. It was excellent practice to work with different age students and visitors to
the MAPS site. I had a chance to think about how to explain the banding process
at a variety of levels.

3. I am always looking for new projects to do with my students. It is a selfish thing
because I find that each new challenge enhances my life and day-to-day living.
New things, new ideas, and excited students keep me feeling young and energetic.
I want to start with some of the field techniques I learned and develop a learning
area at our new high school site. The combination deciduous forest, wetland, old
farm land will be a perfect place to engage students, teachers and the community
in a joint effort to plan an manage a piece of our living space/playing space that is
slowly being eaten up by business and residential development.
Appendix 1.4A

Ecologist Post-program Interview
Location: TSS
Date: 7/10/01
Participants: ME (Matt Erickson) & R1

ME – Would you do something like this again?

R1 – Oh yeah, Yes I would, Matt

ME – Did you get that Doug? What about it?

R1 – I think just being on the periphery of it. I still think it sounds like a great way to run a teacher workshop. It had all the component including, time with professionals that were doing it on a large scale out in the field. Which was a great time, That interaction was really neat with the teachers because I think they got a lot more out of it then I initially anticipated because I guess I think about it all the time and it is pretty second nature. But with them everything is new and you think about things that you do a million times and you come up with little tricks of the trade and those little bits of wisdom that they got without having to go through the painful learning process themselves. They can get that kind of thing from them [scientists] and including ideas for research and what kind of thought needs to go into it: learning methodologies and what not. But then have one on one time with someone like Doug or you supervising a planning process to make sure all the elements get incorporated. The peer interaction that they had with one another was a real element and then throw in kids and actually do it all. You couldn’t do anymore. Getting teachers to teach something, Geometry or whatever, I couldn’t think of a better way to do it.

ME – How about your time with the teachers, was there enough front-loading, what did you think of that?

R1 – It definitely has an impact on the research. I sent Jo off to do real bird counts. Then I just kind of you know. It had an impact, I’m not saying that is a negative thing, just that it would be an important thing to communicate to the researchers. It is going to slow you down. There is just going to be an impact. I thought it was totally worth it. They did some data collection some afternoons and I think I need to go back and check those numbers with what's out there. If you are involving them in the data collection you just need to be really looking over their shoulder. It would be like that with anybody, if you were training a new tech, it would be like training a new tech. If they are going to be writing down real numbers then they are going to have to be going through the training usually with a tech that can take weeks. It just takes a while to supervise them, put them on task so that it is pretty straight forward.

ME – What do you think of the data collected by students?
R1 – I still think that is possible to have them do it. Obviously, there is some-- like for my study I wouldn’t be introducing observer bias, its bad enough to have a technician doing bird data for me that’s just observer bias all over the board, but we did some things to minimize those things. I wouldn’t say I could ever have help with the bird work, but with vegetation, they could do great work and again they just need to be really properly trained. You know if it takes you a week and a half to train your tech then a week and a half with the kids, or really standing over their shoulder each time they write a number down, confirming it, will take a long time until they really get going with it. But their data would definitely be useful. But if they were doing their own project, then they need to think how they are controlling their own variables and observer bias. They don’t want me coming in there counting birds for them, messing it up.

ME – talking to [participating ecologist]… Would it be more valuable to have one class you work with, or a place like the science school were you have new students each week?

R1 – there are certainly some long term studies, like Christmas bird counts that people are drawing some nationwide trends from you don’t even think of observer bias in that one. It depends on what the outcome are used for

ME – Does this change you to change your view on education, does it cause you to focus more on including your research in what you do with students?

R1 – It definitely doesn’t give me new information that makes me want to do it less. I think I’m doing it a lot. I have really enjoyed talking about it with other people. It probably would have happened anyways, I just think my position is kind of weird, unique. I really enjoyed talking about it [his research] with other people, and people seemed interested and it seems to be a pretty basic concept and the trends I’m finding are pretty easily grasable. Its really easy to show people. I’m going to work with a High School Field Ecology group that are looking at a mini version of what I’m looking at, and provide data and talk to them and show them the study area, just like what I did with the teachers, which was a lot of fun.
Appendix 1.4B

Ecologist Post-program interview  
Location: TSS  
Date: 7/6/01  
Participants: ME (Matt Erickson) & R2  
ME – What did you think about going out with the teachers?

R2 – I liked it, they were helpful. That is why I liked it the most. I actually did things in the field that I wouldn’t have been able to do without help. They were an asset. At first I was skeptical about having the same people for the whole week. I thought they were going to get bored, or I didn’t know how it was going to go. That was definitely the way to go. They knew the routine. If I had new people, I couldn’t have done the things they did. By the end they were just as informed on the project as I was.

ME – How about you personally? Did you get out of the program what you wanted?

R2 – I certainly drilled them on what their professions were like. It was interesting, because they had such different roles in education. I got some different perspectives. It was helpful for me to see what they were into, and how it suited to me. I certainly didn’t come to any final conclusions about what I wanted to do in life. It was good. They both were inspiring. I found out some of the things they do teach their kids. Just like this program is about getting teachers to get their kids out in the field. They are doing that in their own disciplines.

ME -- Did you talk to them about staying in contact throughout the year?

R2 – Yeah I have their addresses, and they both want to know how the project goes. We are going to keep in touch.

ME – Does this change anything for you, as far as in the future, are you going to seek opportunities like this?

R2 – It encourages me to do it more, I will keep up on trying to do this stuff. It is always helpful, more helpful than you think to be involved in these community programs. A lot of times think it is going to be a lot of work, it wasn’t really. Like this one, I had good expectations for it, but I was kind of neutral. I thought well they’ll come out, hopefully we’ll have some fun. Instead it was great. These people helped me, I helped them, and it was a good thing. It was a good thing not just for me, but for them and their students. As well as your program at TSS. In that sense it keeps me fired up on trying to do community stuff. So it doesn’t really change it, because I’ve always liked to do community types of things. But you need to get kicked in the rear to do it occasionally. Something I was thinking about this before, I don’t know if you knew this, but the wildlife department up in Missoula was hiring a new Landscape Ecologist. A big thing they looked at was community involvement. I didn’t know that the school even cared about that. I thought it was just the professional and educational record. Before I wasn’t
thinking this was really good for me. I thought I would just put it in my pocket as a community involvement thing, but afterwards I see it as that but also just a fun thing to be involved in. It was more fun and more helpful then I thought it would be. It was a kind of bonus either way. So I will keep doing it. I’ll do it next year, if I’m here. I loved it.

R2 – Did the teachers get to explore the area enough? One day we just went for a hike up Death Canyon, and they loved it.

How did the projects go?
Appendix 1.4C

Ecologist Post-program Interview
Location: TSS
Date: 7/6/01
Participants: ME (Matt Erickson) & R3

ME - What did you get out of the project?

R3 – I think just in general I like teaching so much. I don’t feel like they were students, but the whole thing did have an educational overtones. Being out there and discussion how you would involve students in this type of thing. And that part of it was definitely good for me. I don’t have the kind of classroom experiences that they do. I have taught in a lab at the university, but I bet that is quite different. It was good for me to see what they are doing with this. To be honest, with the habitat stuff they were just flat helpful. I had a hard time believing it but we ended up getting a lot more done then I would have done myself. That was great.

My experience at the science school had been that people who come to the science school, only a fraction are functional in the field. A lot of them are good people, but they were just really sharp. I have every confidence that they are going to do great things in their programs.

ME – Does this change your view about the value of the data they can collect?

R3 – My response to that was that it really depends. It depends on the students. Some are just way more responsible and diligent with data. It also depends on the researcher. It depends on the amount of training that you want to invest in the students. I think ultimately for me. What I am really weary of, For the data that it takes me months to gather I’m really weary of having people come and go. A) I don’t want to do that without investing a lot time to train them to do it. B) The more observers you get, the more observer bias you get. I think a lot of students with the right guidance are very capable of it, but from a scientific or statistic background it is important you have a handle on the number of different people and there different biases. What I would be more inclined to do would be to do an adequate amount of training and have students just scope out one chunk from beginning until end. That would solve a lot of these problems.

ME – Along those lines it would be more valuable to have one high school class throughout an entire year versus doing something like at the science school where you have kids coming out weekly.

R3 – Definitely. Those students that come and go aren’t going to feel any commitment or ownership. I think it would be interesting for them, but it takes a while to get the methods down. With a week-long program you could spend a fair amount of your time just getting everyone on the same page. But just having one group for an extended amount of time from a purely scientific standpoint would be much more desirable.
ME – Do you think you would do something like this again?

R3 – Definitely, totally enjoyed it. I kind of have a feeling that I want to teach, probably at the university level. I don’t think I would be able to go through these graduate programs as easily without having these little programs to be involved in periodically. It’s just nice to keep your hand in. I think any research that is worth doing at all it’s really getting people involved in. Both with the results and the issues. But it is a challenge. This was very doable, because they were very helpful. But doing research in a place like Jackson, it is very tight. If you are studying a thing like birds. The breeding season is so concise here. Even on a daily basis. So from that perspective it is hard to believe that you can invest a lot in students or other people who want to be involved.

ME – How did you feel going into this? Did you feel prepared, or what could we have done to ease that?

R3 – Given the particular focus of this project it was fine. It was nice to have them have an idea to know what the project was. So that we could just go out in the field. I think the fact that I didn’t take them out on bird surveys the very first day was probably a really good deal. I think it would have been a little rushed and uncomfortable the first day. I think in general just having two people who were really interested in it all. They were just phenomenal. I just wish my field techs were half as enthusiastic. I think that was totally fine. I think that was a busy time for you and I just don’t think they required any preparation.

ME – The teachers really did feel like colleagues.

R3 – In my opinion, the extent to which that was the case really has to do with them. If they hadn’t been so capable and so interested it may not have been like that. I could see the potential for getting a group of people that you would have to drag around out there.

ME – Next year we are thinking of having one master teacher paired with a less experienced teacher.

R3 – That or even a teacher from another school in their district. You have one teacher at one school get things going if they are motivated enough, but also to have it going at a neighboring school. Get more of the combined effect going.
Appendix 1.4D

Ecologist post program interview
Location: Phone interview
Date: 7/17/01
Participants: ME (Matt Erickson) & R1

*The recording of this interview contained too much static to transcribe the exact interview. The summary of this interview is presented here, based on notes taken during the interview. The information presented here is my interpretation of the researchers responses and are not direct quotes.

ME: What did you gain from working with the teacher?

MH: The researcher commented on the discussions about education as being the most valuable. They discussed how to make a difference in ecoliteracy. The teacher told him the student need to be the target. The other valuable part about working with the teacher was the plan they created for continued involvement. The researcher and the teacher planned to continue their relationship, with the researcher coming to the teachers classroom to give a presentation. The researcher felt that this gave value to his work beyond the narrowness of his academic field.

ME: What did he think was most valuable for the teacher?
MH: The researcher felt that exploring the project design was the most valuable part for the teacher.

ME: Would you participate in a program like CREST again?
MH: The researcher replied that he would do a similar program again.

ME: What would you like to see happen again, and what would you change about your involvement in the program?
MH: The researcher replied that he liked the one on one contact that he had with the teacher. For his project, the researcher said two teachers in the field with him may have worked, but no more than two. As far as things to change, the researcher commented on the need for a meeting between researcher and teacher before the program. He also commented on having some background information about the researcher’s project available to the teacher.
Appendix 2

Assessment Data
## Appendix 2.1A

### Student Attitude Survey Results

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<td>5. I would donate money to an organization that protects or cleans up the environment.</td>
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<td>6. I would organize a group in my community to work on an environmental issue.</td>
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### Student Attitude Survey Results Continued

**Appendix 2.1B**

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<td>7. Humans can affect the environment in positive ways.</td>
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<tr>
<td>8. Science forms the basis for solving environmental problems.</td>
<td></td>
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<td>PRE 3 1 2 1 1 2 2 2 2 1 1 1 3 2 2 2 2 1 1 2 2 1 1 1 2 1 1 1 2 1 1 2 1 1 2 2</td>
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<tr>
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<td>9. Present generations are responsible for the quality of the environment experienced by future generations.</td>
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<tr>
<td>PRE 1 1 2 1 1 1 2 2 1 1 1 1 1 1 2 3 3 1 1 1 1 2 5 1 1 2 1 1 1 1 2 1 1 1 2 1 1 1 2 1 1</td>
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<td>10. Humans have a responsibility to other animal species.</td>
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<tr>
<td>11. Humans have a responsibility to plants.</td>
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<tr>
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<tr>
<td>POST 1 1 3 1 1 1 1 1 2 2 1 1 1 2 1 1 1 2 1 1 3 3 1 1 1 1 1</td>
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<tr>
<td>12. Humans have a responsibility to nonliving things (e.g. rivers, soil, air).</td>
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<tr>
<td>PRE 1 1 2 1 1 1 2 2 1 1 1 2 1 1 2 1 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1</td>
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<td>POST 1 1 3 1 1 1 1 1 2 2 1 1 1 2 1 1 1 2 1 1 3 3 1 1 1 1 1</td>
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### Appendix 2.2

#### Student Short-Answer Data

| Question                                                                 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|--------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Define Ecology                                                          | PRE 2 4 2 2 3 1 4 3 4 2 2 2 2 4 3 1 1 2 3 2 3 2 0 1 1 | POST 1 2 2 4 3 1 3 0 4 2 2 4 2 4 2 0 1 2 2 2 3 3 |
| Describe how you would teach a class of third graders about connections between animals, plants, and their environment. | PRE 2 3 3 3 2 2 3 2 3 2 3 2 3 2 2 3 3 2 3 2 0 3 2 | POST 1 2 3 2 3 2 2 2 3 1 2 2 2 3 2 1 1 2 4 2 1 2 |
| Make a decision on an environmental issue and provide evidence to support your decision. | PRE 1 3 4 3 4 2 2 3 4 2 3 3 3 3 2 0 2 3 4 1 3 3 2 2 2 | POST 2 1 3 3 3 1 3 2 3 3 3 1 3 1 2 1 2 3 3 2 3 2 |

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## Ecologist Survey Data

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<tr>
<td>1. I have a lot to gain from working with educators.</td>
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<td>5</td>
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<tr>
<td>2. Education is a key component to promoting ecological literacy.</td>
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<tr>
<td>3. I can assist high school science teachers in developing field research projects for students</td>
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<tr>
<td>4. Working directly with high school science students, interests me.</td>
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<tr>
<td>5. Data collected by high school students is valid.</td>
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<td>6. I commit an adequate amount of time to working with students and/or educators.</td>
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### Teacher Attitude Data

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<tr>
<td>My administration encourages innovative instructional practices.</td>
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<td>4</td>
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<tr>
<td>My administration supports our science program with needed materials and equipment.</td>
<td>PRE</td>
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<td>4</td>
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<tr>
<td>My administration would provide ample time to plan a field research program.</td>
<td>PRE</td>
<td>3</td>
<td>3</td>
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<tr>
<td>My administration would support travel by my class to field-research sites off school grounds.</td>
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<tr>
<td>My school has ample resources to conduct field-research.</td>
<td>PRE</td>
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<tr>
<td>My school had funds to purchase necessary field-research equipment and supplies</td>
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<tr>
<td>My school has good access to quality computers.</td>
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<tr>
<td>My school is located in close proximity to potential field-research sites.</td>
<td>PRE</td>
<td>5</td>
<td>5</td>
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<tr>
<td>My community offers opportunities to engage in partnerships</td>
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<tr>
<td>My students would benefit from participation in field-research.</td>
<td>PRE</td>
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<tr>
<td>I feel confident in leading my students in field-research.</td>
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<td>5</td>
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<tr>
<td>I feel confident that I can address standards through engaging my students in field-research.</td>
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<tr>
<td>I will continue to seek out opportunities to work with ecologists.</td>
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<td>5</td>
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<td>Ecologists could learn a great deal from working with me.</td>
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## Teacher Attitude Data Continued

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<td>The information that my students collect during field research will be valuable to ecologists</td>
<td>PRE</td>
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<tr>
<td>POST 4 5 4.5 4 5 5 5 4 4 5</td>
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<tr>
<td>I would like to continue with field research in my personal time.</td>
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<tr>
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Appendix 3

Surveys
Teacher Pre-program Survey

Teton CREST:
Combining Research and Education in Science Teaching
June 10-30, 2001

*Please take the time to fill out this background information. It is important in helping us best meet the needs of CREST participants.

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What science subjects do you currently teach?

List degrees and/or coursework related to science:

List any professional development you have participated in related to science education:

Have you participated in partnerships with scientists in the past (i.e. classroom visits, fieldtrips, etc.)? Please explain:

Describe any previous experience you have with ecological field research:
Approximately how much of your total teaching time directly involves ecology: ____% 

What concepts have you focused on when teaching ecology?

What areas of ecology are most interesting to you (e.g., plant and animal characteristics/identification, behavior, species interactions, habitat, nutrient-cycling, energy flow, etc.)?

What type of research project would you like to be involved in during the CREST program?

What do you hope to gain from interacting with ecologists in the field?

What do you think ecologists can gain from working with you?

Have you previously engaged your students in field-based research? Explain successes and/or failures:
When teaching ecology to your students, what are some of your greatest challenges (planning, logistics, concepts, process, etc.)?

What ecological concepts are most relevant to your students’ lives?

Do you feel field research can fit into your science curriculum? Explain why or why not

Please state at least three goals you would like to accomplish through participation in the CREST program?
Please rate the following your agreement with the following statements. (Circle your choices):

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<tr>
<td>2. My administration supports our science program with needed materials</td>
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<td>3. My administration would provide ample time to plan field research</td>
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<td>program.</td>
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<td>4. My administration would support travel by my class to field-research</td>
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<td>sites off school grounds.</td>
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<td><strong>School Resources</strong></td>
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<td>5. My school has ample resources to conduct field-research.</td>
<td>5</td>
<td>4</td>
<td>3</td>
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<td>1</td>
</tr>
<tr>
<td>6. My school has funds to purchase necessary field-research equipment</td>
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<tr>
<td>and supplies.</td>
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<tr>
<td>7. My school has good access to quality computers.</td>
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<td>1</td>
</tr>
<tr>
<td>8. My school is located in close proximity to potential field-research</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<td>sites.</td>
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<tr>
<td>9. My community offers opportunities to engage in partnerships with</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>scientists.</td>
<td></td>
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<tr>
<td><strong>Value of Field Research</strong></td>
<td></td>
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</tr>
<tr>
<td>10. My students would benefit from participation in field-research.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>11. I feel confident in leading my students in field-research.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>12. I feel that I can address standards through engaging my students in</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>field-research.</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>13. I could learn a great deal from working with ecologists.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>14. Ecologists could learn a great deal from working with me.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Please comment further on any of the choices you selected:

Thank you for taking the time to fill out this survey. Your input will help assure that the CREST program is able to meet your needs.
Thank you for your participation in the Teton CREST program. Please take some time to fill out this form as completely as possible. The information you provide on this form aids in the overall assessment of the effectiveness of this program.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. My school is located in close proximity to potential field-research sites.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>16. My community offers opportunities to engage in partnerships with scientists.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>17. My students would benefit from participation in field-research.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>18. I feel confident in leading my students in field-research.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>19. I feel confident that I can address standards through engaging my students in field-research.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>20. I will continue to seek out opportunities to work with ecologists.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>21. Ecologists could learn a great deal from working with me.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>22. I feel confident about integrating field research into my science curriculum.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>23. The information that my students collect during field research will be valuable to ecologists.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>24. I would like to continue working with field research in my personal time.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Name: _______________________________________

Please circle the number that best represents your opinion about the statement.

What parts of the Teton CREST program will be most useful when you return to school?

How do you see field research fitting into your science curriculum?

Did you obtain the goals you set for the CREST program? What aspects of CREST helped you obtain those goals and/or what aspects prevented you from attaining them?
When teaching ecology to your students, what do you foresee as the greatest challenges (planning, logistics, concepts, process, etc.)?

What was the greatest part of working with ecologists in the field?

What do you think ecologists gained from working with you?

Approximately how much of your total teaching time next year will involve ecology:

____ %

What ideas do you have for partnerships during the next school year?

Would you do a program similar to CREST in the future? Why or why not?
Thank you for participating in the Teton CREST program. In order to better facilitate the partnership between ecologists and educators, please take a few moments to fill out this questionnaire. The information provided on this form will help us not only match educators with interest in your field, but will also assist us in the evaluation of this program.

Name: ________________________________

List degrees (completed and/or in progress):

In the past, have you worked with educators on field research projects? Please explain.

Give a brief description of the project(s) you are working on this summer:

What ecological principles can be addressed during your time in field with the educators?

On average, how much time per month have you devoted to working with educators and/or students? Circle one.

<table>
<thead>
<tr>
<th>&lt; 1 hour</th>
<th>1-5 hours</th>
<th>5-15 hours</th>
<th>15-25 hours</th>
<th>&gt; 25 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What prompted you to be involved with the CREST program?

What do you think you have to gain from working with high school science educators?

What do you think high school science teachers have to gain from working with you?

What do you see as the role of ecologists in promoting ecological literacy?

Congratulations your dream has come true, you’ve been asked to give the commencement address at the high school you graduated from:

a) Who do you thank for steering you onto the path you’re on today?

b) What ecological knowledge/concepts do you want to make sure these students head out into the world with?

c) What basic science process skills (observing, questioning, design, ...) would you make sure these students possess?

Please circle the number that best represents your thoughts on the statement.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

183
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I have a lot to gain from working with educators.</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Education is a key component to promoting ecological literacy.</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>I can assist high school science teachers in developing field research projects for students.</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Working directly with high school science students interests me.</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>Data collected by high school students is valid.</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>I commit an adequate amount of time to working with students and/or educators.</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Please comment on any of your selections:
Appendix 3.3A - Student Pre-program Survey

Your participation in this assessment is completely voluntary, and truly appreciated. The information that you provide for this survey will be used to help understand how effective programs, like CREST, are at educating students like yourself. This survey is not graded in any way. Your thoughtful, honest responses are greatly appreciated.

Name: __________________________ Year in school (next year): __________________________

*Feel free to comment on any of your choices on the back of this sheet.*

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I enjoy spending time outside during my spare time.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. I have participated in actual scientific research before.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. I participate in science related activities outside of school.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Science classes are my most enjoyable classes at school.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. If a wild animal would eat from my hand, I would try to feed it.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. I would write a letter to my state’s congressional representative asking them to take action on an environmental issue.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. I would donate money to an organization that protects or cleans up the environment.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. I would organize a group in my community to work on an environmental issue.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Humans can affect the environment in positive ways.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. Science forms the basis for solving environmental problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. Present generations are responsible for the quality of the environment experienced by future generations.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12. Humans have a responsibility to other animal species.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. Humans have a responsibility to plants.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>14. Humans have a responsibility to nonliving things (e.g. rivers, soil, air)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>15. I have changed one of my daily habits because of an environmental concern. Yes No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. I have taken action on an environmental issue that concerned me. Yes No</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>17. I plan on attending university after high school. Yes No</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

If yes, what do you plan on studying: 185

u like to do:

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
1. Congratulations, we’ve decided to bypass the remainder of your high school career. Instead you will now attend the college of your choice, where you will study ecology. What sort of things do you expect to study, while learning about ecology?

2. Think of a park or other natural area, where you have spent some time. While keeping that place in mind, imagine this scenario:

Due to the recent national, energy crisis, plans have been created to place a new coal burning-energy plant on a portion of the land. The plant will provide energy to a large number of people, but will decrease the quality of the air. You are on the committee that decides to approve or reject the plan for the energy plant. Whatever you decide, you must support your decision with some evidence. Your decision must be made in two months. What will you decide to do? How will you collect the evidence to support your decision?

3. Mission Impossible: Your mission, should you choose to accept it, is to teach a nature lesson to 12 squirrelly third graders. After gathering up your little angels (kind of like herding cats), you begin to talk about how things are connected to each other. The goal of the nature lesson is to explore the connections between animals, plants, and their environment. Also, you must also help them to understand they, too, are connected to the environment. How would you teach this lesson?
Appendix 3.3B – Student Post-program Survey

Well you did it, a wonderful week in the Tetons. I’d just like to take a minute to reflect on how you felt about the program, and how the program may have affected you.

Name: __________________________ Year in school (next year): ________________

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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</thead>
<tbody>
<tr>
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<td>2</td>
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</tr>
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<td>2. I have participated in actual scientific research.</td>
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<td>3. If a wild animal would eat from my hand, I would try to feed it.</td>
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<td>4. I would write a letter to my state’s congressional representative asking them to take action on an environmental issue.</td>
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<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. I will change one of my daily habits because of an environmental concern.</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. I will take action on an environmental issue that concerns me.</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. I plan on attending university after high school.</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

If yes, what do you plan on studying: ____________________________

If no, what would you like to do: ____________________________

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1. Think about the research that you were involved in during the CREST program:
   a. What the most valuable part of the research project you were involved in?
   b. What would you have changed about the project?

2. Mission Impossible 2: Time to herd the cats once again (teach the third graders a nature lesson). The same third grade class you taught the nature lesson to last week, is back. How do you teach them about the connections that exist in nature this time?

3. Define ecology:

4. Since last week, the evil government that was going to put a power plant in your favorite natural area has been defeated. Now a local community organization wants to begin an ecological study in the area on a rare insect species. They are requesting your help with the process. Do you want to be involved? If so, what suggestions do you have for the group that would help them complete their study?
Appendix 3.4A – Student Institutional Feedback Form

The remainder of this form involves questions specific to your experience as a participant in a program at the Teton Science School. Compliments are great, but criticism is also highly valuable in regards to the maintenance of our programming. This portion of the form will remain anonymous.

How would you rate this experience compared to other learning experiences you have had?

If you had to explain this experience to a friend, what would you tell them?

What comments do you have for us concerning the way Teton Science School runs? In other words, do you have feedback on such things as kitchen, office, vehicles, cabins, telephones, and guidelines?

Please comment on the Field Research Station staff and facilities. Were you comfortable and were your needs adequately met? Also, please comment on the food.

Comment on your instructors:

A. Evaluation of Keith

1. Knowledge of subject matter
   Excellent: 4  Good: 3  Needs Work: 2  Poor: 1
2. Preparation and organization
   Excellent: 4  Good: 3  Needs Work: 2  Poor: 1
3. Ability to communicate
   Excellent: 4  Good: 3  Needs Work: 2  Poor: 1
4. Attitude toward subject and ability to stimulate interest
   Excellent: 4  Good: 3  Needs Work: 2  Poor: 1

Specific comments regarding Keith:

B. Evaluation of Ryan

1. Knowledge of subject matter
   Excellent: 4  Good: 3  Needs Work: 2  Poor: 1
2. Preparation and organization
   Excellent: 4  Good: 3  Needs Work: 2  Poor: 1
3. Ability to communicate
   Excellent: 4  Good: 3  Needs Work: 2  Poor: 1
4. Attitude toward subject and ability to stimulate interest
   Excellent: 4  Good: 3  Needs Work: 2  Poor: 1

Specific comments regarding Ryan:
Appendix 3-4B – Teacher Institutional Feedback Form

The remainder of this form involves questions specific to your experience as a participant in a program at the Teton Science School. Compliments are great, but criticism is also highly valuable in regards to the maintenance of our programming. This portion of the form will remain anonymous.

How would you rate this experience compared to other field courses experiences you have had?

What would you change about the information you received from us before your arrival?

Please comment on the materials you received while attending the program? (appropriateness, usefulness, appearance, amount, ...)

What comments do you have for us concerning the way Teton Science School runs? In other words, do you have feedback on such things as kitchen, office, vehicles, cabins, telephones, and guidelines?

Please comment on the Field Research Station staff and facilities. Were you comfortable and were your needs adequately met? Also, please comment on the food.
Comment on your instructors.

A. Evaluation of Dr. Doug Wachob

1. Knowledge of subject matter 4 3 2 1
2. Preparation and organization 4 3 2 1
3. Ability to communicate 4 3 2 1
4. Attitude toward subject and ability to stimulate interest 4 3 2 1

Specific comments regarding Dr. Doug Wachob:

B. Evaluation of Matt Erickson

1. Knowledge of subject matter 4 3 2 1
2. Preparation and organization 4 3 2 1
3. Ability to communicate 4 3 2 1
4. Attitude toward subject and ability to stimulate interest 4 3 2 1

Specific comments regarding Matt Erickson:
Teton Science School Mission

The Teton Science School provides and encourages experiential education in natural science and ecology while fostering an appreciation for conservation ethics and practices. The Greater Yellowstone region serves as our outdoor classroom and model for year-round programs that offer academic, professional and personal benefits to students of all ages.

Educational Philosophy

The guiding philosophy for all Teton Science School instruction is that experience teaches best. We don't just talk about it if we can do it. We offer direct experience with the natural world through exploration of the landscape and wildlife of the Greater Yellowstone Ecosystem. We teach people skills they can use to explore other places, including the environment of their own communities.

Education and the TSS Community

The comprehensive nature of education at TSS that includes studying, working, eating and playing while learning means that all members of the TSS community play a role in the education of any student who comes to TSS.

Teton Science School has been in operation since 1967. The secluded campus is located in Grand Teton National Park in Jackson Hole, Wyoming. Our programs also use the wild lands of Yellowstone National Park, Bridger-Teton National Forest and the National Elk Refuge. In all seasons, participants are involved in hands-on studies, learning basic concepts in ecology, geology, botany, zoology, astronomy and the unique natural history of the Greater Yellowstone Ecosystem.
### Combining Research & Education in Science Teaching

**Teton C.R.E.S.T.**

<table>
<thead>
<tr>
<th>Week #1</th>
<th>TSS Staff: Doug Wauchob, Matt Erickson</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dates</strong></td>
<td><strong>Morning</strong></td>
</tr>
<tr>
<td>Sun</td>
<td>June 10</td>
</tr>
<tr>
<td>Mon</td>
<td>June 11</td>
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<td></td>
<td></td>
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<td>Tue</td>
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<td>Wed</td>
<td>June 13</td>
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<td>Thu</td>
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<td>Sat</td>
<td>June 16</td>
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<td></td>
<td></td>
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<tr>
<td>Sun</td>
<td>June 17</td>
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</tbody>
</table>

**Teachers move to Field Research Station**
Combining Research & Education in Science Teaching Teton C.R.E.S.T. Teacher Week #2 Lodging is wall tents at Field Research Station

<table>
<thead>
<tr>
<th>Dates</th>
<th>Morning</th>
<th>Afternoon</th>
<th>Evening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon June 18</td>
<td>Breakfast Field Research Station</td>
<td>Field lunch from TSS</td>
<td>6:00 Dinner Field Research Station</td>
</tr>
<tr>
<td></td>
<td>Teachers assist field researchers</td>
<td>Teachers assist field researchers</td>
<td>7:30 Discussion of Research Experience</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Field Research Station</td>
</tr>
<tr>
<td>Tue June 19</td>
<td>Breakfast Field Research Station</td>
<td>Field lunch from Field Research Station</td>
<td>6:00 Dinner Field Research Station</td>
</tr>
<tr>
<td></td>
<td>Teachers assist field researchers</td>
<td>Teachers assist field researchers</td>
<td>No Scheduled Activities</td>
</tr>
<tr>
<td>Wed June 20</td>
<td>8:00 Breakfast Field Research Station</td>
<td>12:00 Indoor lunch from Dornan’s Deli</td>
<td>6:00 Dinner Field Research Station</td>
</tr>
<tr>
<td></td>
<td>10:00 Project Design &amp; Students Major Lab</td>
<td>1:00 Brainstorming &amp; Research Project Development</td>
<td>No Scheduled Activities</td>
</tr>
<tr>
<td></td>
<td>11:00 Pondering a Research Curriculum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thu June 21</td>
<td>7:30 Breakfast Field Research Station</td>
<td>12:00 Indoor Lunch from Dornan’s Deli</td>
<td>5:30 TSS Patrons Event TSS Campus</td>
</tr>
<tr>
<td></td>
<td>9:00 Hypothesis Testing &amp; Statistical Analysis</td>
<td>1:00 Research Project Development</td>
<td></td>
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<tr>
<td></td>
<td>Major Lab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fri June 22</td>
<td>7:30 Breakfast Field Research Station</td>
<td>12:00 Field Lunch from Field Research Station</td>
<td>6:00 Dinner Field Research Station</td>
</tr>
<tr>
<td></td>
<td>9:00 Project Development check-in Major Lab</td>
<td>2:00 Project Presentations Major Lab</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Students arrive &amp; Orientation to Field Station</td>
<td></td>
</tr>
<tr>
<td>Sat June 23</td>
<td>7:30 Breakfast Field Research Station</td>
<td>Field Lunch from Field Research Station</td>
<td>6:00 Dinner Field Research Station</td>
</tr>
<tr>
<td></td>
<td>No scheduled activities</td>
<td>No scheduled activities</td>
<td>No scheduled activities</td>
</tr>
<tr>
<td>Sun June 24</td>
<td>7:30 Breakfast Field Research Station</td>
<td>Field Lunch from Field Research Station</td>
<td>6:00 Dinner Field Research Station</td>
</tr>
<tr>
<td></td>
<td>No scheduled activities</td>
<td>No scheduled activities for teachers</td>
<td>7:30 Student Introduction to Research Projects by Teachers Main Lodge</td>
</tr>
</tbody>
</table>
Combining Research & Education in Science Teaching Teton C.R.E.S.T. Teacher Week #3  Lodging is wall tents at Field Research Station Monday to Thursday, cabins on campus Thursday to Saturday.

TSS Staff: Doug Wachob, Matt Erickson, Ryan Atwell, Keith Barnes, Mike Musialowski

<table>
<thead>
<tr>
<th>Dates</th>
<th>Morning</th>
<th>Afternoon</th>
<th>Evening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon</td>
<td>Breakfast Field Research Station</td>
<td>Field Lunch from Field Research Station</td>
<td>Dinner Field Research Station</td>
</tr>
<tr>
<td>June 25</td>
<td>Student Field Research Projects led by Teachers</td>
<td>Student Field Research Projects led by Teachers</td>
<td>Data Organization Major Lab</td>
</tr>
<tr>
<td>Tue</td>
<td>Breakfast Field Research Station</td>
<td>Field Lunch from Field Research Station</td>
<td>Dinner Field Research Station</td>
</tr>
<tr>
<td>June 26</td>
<td>Student Field Research Projects led by Teachers</td>
<td>Student Field Research Projects led by Teachers</td>
<td>Data Organization &amp; Analysis</td>
</tr>
<tr>
<td>Wed</td>
<td>Breakfast Field Research Station</td>
<td>Field Lunch from Field Research Station</td>
<td>Research Presentation Do's &amp; Don'ts Major Lab</td>
</tr>
<tr>
<td>June 27</td>
<td>Student Field Research Projects led by Teachers</td>
<td>Research Project Analysis &amp; Presentation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preparation Major Lab, Library, Earth Science Classroom</td>
<td></td>
</tr>
<tr>
<td>Thu</td>
<td>7:30 Breakfast Field Research Station</td>
<td>12:00 Indoor Lunch Dining Lodge</td>
<td>6:00 Dinner Dining Lodge</td>
</tr>
<tr>
<td>June 28</td>
<td>Teachers move to cabins on campus (Students remain at Field Research Station)</td>
<td>Research Project Analysis &amp; Presentation</td>
<td>7:30 Teton CREST Research Presentations Main Lodge</td>
</tr>
<tr>
<td></td>
<td>Research Project Analysis &amp; Presentation</td>
<td>Preparation Major Lab, Library, Earth Science Classroom</td>
<td>9:00 Celebration</td>
</tr>
<tr>
<td></td>
<td>Preparation Major Lab, Library, Earth Science Classroom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fri</td>
<td>7:30 Breakfast Dining Lodge</td>
<td>12:00 Indoor Lunch Dining Lodge</td>
<td>6:00 Dinner Celebration TBA</td>
</tr>
<tr>
<td>June 29</td>
<td>Students hike in Tetons</td>
<td>1:00 Where to go from here? The Take Home Message.</td>
<td>Closing remarks</td>
</tr>
<tr>
<td></td>
<td>9:00 Debrief of Student Research Experience</td>
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<tr>
<td></td>
<td>11:00 Course Evaluations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sat</td>
<td>7:30 Breakfast Buffet Dining Lodge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 30</td>
<td>Departures</td>
<td></td>
<td></td>
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</table>