

Salamanders and Science: Place-based Environmental Education in Rural Appalachia

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ABSTRACT

The opportunity to learn science by doing authentic science in a rural community is not a common occurrence, yet for over thirty years, a group of dedicated educators have provided the experience of learning field biology and ecology to students in a geographically isolated area of the Appalachian Mountains. The over-arching research question in this study is: how does a Field School program in Appalachia use a place-based environmental education approach to teach students about their local community and environmental issues, while also extending their understanding of global environmental issues? Foundational literature includes work in place-based education, critical pedagogy, critical pedagogy of place, and Appalachian studies. This qualitative, ethnographic case-study examines the experiences and reflections of three instructors and four students throughout the program. As a high school student, I was a participant in this program, and my own experiences and perspectives are included as an ethnographic chapter in the data analysis as well. The teachers in the program share a deep commitment to environmental education and ecojustice, and the students gain valuable insight into what it means to be a scientist, how local environmental issues relate to global environmental and economic issues and move towards becoming advocates for the environment.

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GENERAL AUDIENCE ABSTRACT

Environmental education is often overlooked and under-researched, particularly in rural areas. The purpose of this study was to examine a long-running summer educational program in Appalachia that teaches students about local environmental issues through hands-on scientific field research. This study examined the long history of the program, how the curriculum has changed throughout the years, what teachers believe is important about the curriculum they teach, and ultimately what students learn from the program. In this rural community, the opportunity to learn science by doing science is an important aspect of this program, as is the opportunity to learn about local environmental issues that ultimately have global consequences.

This paper is dedicated to the talented and passionate instructional staff of the Field School, and to the memory of The Doctor, who inspired generations of young scientists, and made all of this research possible. Thank you for introducing me to a world I lived in, but had never seen before.

I would also like to sincerely thank my mother, Jackie, and my spouse, Matt, for their support throughout this process. And, a special treat ball for Brown Dog, who did his best to make sure I never spent too long sitting at my desk.

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CHAPTER 1

INTRODUCTION

The purpose of this research is to examine the literature in place-based science education, critical pedagogy of place, and the connections to rural science education as students participate in an ongoing summer educational program in rural Appalachia. In this introduction I will discuss my philosophical framework and positionality within the field of rural science education, as student, teacher, and researcher. Situating myself within the literature of place-based education (PBE) and critical pedagogy, I place this work in the context of Appalachian Studies, partly for research purposes, but also because it is the world view that I understand, from both insider and outsider perspectives. It is also the context in which I feel that scholarly activism is necessary.

From these broad themes in the literature, I move to the intersections of these themes, and after introducing each crossroad, I bring them into conversation with each other, to inform the dialogue around the critical places of inquiry by exploring the following questions: What is a critical pedagogy of place, and how can it inform or define a contested, rural space? If we scholars are teaching for social justice, what does that look like in Science Education? Perhaps more importantly, what do social and ecojustice look like in Place-Based Education?

Philosophical Framework

Throughout my teaching and research career, I've been introduced to the myriad of possibilities for power, corruption, silence, and complicity. Stepping outside of the classroom, I've been permitted to see the ways that my own race, gender, culture, and worldview have privileged and shaped my classroom practices, and how my students have

responded, based on their race, gender, culture, and worldview. As a practicing teacher, I never felt entirely comfortable in my role as a privileged, dominant voice, but I never had the vocabulary to express my discomfort, let alone examine it critically.

My philosophical framework begins with cultural production and through situated learning, moves towards identity formation. Bourdieu's (1977) work on symbolic power, habitus, and the unquestioned "doxa" is the framework for my view of cultural production. As power is exerted within a culture, such as a school system, the ways of teaching and learning are reproduced unconsciously, and remain accepted as the status quo. Teachers have unquestioned power within their classroom, and students are expected to submit themselves to this authority in order to achieve mastery of the subject.

The structure of simultaneous mastery and submission, even in higher education, is part of the symbolic and practiced power of schooling culture. Because it is not obvious to the casual observer, or the earnest participant, this power is not questioned, nor is it challenged; as Davies and Saltmarsh (2007) define them, in "the practices of teaching-as-usual, the practices that are not automatically available to the teachers' or students' reflective, analytic gaze" (p. 5).

Through this "teaching-as-usual", and consequently "learning-as-usual", learners are situated within the school culture, and classroom culture. Lave and Wenger (1991) refer to these "communities of practice" where apprenticeship is one form of the master-student relationship. The power of mastery and submission is elegantly displayed in social apprenticeship within rural schools and communities. Not only do children strive to please their parents, grandparents, and extended families, but also their teachers, coaches, and principals. Children also submit to multiple levels of authority, both at home and at school.

Mastery in, or acceptance into, rural social circles is not achieved until submission into the accepted practices of learning and being are visible, practiced, and documented.

As classroom teachers, and particularly as teacher educators and scholars, we are generally unaware of the far-reaching symbolic power we have—beyond the walls of the classroom, deep in the minds of our students. Even though teachers are responsible for the classroom learning of their students, it becomes obvious that the teacher and the school culture are responsible for shaping the internal and external habitus of the student. Should the school culture, and consequently teacher, replicate gendered ideas of what it means to be a “good student” in science and math, it is unquestionable that female students will believe their talents are fixed to certain subjects, thus limiting them from higher education in science or math. In a similar way, should the teacher, or school culture, seek to limit academic possibilities for students in rural areas, the result is the same—decreased interest and engagement in STEM fields.

Positionality

Place is a difficult construct to unravel, as my experience with place is tied to many emotions, including love and loss. It is constructed around me as home, familiar and safe, yet it is simultaneously constructed as a cage, apart from civilized life, distrustful and wild. My worldview could have been as narrow as the valley I grew up in, or as broad as the horizon from Lookout Mountain on a clear day. Yet, as I write this, I exist in both realities at once, both local and global, a sort of cultural border-crosser. However, there is risk in this position, this rooted notion of a home, a place, an identity. As Elizabeth St. Pierre states, “The point here about attachment to places, and our histories in them, is that home is not a haven; identity can never be a refuge.” (1997, p. 366)

Looking back through my past, my rural identity has been a complicated refuge, particularly as a scholar. I approach the world with a trusting, naïve, openness that many urban and suburban acquaintances find endearing, if not puzzling. I still have trouble remembering to lock the doors to my car, or to the house on my way out. It's difficult for me to walk through the streets of San Francisco, or even across campus, and avoid eye contact with strangers, but I consciously make the effort because I don't want people to think I'm dangerous.

As part of my habituation to higher education, I learned certain ways of metropolitan being—many of which are reinforced by my ecological ethics. I take public transportation, sort my recycling, and use my own bags at the checkout line at the grocery store. Yet, when I'm at home in the mountains, I drive everywhere on one or two lane roads, eyes watchful for deer and bear. I swallow my guilt at putting a glass bottle in the trash, as I drive the whole bag to the dumpster (we do not have curbside trash pickup, and glass recycling is too expensive—the gasoline for the truck costs more than the recouped costs from recycled glass.). The cashier at the local grocery store greets me by name, as I awkwardly find cash to pay the bill, give up, and write a check instead. She does not ask for my ID.

In 2012 the National Center for Educational Statistics reported that twenty-five percent of school aged children, K-12, were enrolled in schools in rural areas. As additional twelve percent were enrolled in schools located in towns (NCES, 2012). Approximately thirty-two percent of the students in the United States were enrolled in schools outside of suburban or urban areas. Yet, the major focus in educational research, specifically Science Education, maintains a decidedly metrocentric agenda (Campbell &

Yates, 2011). While I read research centered in metropolitan or suburban areas, focused on increasing equity and access for STEM education, I absorb critical theory from Freire (1998) and Giroux (2009), and I write to an informed intelligentsia based on our shared interest of science education. But as I read, write, work, and learn, I find nothing of my rural self in this research, nothing that speaks to my schooling experience. I read very few articles about increasing access and equity in rural classrooms—why?

My rural identity is not a refuge. In academic circles, it's the equivalent of a lilting Southern drawl, remaining invisible until I choose to speak. My way of being, my way of looking at the world, might exist in a rose-colored lens to others, but academic indoctrination has taught me to observe freely first—and then interrogate my observations from that of a metrocentric reader second. Perhaps the most useful example of this observational duality comes with socioeconomic status and class.

Many people who visit my hometown are quick to point out that there is no middle class. They see the affluent opulence and conspicuous consumption of the resort culture (clearly defined during the Rolls Royce Rally days, in which tweed-capped gentlemen tool around our country roads with their tops down and collars up), juxtaposed with immigrant (predominantly Jamaican) hotel workers on six-month work visas, and isolated single-wide trailers set on cinderblocks just half a mile from the resort. They see PGA golf courses, manicured and fertilized within an inch of their lives, hobby farmers with heirloom goats or cattle for pets, and just one road down the holler, a tar paper shack held up only by the occupants' faith and a few rusty nails.

Coming to terms with wealth and privilege, as well as abject poverty and shame, was a way of life in our home. My father, my elementary school principal, was always

quick to point out that when children showed up to school wearing shorts in the mountain flurries of late November, it was likely because they had outgrown last year's clothing and simply didn't have anything else to wear. After a call home to the parents (or a call to the hotel where they worked), my father or one of the teachers would make some inquiries, and the child would usually go home with at least one pair of pants, if not a sweater and coat too. These are things we don't teach about in science education, because they don't fit neatly into the standards.

We don't teach about the shame we feel, seeing our classmates' younger brothers and sisters wearing our old clothing, tossed from our closets because it wasn't fashionable or because of a new replacement. But we also don't teach about the danger in creating a culture of social victimization, in which we blame the children, or their parents, for their social station in the community. I heard it discussed often between my parents, the difficulty they had with folks who were new to the community, who had more than others, who felt that poverty was justified because "those people just didn't work hard enough". Indeed, "those" people were often pulling 12-hour shifts at the hotel, often doubling shifts, just to make ends meet.

If science education research in rural areas has been restricted for various academic reasons, then research and discussion about rural class and socioeconomic status within the context of science has been absolutely taboo. Is it the whiteness that the academy sees in rural areas? Is a noted lack of racial diversity enough to discourage inquiry in how children and teachers in rural areas interact with the curriculum, or with global issues? Rurality does not need a racial basis but should not be denied as a sole source of diversity. As Smith notes in the field of Appalachian studies, the inattention to race "can be traced, in

part, to the tendency of the field to adhere to a ‘race relations’ perspective, whereby race is viewed as operative only in settings where people of color are present.”(2004). Is this true of science education as well?

Good science education takes into account not only the student, but the culture and community surrounding it. As a rural science teacher, my goal was to make the content interesting, relevant, and accessible for all of my students, regardless of their gender or socioeconomic class. To engage in identity politics within science education, from a metrocentric or rural position, is to obscure “persistent problems of inequality, domination, and privilege including academic roles in the political containment of critical regional consciousness” (Reid & Taylor, 2002, p.11).

My purpose throughout this paper is to bring my rural experience, as a student, teacher, scholar, and citizen, to the foreground of my research agenda. Reid and Taylor (2002) describe this as a “civic professionalism” that “requires rethinking knowledge and identity beyond scientism or technocratic models of research and professional purpose” (p. 28). As I frame my work in rural science education, I want to push the conversation beyond boundaries of cultural studies, to implicate place and identity in the crosshairs of rural development and local political economy.

Building on the idea of Reid and Taylor’s (2002) “civic professionalism” is part of my purpose in completing this study. As I will explain in greater detail in Chapter 5, I was a student at the Field School in the early 90’s, a program designed to introduce students to the fascinating world of Field Biology and Field Ecology. In a rural area with limited summer educational opportunities, this program stood out as being challenging, engaging, and fun. My experiences at the Field School that summer led me down many sinuous

pathways, ultimately leading to a BS in Environmental Science, a MS in Science Education, and a PhD in Curriculum and Instruction, Science Education. I owe the Field School for helping develop my personal civic professionalism, and my advocacy for science and the environment.

That I attribute so much of my personal and professional development to a short three weeks spent traipsing across windy mountain ridges to collect tree cores, battling dense greenbrier searching for salamanders, and splashing through riffles to capture hellgrammites speaks to the power of the curriculum, but also to the passion of the instructors of the program. The literature review in Chapter 2 sets up the foundation for my interest in studying the Field School—their focus on place-based and outdoor environmental education illustrates the importance of learning science by doing science in authentic, meaningful, ways. Making the connection from a local environmental issue to a global phenomenon is an important part of doing authentic science in a local context. Research by Sobel (1996), Gruenewald (2003), Bowers (2008), and Nespor (2008) in the fields of place-based education and critical pedagogy of place, as well as work by researchers in Appalachian Studies connects the literature to the research context. Chapter 3 discusses the methodology further, including the study context, research questions, data collection and analysis.

The data are presented in four vignette chapters. Chapter 4 explores the History of the Field School. Chapter 5 is a personally reflective inquiry into my own experiences as a student in the early 1990's. Chapter 6 discusses an unintended theme in the data, specifically the effect of the economic downturn in 2008 and the downward slide since. Chapter 7 analyzes the stories of the teachers, students and their experiences in the

program, from salamanders to night journaling and discussing climate change. Chapters 8 and 9 focus on the analysis and discussion of the data, specifically how this program uses place as a foundation for teaching about science in a meaningful way, and how the experiences of the teachers and students in the program contribute to a critical pedagogy of place while developing an understanding and appreciation of ecojustice issues affecting their local and global communities.

CHAPTER 2

LITERATURE REVIEW

This literature review is intended to introduce the main ideas in Place-based Education, Critical Pedagogy, Critical Pedagogy of Place, Appalachian Studies, contested rural places, and ecojustice and to bring them into conversation with each other. The place-based education (PBE) discusses the background of the movement to situate education in local environments and culture and presents a snapshot of where we are currently. Critical pedagogy (CP) addresses the same topics, relating the history of the movement and its current trajectory. The notion of critical pedagogy of place is introduced to bring together the “best of both worlds” (Greunewald, 2003). Appalachian studies is used to introduce a context to this discussion, and to bring the inherent problems with place into the foreground.

Place-Based Science Education

The idea of place-based education (PBE) isn't new, and many contemporary scholars in PBE point to early beginnings with the work of John Dewey as the genesis of the field (Greenwood, 2008; Gruenewald, 2003a; Mueller, 2011; van Eijck & Roth, 2010, 2013). Indeed, Dewey warns of the disconnect that students must feel from their home lives and schooling, and notes the dreadful task of educating the unwilling and uninterested:

That is the isolation of the school—its isolation from life. When the child gets into the schoolroom he has to put out of his mind a large part of the ideas, interests, and activities that dominate in his home and neighborhood. So the school, being unable to utilize this everyday experience, sets painfully to work, on another tack and by a

variety of means, to arouse in the child an interest in school studies. (Dewey & Dewey, 1969, p. 77)

As Dewey explained, the school now has the responsibility of engaging the student interests, but not necessarily in the everyday experiences of interest to the student.

Dewey's answer to this painful experience of education was to create a curriculum of meaningful experiences that linked back to the contemporary curriculum. In the context of a laboratory school, Dewey was able to engage students in real-life learning experiences that related to the present moment, rather than some arbitrary future test (Smith & Sobel, 2010). The idea that education should be relevant, important, and applicable to the lives of students has grown over the last century and has embedded itself into our teacher education courses through the mantra of "know your students". If you don't know who your students are, as people, it is very difficult to make the curriculum engaging or relevant for them. Place-based education is one pedagogical method that seeks to bring the school and lived experience together through education.

There are many different ways to define PBE, but one of the most encompassing definitions comes from David Sobel:

Place-based education is the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum. Emphasizing hands-on, real-world learning experiences, this approach to education increases academic achievement, helps students develop stronger ties to their community, enhances students' appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens. (Sobel, 2004, p.4)

Based on Sobel's definition, in the context of PBE, the students first start at the local level and gain experience and understanding, making connections with things that are already familiar, but in new ways. Starting with this mind-set, students can then begin to extend this new knowledge to broader, more global contexts.

In their ethnographic study of urban school children in an after school science program, Calabrese-Barton and Tan (2010) use this same concept. Their participants studied the urban heat island effect in River City as a local phenomenon, and eventually extended their new identities as "funky scientists" (p. 198) or "community science experts" (p. 205) to inform others about the issue in a more global context. The place of an urban setting allows the students to leverage their personal experiences and ties to the community to create their new scholar-activist identity.

The notion of PBE follows a logical argument from Dewey to Sobel, that is, to create engaged and critical citizens, students need to be actively involved in their education and need to understand the local implications to global phenomena, be they environmental, economical, or political, or consequently all three. The connection from PBE to environmental education is natural, from this reasoning. What better way to understand the content and curricula of science than in one's own back yard?

The history of environmental education through outdoor education can be traced to Outward Bound in 1941, focusing on experiential education in the outdoors ("Outward Bound History," 2013) and the National Outdoor Leadership School, or NOLS, in 1965 (Wood, 2013). The histories of Outward Bound and NOLS represented the wilderness ethic of the time, as masculine and survivalist, pitting man against nature. Indeed, both programs started for men and boys, to provide leadership training for the next generation of

outdoor educators (Wood, 2013). Both non-profit organizations evolved through societal shifts and second-wave ecofeminism (Mellor, 1997) to currently offer a variety of programs that seek to enrich the lives of both adult and adolescent students through direct and meaningful experiences in wilderness settings.

That programs like NOLS and Outward Bound have created a cottage industry of experiential and adventure education, seated in the ethics of environmentalism, is certainly a step in the right direction towards increasing awareness of conservation, and both local and global environmental issues. Yet, these experiential education programs exist largely outside of the confines of traditional K-12 schooling and is perhaps why curriculum-based environmental education programs like Project WET, Project WILD, and Project Learning Tree are so popular in teacher education programs.

The late 1970's and early 1980's were an era of proliferation for classroom environmental education, with the introduction of three national curricula projects, Project Learning Tree, Project WET and Project WILD, which aimed to educate teachers in environmental education, and to introduce inquiry-based activities to their classrooms ("PLT, Who we are," n.d.; "What is Project WET?," n.d.; "WILD Through the Years," n.d.). Through educating teachers in ecology, many schools embraced "green" practices and incorporated place-based eco-service projects like water quality monitoring of local streams and created on-campus outdoor classrooms, butterfly gardens and rain gardens.

The call to increase focus on environmental education, environmental literacy, and educating critically conscious citizens in school classrooms is best described in Sobel's (1996) early work:

What we need, beginning in middle schools, is an orientation towards service.

Environmental projects that serve the community show students the relevance of the curriculum and give community organizations an injection of youthful energy.

Examples of service initiatives conducted by school children can serve as beacons for other children and teachers to follow. (p. 33).

Indeed, much of the environmental education work throughout the 1990's focused on service learning and small-scale environmental projects, like school recycling, or community rain gardens.

Place remained an important component of environmental education efforts throughout the 1990's, and as Smith and Sobel (2010) note, the term "place-based education" appeared on the cover of a book for the first time in 1998, in *Stories in the Land: A Place-Based Environmental Education Anthology* (Elder, 1998). Yet, authors like David Orr had been theorizing the connection between place and pedagogy since the start of the decade (Orr, 1992). As the field of environmental and place-based education emerged from the green-washing of the 1990's, it encountered a new shade of grey in the early 2000's, largely due to the technology bubble, Web 2.0, and high-stakes testing.

With the advent of No Child Left Behind legislation, increased focus on standards-driven assessment and high-stakes tests, teachers were left with few options except to take free time and devote it to remediation. Richard Louv (2005) wrote extensively about these issues, and even coined the term "nature deficit disorder" in reaction to the societal pressures forcing children indoors. Not only is it high-stakes testing, Louv argues, but also parental fear that contributes to the lack of time spent in natural settings (p. 123). This fundamental disconnect from nature, a code for place in many environmental education

books, has far-reaching ramifications. Quoting Robert Michael Pyle, Louv notes “[What is the] extinction of a condor to a child that has never seen a wren?” (p.145).

The political response to high stakes testing in the early 2000’s has grown to a collaborative group of environmental educators and activists who support the No Child Left Inside bill, which was introduced in 2011 as a bi-partisan effort to include environmental education in educational reforms (“About the No Child Left Inside Act,” 2011). Environmental advocacy groups like the Chesapeake Bay Foundation, Project Learning Tree, Project WET, The Appalachian Trail Conservancy, and the Sierra Club have lobbied extensively to include greater emphasis on environmental education in national curricula.

The academic literature theorizing place also emerges in the early 2000’s and begins to connect the practice of place-based environmental education to the greater theory of education. Through experiential education, environmental education, service-learning, and a host of other forms of educational experiences that could be considered place-based, Gruenewald states:

The point of becoming more conscious of places in education is to extend our notions of pedagogy and accountability outward toward places. Thus extended, pedagogy becomes more relevant to the lived experience of students and teachers, and accountability is reconceptualized so that places matter to educators, students, and citizens in tangible ways. (Gruenewald, 2003, p. 620)

This is an important notion in PBE, or place conscious education, that civic accountability is extended outward *toward* a place, rather than maintained or refracted within the walls of institutions like schools. With high-stakes testing, accountability measures are only

located within the classroom, and usually hold the teacher and students hostage to unrealistic demands of quantitative improvement, based solely on testing and assessments. To reconceptualize education through a place-based lens is to expand accountability to the community, and vice-versa. Just as it takes a village to raise a child, so should the child be an informed participant in the village.

Place, however, is a tricky theoretical construct. As Gruenewald states, “people make places and places make people” (2003, p. 621). Casey, in work related to understanding place as a philosophical inquiry, writes:

To be at all-to exist in any way-is to be somewhere, and to be somewhere is to be in some kind of place. Place is as requisite as the air we breathe, the ground on which we stand, the bodies we have. We are surrounded by places. We walk over and though them. We live in places, relate to others in them, die in them. Nothing we do is unplaced. How could it be otherwise? How could we fail to recognize this primal fact? (Gruenewald, 2003, p. 622)

This aphorism, that place is everywhere and everything, and contingent upon human interaction and construction, is foundational to the theoretical construct of place. However, this same ubiquity allows us as humans to reduce place to a name or location on a map, and to ignore “geographical relationships of power, contested territories of identity and difference and aesthetic or even cybernetic experience”(Gruenewald, 2003a).

Indeed, in more recent theoretical work constructing place, van Eijck and Roth (2010) note the “problematic notion of place”, and ask, “Whose (account of the) place is recounted here?”. In their paper, van Eijck and Roth discuss an environmental study in the Tod Creek watershed, located in British Columbia, Canada, in which students collected a

variety of water quality measurements, wrote reports that were featured in local newspapers and websites, and contributed to sustainable changes in policy and management of the watershed area. The science and connections to the place of the Tod Inlet are the focus of the study, and while it appears that students were motivated by the activity, van Eijck and Roth are quick to note that “place-based approaches do not often link natural scientific themes explicitly with critical themes” (p. 878). In this case, critical themes include First Nations people, their historic use of the land, and the effects of colonization by Western settlers. All of these critical issues are made invisible by the emphasis on natural science.

In a critique of PBE literature, Nespor (2008) notes the problematic constructs of ideas like “place” and “community”. Nespor is blunt regarding the literature, and states:

(The literature) makes it possible to simply orient the PBE theoretical discourse around an idealized image of “place” as a stable, bounded, self-sufficient communal realm. This image is then put to use as the starting point of a narrative in which Western, Northern, urban people’s ecological awareness and spiritual connection to the land, dependent on access to the “ancient commons,” has been desiccated by 200 years of “industrial culture”. (p. 479)

Indeed, this relates back to van Eijck and Roth’s (2010) work in the Tod Inlet. Limiting the discourse of place to a bounded and fixed notion makes it difficult to “distinguish among different historical, geographical, cultural, political, economic and other dimensions of place” (Nespor, 2008, p. 478).

Of course, in PBE theorists’ defense, those same dimensions are largely ignored in the day-to-day activities of the classroom. Gruenewald, in his earlier work of which

Nespor (2008) is critical, does note the importance of these multi-faceted notions that contribute to place:

Place-conscious education, therefore, aims to work against the isolation of schooling's discourses and practices from the living world outside the increasingly placeless institution of schooling. Furthermore, it aims to enlist teachers and students in the firsthand experience of local life and in the political process of understanding and shaping what happens there. (Gruenewald, 2003a, p.620)

The basic argument that Nespor makes against the theoretical construct of place is that it has the tendency, not necessarily the purpose, to ignore the greater cultural context of any space/place/temporal region. Nespor's (2008) call for an inclusion of more critical social issues in PBE is warranted:

Instead of following a PBE narrative that constructs people as unconscious of their immediate environments, we could give people the benefit of the doubt and assume that all of us think and care about the places we stand, but that most of us have trouble understanding how these places have come to be or might be changed. (p. 487)

To understand how places and people are changed, constructed, reconstructed, and deconstructed requires a study of the power structures of the culture have been influential. The dose of critical thought that Nespor and van Eijck and Roth call for can be found in critical pedagogy. Gruenewald (Greenwood, 2008; Gruenewald, 2003b) theorizes a critical pedagogy of place, which is discussed later in this paper. Critical pedagogy and its strengths and weaknesses are discussed in the next section.

Critical Pedagogy

Critical pedagogy examines the power structures that oppress the individual in the context of schooling and society. According to Kincheloe (2005) “a critical pedagogical vision grounded as it is in social, cultural, cognitive, economic, and political contexts understands schooling as part of a larger set of human services and community development” (p. 6). To paraphrase Kincheloe, schooling, and the political act of educating an individual, is situated in the greater context of the student to include the numerous dimensions in which we exist and are often defined.

As critical pedagogy is not uniquely American as that of place-based education, the underlying critical theory has its roots in the Frankfurt School and their “commitment to penetrate the world of objective appearances to expose the underlying social relationships they often conceal” (Giroux, 2009, p.27). Indeed, critical theory seeks to eliminate the “positivist legacy of neutrality” (p. 33) that proliferated in theory, technology, science, and scientism during and after the World Wars. According to Giroux, the Frankfurt School believed that “the outcome of positivist rationality and its technocratic view of science represented a threat to the notion of subjectivity and critical thinking” (p.32). To read this in context of Post-War Germany is chilling indeed.

This rejection of empirical, positivistic theory begins to set a rift between the established scientific community and those in some areas of the social sciences, education included. Perhaps this positivistic rejection is partly to blame for critical pedagogy’s latent entrance into Science Education, long after many other disciplines have embraced it. In fact, “science carries with it a social, cultural, political, and economic history replete with pain, suffering and privilege”(Kincheloe, 2008, p. 30), but without specific standards to

address and teach the history and nature of science, this largely goes unnoticed in the science classroom.

In their classroom, the critical pedagogue works to subvert the curriculum; to create opportunities for students to see the inherent power structures, the positivistic notions, even the neoliberal policy, that shapes their experience with and in the world. This is in sharp contrast to the traditional “banking model of education”, refuted by Paulo Freire (2007). According to Freire, the banking model of education seeks to “minimize or annul the students’ creative power and to stimulate their credulity serves the interests of the oppressors, who care neither to have the world revealed nor to see it transformed” (Freire, 2007, p. 73).

Instead, Freire presents what he calls a “pedagogy of the oppressed”, which makes visible the inequities and injustices of society. In this pedagogy, he seeks to radicalize the forum of education, beginning with teachers, but extending to students, so that they may be freed from the oppressive structures of culture. As Freire (2007) describes it:

The pedagogy of the oppressed, as a humanist and libertarian pedagogy, has two distinct stages. In the first, the oppressed unveil the world of oppression and through the praxis commit themselves to its transformation. In the second stage, in which the reality of oppression has already been transformed, this pedagogy ceases to belong to the oppressed and becomes a pedagogy of all people in the process of permanent liberation. (p. 54)

With such emphasis on race, class, ethnicity, gender within critical pedagogy, it’s not surprising that most of the work in critical pedagogy focuses on urban areas. In fact, McLaren and Giroux (1990) comment on this very fact:

While critical pedagogy in its early stages largely grew out of the efforts of Paulo Freire and his literacy campaigns among peasants in rural areas of Brasil and other Third World countries, subsequent generations of North American teachers and cultural workers influenced by Freire's work have directed most of their attention to urban minority populations in major metropolitan centers. Very little writing exists that deals with critical pedagogy in the rural school classroom and community (p. 154).

Indeed, over two decades after this paper was published, there is still scarce work in rural areas devoted to critical pedagogy.

Because “critical educational theorists view school knowledge as historically and socially rooted and interest bound” (McLaren, 2009, p. 63), it would follow that critical pedagogy was a large part of the environmental education and place-based education movement, yet the themes of critical pedagogy infrequently appear in early PBE projects. As others have noted (Bowers, 2008; Nespore, 2008), place-based education often foregrounds the environment or the science of a place, rather than the social and historical dimensions, projecting a Western ideal for knowledge. In a similar account, Kincheloe (2008) is extremely critical of “positivistic science”, and the emphasis of Western history in current educational practices. It would seem as though place-based education would find an ally within critical pedagogy, yet there exists a rancorous debate between those critical of both place-based education and critical pedagogy, and those who theorize to bring both together into a critical pedagogy of place (Gruenewald, 2003b).

Critical Pedagogy of Place

“A complex critical pedagogy is always searching for new voices that may have been excluded by the dominant culture or by critical pedagogy itself” (Kincheloe, 2008, p. 24). The notion that PBE has marginalized sociological implications of place, and that critical pedagogy ignores the greater context of the environment (and the human relationship with the environment), is the intersection for a new voice in both fields of study. Gruenewald (2003) sets the theoretical frameworks of both critical pedagogy and PBE next to each other and notes their commonalities.

Perhaps the two most significant intersections between these traditions are place-based education’s call for localized social action and critical pedagogy’s recognition that experience or Freire’s (1970/1995) “situationality”, has a geographical dimension. Acknowledging that experience has a geographical context opens the way to admitting critical social and ecological concerns into one’s understanding of place, and the role of places in education (p. 9).

The situationality that Gruenewald attributes to Freire is well documented. “Education as the practice of freedom—as opposed to education as the practice of domination—denies that man is abstract, isolated, independent, and unattached to the world; it also denies that the world exists as a reality apart from people.” (Freire, 2007, p. 81). While it could be argued that Freire was conceptualizing “world” from a societal view, it also stands that the world that Freire was describing was situated within the context of place and the environment.

The theoretical grounding of critical pedagogy of place allows it to be a useful lens in a variety of settings. From indigenous populations in Malawi (Glasson, 2009), to rural

farming in Spain (Dopico & Garcia-Vazquez, 2010; Glasson, 2011), the Navajo Nation (Semken & Freeman, 2008), First Nations tribes in Canada (van Eijck & Roth, 2010), and even rural upstate New York (Avery & Kassam, 2011), the flexibility and rich theory of both critical pedagogy and PBE creates a space for the voice of people marginalized by one theoretical stance or another.

There are many criticisms of critical pedagogy of place posited by Gruenewald, but none as vocal as Bowers (2008) and Nesor (2008). Although Nesor seeks to engage scholars in strengthening the theory through a specific grounding in definitions, particularly troublesome constructs like “community”, “place” and “the cultural commons”. Nesor (2008) suggests:

Treating the commons not as “romanticized relics of the past but rather dynamic contemporary institutions that act and react to current challenges and opportunities” might allow us to give curricular and pedagogical attention to “unhiding” the ways people in different locations are linked by translocal (indeed, global) “natural-resource commons” (for example, water, air), “social commons” (such as education), “intellectual and cultural commons” (ideas, arts, and the like), and “species commons” (gene sequences, bodies). (p.488)

One of his primary grievances with the notion of critical pedagogy of place is its tendency to oversimplify complex cultural and environmental situations. Perhaps it is his experience with positivistic reductionism in the canons of science, but many scholars who have used the lens of critical pedagogy of place do not submit neat and tidy articles for publication. If anything, a critical pedagogy of place creates more complex, more difficult, more nuanced stories about how people view and relate to the world.

Bowers (2008), on the other hand, is purely critical of both camps. Accusing both Freire and Dewey of “social Darwinism” (p. 326), he attacks modern theorists in critical pedagogy, such as Giroux, McLaren, and Kincheloe, for continually quoting the works of Dewey and Freire. Bowers alleges that these recent works in critical pedagogy are flawed because they “need to transform the world by relying upon an abstract Western epistemology that carries forward a number of misconceptions and prejudices that can be traced back to Plato’s *Republic*” (p. 327). These prejudices are, of course, learned from the silencing of higher education (p. 326). Rather than constructively contributing to the theoretical basis for critical pedagogy of place, Bowers seeks to drive downloads of his online handbooks for mediating the “local cultural commons” (p. 333), and simply says that others in the field are severely misguided and blinded by their Western privilege.

Greenwood (2008) seeks to respond, and even reconcile Bower’s scathing critique of the critical pedagogy of place by responding personally and outlining his initial intent:

I wanted to *invite* educators from primarily ecological and rural traditions, and educators from primarily social justice and urban traditions, into a shared conversation about what we might be concerned about together. I argued that the construct, ‘place’ – what I think of as a potential grounded nexus of cultural and ecological thought and experience – can help educators and citizens become more aware of the relationships between culture and ecology. Place, I asserted, can help bridge the ‘unnatural’ cultural–ecological divide, and can make concrete abstractions about culture that dominate the discourse of schooling. (p. 339)

While Greenwood is appreciative of the criticism, and the opportunity to comment constructively on Bower’s work, he notes that “Bowers’ critiques often reflect an

intolerance that constricts rather than opens the conversation...that is, we are all in this together and we may have something to learn from others unlike ourselves” (p. 340).

To this end, Greenwood takes the idea of the cultural commons that Bowers supports, and shows its congruence to the work of critical pedagogy of place:

I believe that all of Bowers’ recommendations for a commons-based education should be included in the theoretical scope of critical place-based education, ecopedagogy, environmental education, education for sustainability, or whatever people choose to call this work. Though the label is less important than the work, I prefer ‘place’ to ‘the commons’ as a grounding theoretical construct mainly because I am more familiar with the literature on place and because there is more theoretical breathing room with place. (Greenwood, 2008, p. 340)

Place is a more familiar construct to most people in environmental education, I would argue, and from the recent work in reconceptualizing what place is (Lim, 2010; van Eijck & Roth, 2013), there certainly is the theoretical breathing room that Greenwood mentions. Critical pedagogy of place, to me, is an open field waiting for new research contexts. Specifically, the critical pedagogy of rural places in Appalachia seems to be an under-theorized and under-researched area of study.

Appalachian Studies

My choice of situating this literature in the context of Appalachia is not simply convenience. From a theoretical perspective, place-based education is a pedagogical tool that works well in this area due to its relative wealth of natural spaces, environmental issues, and increasing industrialization. Critical pedagogy is a natural fit for this area as well, as a historically poor and oppressed region within the United States. A critical

pedagogy of place in Appalachia is of interest in this section, particularly as it connects environment and culture within the region. This section traces the history of Appalachian studies and introduces the problems inherent to this context.

First, I'd like to re-address my position as both an insider and outsider of the region. My claims to Appalachia go back many generations, as many scholars in Appalachia are quick to point out (Smith, 1999), but the Appalachian region is so diverse that even a number of scholars sitting around a table can attest to the strange and peculiar diversities of their hometowns (class notes, APS 5984, January 22, 2013). Even the notion of an insider/outsider dichotomy has grounding in identity politics, which has the dual purpose of both venerating the Appalachian identity as privileged and simultaneously defining "a strange land with peculiar people" (Shapiro, 1978).

Greenwood (2008) states, "The best place-based education...emerges from the particularities of places, the people who know them best (including people with indigenous roots), and the people who wonder about all the opportunities that might arise from action-oriented place study" (p. 339). Who better to examine a critical pedagogy of place in Appalachia than a native daughter or son? Indeed, Appalachia does have a number of particularities, many of which can be ascribed to cultural stereotypes, pervasive myths, and general misunderstandings.

In her introductory course in Appalachian Studies, Satterwhite (2013) lists the "Five Myths" most undergraduate students enter the course with. Satterwhite lists these overgeneralizations in a PowerPoint for her class:

1. Appalachia is *all* poor and the poorest place in the United States.
2. Appalachia is *all* rural and also the most rural part of the country.

3. Appalachia is *all* white and the whitest place in the United States.
4. Appalachia is *all* mountains.
5. Appalachia is pre-modern. (p. 18)

Many people would have difficulty refuting these assertions, as it does seem that the Appalachian region has long been constructed as unilaterally poor, white, rural, isolated, and backwards. Without specific instruction to the contrary, many of Satterwhite's students continue to believe that Appalachia is a bucolic paradise or agrarian holler that time forgot.

Unfortunately, Appalachia does have higher poverty rates than comparable rural regions, but not uniformly so (Billings & Blee, 2000). While the Northern and Southern Appalachians have seen increases in tourism and industrialization, Central Appalachia, which includes all of West Virginia, parts of Eastern Kentucky and extreme Southwestern Virginia, continues to experience persistent poverty. Scholars have theorized many reasons for the endemic poverty of the Appalachians, yet two models continually rise to the surface. Billings and Blee note,

The culture-of-poverty theory directs attention to how families and individuals in Appalachia, for better or worse, cope with poverty. The theory of internal colonialism, on the other hand, attempts to focus attention on the structural causes of poverty in Appalachia. (2000, p. 8)

While neither is a satisfying or sufficient explanation of poverty in Appalachia, or poverty in the United States, they provide a starting place to talk about economics in the region.

When the media discusses topics like "urban poverty", "welfare recipients", and "at-risk-youth", they unintentionally paint the subjects of the story with the same broad

strokes of race and gender, from a largely metrocentric brush. As scholars, we find this practice abhorrent, yet, outside of the arena of Appalachian Studies, this same phenomenon happens frequently outside of the region. Intending to prove otherwise, Shapiro (1978) states that his intention is to “examine the origins and consequences of the idea that the mountainous portions of eight or nine southern states form a coherent region inhabited by an homogenous population possessing a uniform culture.” (p.xi).

Before getting to a culture-of-poverty model, or an internal colony model of poverty, it is helpful to see how Appalachian Studies has attempted to construct the region, to define or examine the place and how it is constituted in a cultural context. Shapiro, in describing the years after Reconstruction in the south, notes:

It became clear to a number of persons that the existence of a strange land and peculiar people in the southern mountains could not be understood in terms of contemporary conceptions of America as a unified and homogenous national entity; and that conventional modes of resolving the dilemma posed by the perception of “deviance” from the American norm by a region or a people—ascriptio of geographic, chronological, or ethnic distance which made such “deviance” seem natural and normal—could not be used to explain the “deviance” of white, Anglo-Saxon, Protestant, native-born Americans living in the present and within miles of the older centers of American civilization. (1979, p. x)

That is, the usual method of resolving deviance, by geographic barriers, ethnic epithets, or condemnation to the past, would not work for these white “little brothers” of America. As Silber (2001) puts it, “these myths of southern mountain life opened a new path for northern humanitarianism that was far removed from the disturbing racial and social

conflicts that held the South in its grip during this troubling period of economic and political turmoil.” (p. 248).

Historically, or at least from the Civil War through the late 1950’s, the Appalachian region was constructed through literature—either through travel writers, fiction authors, or news media outlets (Satterwhite, 2011). Throughout these literary descriptions, the people of Appalachia are simultaneously venerated as the “salt of the earth”, or “having a special connection to the land”, while also debased as “peculiar”, “backwards”, unintelligent, inbred, and dangerous. It is this duality in construction that allows theorists to posit both internal colony models and culture-of-poverty models so successfully.

In the internal colony model of poverty in Appalachia, the region is poor “because of the nature of its integration with—not isolation from—the US corporate economy” (Billings & Blee, 2000, p.12). Theorists who support the internal colony model of poverty note the influence of coal production and energy extraction in the region and point to the large nameless and faceless corporations with vast land-holdings in the region. Indeed, internal colonialism does foreground the issues of power and privilege in Appalachia, and makes the structures of economic oppression visible (Walls, 1978), and sets the people of Appalachia up as the victims of gross injustice from capitalistic industrialization.

There are numerous contestations to the internal colony model of poverty, the least of which is a comparison of the atrocities endured by Native American and African-American people in American history. As Walls notes, “Mountaineers are able to “pass” into mainstream America both through migration and, for some, through integration into the business elite in the mountains.” (1978, p. 327). That is, their whiteness gives them

legibility in dominant American society. Accents can be lost, clothing and mannerisms can be changed, but race is not as easily evaded.

If the people of the Appalachian region were not the victims in this poverty, as the internal colony model would suggest, the culture-of-poverty model seeks to blame the region's destitution for their own lazy and fatalistic worldviews. In her ethnographic work in the mythological Blackwell, Appalachia, Duncan (1999) records her interactions with local people, exploring their experiences with schooling, the economy, and life in general. Even in her research participants, you can hear the implicit culture-of-poverty language, blaming their neighbors for not wanting a better life, being lazy, or not working hard enough. As one participant states:

People that want to work are the same as people that do work, because they're still trying to work. And then there's people who don't want to work at all, never have and never will. We call them first-of-the-monthers because they come out of the mountains the first of the month with about ten kids and don't wash. When I worked at the grocery store, you could smell them coming. (Duncan, 1999, p. 7)

If the Appalachian people are constructed as dim and ambitionless, it becomes easier to blame them for being on the dole, much like right-wing pundits blame a culture of poverty for maintaining "urban welfare queens" on taxpayer money.

The lens of critical pedagogy would align more closely with the internal colony model of poverty yet would go to great lengths to avoid comparison with historically marginalized and disenfranchised ethnic and minority groups. Similarly, through critical pedagogy of place, the ecologic, economic, and sociologic realities of daily life in Appalachia would be grounded in a critical examination of the larger structures that seek to

oppress and maintain control over both human and resource capital. As Friere (2007) puts it:

The oppressed have been destroyed precisely because their situation has reduced them to things. In order to regain their humanity they must cease to be things and fight as men and women. This is a radical requirement. They cannot enter the struggle as objects in order *later* to become human beings. (p. 68)

As long as literature and media (and capitalistic) portrayals of Appalachia construct its people as things, rather than agentic beings, it is difficult to fight against the myths of rural life. Through a critical pedagogy of place, a pedagogy that, as Friere states, radicalizes education, the oppressed of Appalachia can continue to fight (Fisher, 1993).

The background literature of place-based education, critical pedagogy, critical pedagogy of place, and Appalachian studies introduces the historical trajectory of these disciplines. In the following sections, I will introduce the idea of contested (rural) places and teaching for social justice in rural areas, as extensions into the future for these disciplines.

Contested (Rural) Places

If science education needs to consider critical pedagogy more thoroughly in its research agenda, then place-based educators and critical pedagogues of place should examine contested places more closely in their research. “The identities of place are always unfixed, contested, and multiple” (Massey, 1994, p.5), and the site of contestation can take many forms. A contested place could be a closing local elementary school, a newly paved strip-mall, or a wind-generation turbine site on a mountain top. The idea is

that these places can be small, in the case of a school yard, or large, in the case of mountain top removal, but they all have a political and socioeconomic stake in their identity of place.

The idea of a contested (rural) place in Appalachia is not difficult to find. The decades-long struggle with strip mining and now mountain top removal (MTR) is more than a case study of contestation, but also about whose interests are served in the process. In her essay about resisting a strip mining operation, in Clear Creek, Kentucky in 1967, Bingman (1993) notes multiple sites of contestation; environmental degradation from flooding, landslides, contaminated water, mine spoils, and the issue of land ownership. Coal companies had their own sites of contestation that were largely economic. In fact, as one participant states:

It got to the point where it was not Bessie and Madge fighting the strippers, or the strip mining, it was Bessie and Madge fighting the people mining the coal, the neighbors. And that was a good tactic on their [the coal company's] part, that worked real well. It kind of smoothed over the fact that it was strip mining destroying the land that they were fighting. (Bingman, 1993, p. 23)

Coal and energy extraction in Appalachia are a visible site of contested place, but others exist as well. Interstate 81, a major north-south corridor in western Virginia was the site of a grassroots organization to support Rail Solutions to alleviate truck traffic congestion in the mid 1990's (Shearer, 2012). A community group in Oak Ridge, Tennessee organized a campaign to stop nuclear bomb production that grew into a greater network of allies resisting a broader scope of local and global issues (Hutchison, 2012). In Southwestern Virginia and Eastern Tennessee, a non-profit healthcare coalition set out to limit the sale of OxyContin in the region through a variety of ground-based, legal, and

political measures (Kobak, 2012). Even more recently with the Mountain Valley Pipeline through the New River Valley, grassroots opposition combined with direct action by environmental activists, as well as legal and judicial blockades have significantly slowed the progress of the pipeline. All of these are example of contested places within Appalachia, from highways to medical clinics, and each has a certain politics of place that goes along with it.

The area of mountain top removal, however, has a special identity within the notion of a contested space as a sacrifice zone. Quoting both Kuletz (1998) and O'Connor (1994), Scott (2010) states:

A sacrifice zone is a place that is written off for environmental destruction in the name of a higher purpose, such as the national interest (Kuletz, 1998). Although by their very nature environmental hazards defy social and cultural boundaries, environmental exploitation relies on the maintenance of such imaginary firewalls. A system that depends, contradictorily, on the destruction of its own natural basis (O'Connor, 1994) can only survive because those who benefit feel safe from the type of environmental and economic disaster experienced by the poor. (p.31)

This notion of a sacrifice zone is extended through the dialogue of NIMBY, or “not in my backyard”, relating to a variety of modern necessities that serve the public good yet are relegated to places and spaces without a voice of privilege, like urban trash incinerators in low-income neighborhoods, waste transfer stations in the south that accept largely northern garbage, oil drilling and refining in the Louisiana and Mississippi bayous, or fracking in Wyoming, Pennsylvania, New York, and West Virginia. These firewalls between “civilization” and zones of sacrifice serve to maintain the status quo, with few citizens

outside of the sacrifice zone even aware of the environmental consequences of global capitalism.

Mountain top removal contributes not only a sacrifice zone, but also to a contested place, environmentally, socially, and economically. The players in this dialogue are numerous, from coal companies, to employees, their children, local schools and teachers (who receive classroom materials from the coal companies (Scott, 2010, p.87)), internal activists, external activists, scientists and scholars. My intent is to focus on the contested places of schooling culture in MTR towns.

If these towns can be theorized, and practiced, as sacrifice zones, then their local school systems can serve as a contested place where local interests (mines, coal operators, local politics) can conflict with global desires (energy policy, State environmental and educational regulations, neoliberal dialogue). This sets the town within the context of critical pedagogy of place, and through environmental education and critical pedagogy, allows the players to examine the costs and consequences of oppression.

Educating for Social Justice in Appalachia

As part of an emancipatory framework for education, Freire (1998) said, “to teach is not to transfer knowledge but to create the possibilities for the production or construction of knowledge” (p. 30). Teaching for social justice meets that goal. Through the contested places of Appalachia, and with a lens of critical pedagogy of place, I believe that teachers can actively engage their students in meaningful and authentic discussions about their local issues within a global context.

Teachers who accept the challenge of teaching for social justice are co-constructing knowledge with their students, and helping their students become agentic in their own

learning (McLaren & Giroux, 1990). However, these teachers must believe in the limitless capabilities of their students, in order to see them succeed. “The man or woman who proclaims devotion to the cause of liberation yet is unable to enter into communion with the people, whom he or she continues to regard as totally ignorant, is grievously self-deceived” (Freire, 2007, p. 61).

Educating for social justice in rural areas is not a rudimentary task. As Nganga and Kamutu note, “due to isolation from metropolises with diverse racial and ethnic groups, many rural communities are intolerant toward democracy and social justice work” (2009, p. 191), and tend to believe in meritocracy and other conservative ideals. Nganga and Kamutu go on to note that social justice in Wyoming, their research context, is largely unappreciated because “people simply believe there is no diversity in Wyoming” (p. 193). Similar arguments could be made about Appalachia, particularly the coalfields and rolling mountains of Western Virginia, yet this is also partly an external cultural construct that Appalachia is homogenously poor and white.

I would argue that while dominant cultural perspectives of the Appalachia region paint the area as white and poor, or poor and white, depending on the emphasis of the statement, there is still socioeconomic injustice and class warfare being waged within this “homogenous” region. If class warfare is being waged locally, at the state level, or even on a global scale depends on the extension of the argument. At the state level, it would look like a pork-belly politics of place with “Friends of Coal” and “I (heart) Mountains” competing for constituents. On a global level, it would be the understated export of American coal to China, the discourse of “foreign energy dependence”, and climate

change. Regardless of the context, someone is always becoming wealthier, at the health, welfare, and expense of another human being.

Ecojustice and Critical Science Education Research

“God has cared for these trees, saved them from drought, disease, avalanches, and a thousand tempests and floods. But He cannot save them from fools.” -John Muir (1901, p. 361)

The environment is notably missing from the previous section on critical pedagogy, likely due to the focus of education as a bounded practice, within a classroom or school division, that exists within a culture, yet externally to the context of the physical environment. Even as PBE seeks to bring the local community into conversation with the local school division, there is an inherent danger in PBE to fall into the trap of “nature appreciation”, with cursory neoliberal lessons on what individuals can do to “save the earth”. Indeed, we should start thinking about what is contained within a society, particularly its reliance, and dependence on the Earth’s finite resources.

To concisely define ecojustice, it is the belief that there is a moral imperative to afford all living beings the same inalienable rights as we assign to human kind. That is, the soil, trees, ground squirrels, and pigeons in the park have the same rights to clean air, water, and habitat as humans do. This further extends that all human kind has the right to these same things, regardless of race, gender, socioeconomic status, ability, and nationality. Adding to this definition, Karrow and Fazio (2010) note that “the aim of ecojustice is to develop an understanding of the tensions between cultures and the needs of the Earth’s ecosystems” (p. 210).

John Muir could arguably be the grandfather of western ecojustice, as his above-referenced quote shows. Muir staunchly believed in the divine right of Nature to exist, without the influence of man. He openly marveled at the divine creation of Nature, and engaged in a sort of Calvinist pantheism, evident in his written narratives. In modern ecojustice theory, Muir was a sort of pioneer. Martusewicz et. al (2010) note in their description of an ecojustice framework that it aims to analyze western cultural dialogue that has “led to a logic of domination leading to social violence and ecological degradation”, and offers “an alternate way of knowing” that acknowledges humans as but one part of the bigger tapestry of life forms on Earth (p. 12).

The ecojustice framework supported by Martusewicz et. al is ideologically similar to the “critical domain” of research that Steinberg and Kincheloe describe. In fact, the tenants of each are compared side-by-side in the following figure.

Table 1

Steinberg and Kincheloe, on Critical Research (Steinberg & Kincheloe, 2012):	Martusewicz, Edmonson, and Lupianacci, Teaching for Ecojustice (2011) is:
<p>“1. It rejects positivistic notions of rationality, objectivity, and truth.</p> <p>2. It attains an awareness of its own value commitments and those of others, as well as the values promoted by dominant culture.</p> <p>3. It cultivates an awareness of the social and political construction of professional consciousness.</p> <p>4. It attempts to uncover aspects of the dominant social order that</p>	<p>1. The recognition and analysis of deep cultural assumptions underlying modern thinking that undermine local and global ecosystems essential to life.</p> <p>2. The recognition and analysis of deeply entrenched patterns of domination that unjustly define people...as well as the natural world as inferior and thus less worthy of life.</p> <p>3. Analysis of globalization of modernist thinking and associated patterns of hyper-consumption and commodification...</p> <p>4. The recognition and protection of diverse cultural and environmental commons....</p>

undermine the pursuit of critical egalitarian and democratic goals.	5. Emphasis on strong Earth democracies: the idea that decisions should be made by the people who are most effected by them...
5. It is always conceived in relation to practice.” (p. 1486)	6. An approach to pedagogy and curriculum development that emphasize both deep cultural analysis and community-based learning...” (p. 9)

While Martusewicz et al. focus on the Earth and ecological democracy, Steinberg and Kincheloe focus on the critical reflective lens of educational research and practice, but their overlap is considerable. Both focus on rejection of dominant unquestioned practices, particularly those of domination, globalization, rationality, and positivity. Both seek to educate and disrupt conventional cultural assumptions, and to support democratic and eco-social justice. Blending these two frameworks into “critical ecojustice education research” is a powerful construct with which to analyze local, place-based, environmental education in rural Appalachia.

“Science educators using an ecojustice framework are ethically committed to strong local-living communities using an approach to knowledge that can be described...as situational, local, and supportive of all living systems.” (Martusewicz, et al 2010 p. 22)

With a lens of critical research, it is possible to examine both the teachers living and working in rural communities, and also their students who are living and learning in these places, to uncover the dominant cultural beliefs circumscribed by rural identity, the political and social implications of teaching for ecojustice, and most importantly, the lessons learned by students and teachers as they examine community-based environmental issues.

Summary

Place is a complex and problematic construction, which has the power to foreground environmental issues or natural science, while erasing social issues from the context. Not only is place troublesome, but it leads to the questions of “whose place?” and “whose definition of place?” and questions the legitimacy of claims to a place through privilege. While place is a human construction, it largely ignores the race, gender, and socioeconomic status of those who construct it and are sustained or co-constructed by it. To approach a study in place-based education without full disclosure of these issues is to walk into a forest without a map or compass.

Critical pedagogy, like place-based education, has the ability to foreground the power of race, socioeconomic status and gender, typically in an urban context. The powerful dialogue that critical pedagogy can produce tends to ignore the environment (as a natural world) and place as they relate to the greater construction of society. It is no surprise that Gruenewald (2003b) titled his paper on critical pedagogy of place, “the best of both worlds”, and brought the two disciplines together into dialogue.

Critical pedagogy of place provides an interesting framework to explore a place-based summer science education program in rural Appalachia. The local environmental context of the region combined with the local social and political economy of the region create an ideal site for exploration of critical pedagogy of place and ecojustice issues. What does a critical pedagogy of place look like in rural Appalachia, and what are the possibilities for teaching critical pedagogy of place and ecojustice education? In Chapter 3, after introducing the research context of the Field School in an industrial town in rural

Appalachia, I will further discuss my research questions and their relationship to critical pedagogy of place.

CHAPTER 3
METHODOLOGY
Research Context

The Field School is a four-week summer program for students living in the Western Appalachian region of Virginia. It began with a summer pilot study in 1983 when The Doctor, a local biology and botany instructor, decided to create a field biology research program for high school students in the area. Over thirty years later, the program continues with the mantra of “learning science by actually doing science” (Field School website, 2018).

The region from which the Field School draws its students is a microcosm of the greater Appalachian region. At the center of the region is the industrial town of Clearview, which has been home to a paper mill since the late 1890’s. While the region relies largely on the paper mill and timber products for its economy, tourism, health care, and education round out the economic activities in the surrounding counties. Like much of Appalachia, Clearview has seen extensive deindustrialization as the mill has merged with other paper conglomerates, job competition and cheaper wood pulp are found overseas, and other light manufacturing jobs have found better economic incentives elsewhere. Downtown Clearview is a verifiable ghost town, with a billowing, never-sleeping giant spinning paper at its center.

Clearview is a compelling research context, as it represents something of an environmental and economic lightning rod for the region. Without the mill, there would be less tax revenue to support schools and other county services. Yet, the mill, even with a generous nod to their environmental efforts, still maintains an environmentally deleterious

presence over the town, watershed, airshed, and viewshed. It is not difficult to theorize the Clearview area as a sacrifice zone, both environmentally and economically. Quoting both Kuletz and O'Connor, Scott states: A sacrifice zone is a place that is written off for environmental destruction in the name of a higher purpose, such as the national interest (Kuletz, 1998).

Although by their very nature environmental hazards defy social and cultural boundaries, environmental exploitation relies on the maintenance of such imaginary firewalls. A system that depends, contradictorily, on the destruction of its own natural basis (O'Connor, 1994) can only survive because those who benefit feel safe from the type of environmental and economic disaster experienced by the poor (Scott, 2010, p.31).

There are numerous sacrifice zones throughout Appalachia, and the rural communities contained in these zones have a wealth of history and lessons learned. These communities also have school systems and teachers who struggle with the economic and environmental realities that exist without and within their classroom walls. This case study of the Field School sought to tell the story of how these instructors and students understand and negotiate not only science, but also the political economies of rural environmental education in Appalachia.

Problem Statement and Research Questions

The curriculum at the Field School is a place-based program that uses scientific inquiry to teach not only science content and process skills, but to link this content to meaningful outdoor experiences in the local community. The extension of these local environmental issues to those of global consequence is important to the instructors of the Field School and is evident in their candid talk about the importance of using local

environmental examples in their instruction. There were numerous topics and opportunities to research at the field school--to closely examine the teachers' use of inquiry and place-based education as a foundation to move towards a critical pedagogy of place, to explore the multiple dimensions of place-based and inquiry-based instruction that exist within a rural environmental education context, and to provide a voice for these teachers to share their experiences from the thirty year history of the program. However, the most compelling reason to continue this study rested in the student experience.

In the second summer of this research study, I focused on student experiences to better understand place-based environmental education in practice, and to investigate how students understand and make connections between local environmental issues and global consequences. As the teachers create the possibility for teaching critical pedagogy of place, do the students understand this same message? What are students learning as result of participating in this program?

The over-arching question of my research study was: how does a Field School in Appalachia use a place-based environmental education approach to teach students about their local community and environmental issues, while also extending their understanding of global environmental issues? Specifically,

- How do teachers use scientific inquiry in the place-based environmental education program?
- What motivations and commitments to place-based education and inquiry shape teacher decisions and instruction?
- How do teachers connect scientific inquiry to local environmental issues, and to global environmental and socioeconomic topics?

- What do students learn in the summer program designed to use scientific inquiry, which may provide opportunities to explore local environmental and social issues?
- How do students connect the scientific inquiry to local environmental issues, and to global environmental issues?
- How do students and teachers reflect on their experiences in this program?

These research questions are visualized in the theoretical diagram presented in Figure 1. The inverted triangle, read from the bottom up, helps visualize how the program uses the practices of scientific inquiry to connect to local environmental issues. Through critical pedagogy of place, these local issues are the bridge to larger, global issues, like climate change. The hierarchy of boxes at right, read from the bottom up, shows the connection of practice from the inverted triangle, to theoretical constructs—scientific inquiry is used in a place-based context to merge content with local knowledge and issues, which can then be extended into critical pedagogy of place.

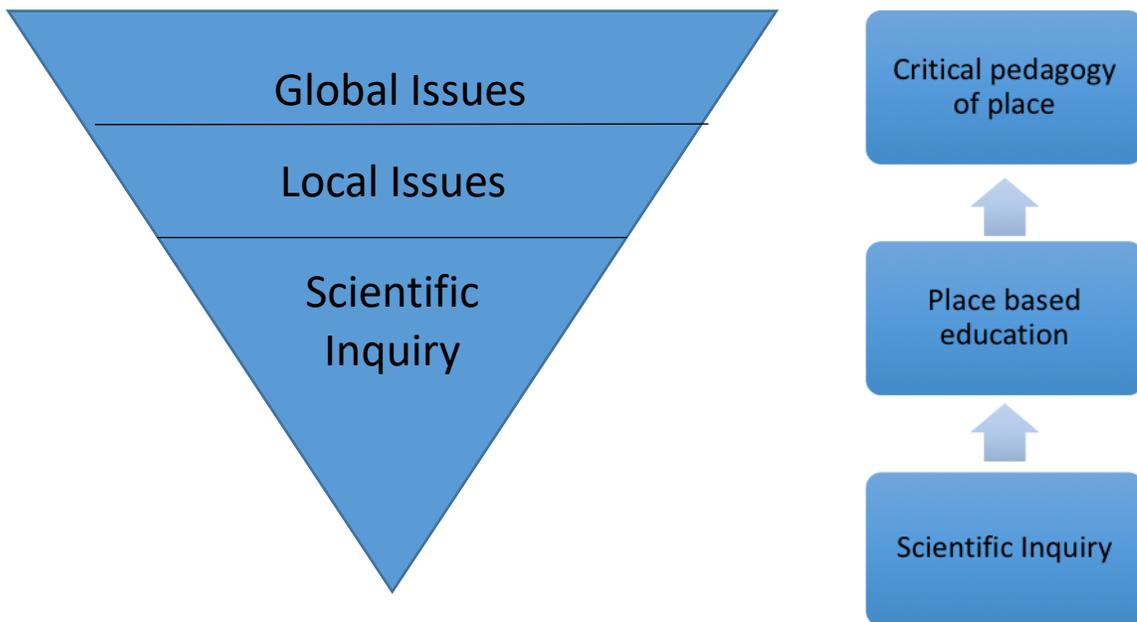


Figure 1. Practice to Theory Diagram

Case Study

The Field School is a clearly bounded context for a case study, as it exists to serve a specific population in a specific area, for a specific time. According to Rossman and Rallis (2012), “case studies are descriptive, holistic, heuristic, (and) inductive.” (p. 103). In this study, I am using an inductive approach through the theoretical lens of critical pedagogy of place in an environmental education program that focuses on scientific inquiry in rural Appalachia.

I used Ethnographic research methods to examine the local context of the Field School, which included the socio-political dimensions of environmental education, and the extension to greater issues surrounding global inequity. As time in the research context was relatively short, I used what Rossman and Rallis (2012) describe as a “mini-ethnography”, which utilizes “the questions and techniques of traditional ethnography”, including but not limited to “observations, formal and informal interviews, interpretation of artifacts, and the researcher’s own experience of events and processes.” (p. 93). Alternatively, this approach allowed me to apply ethnographic methods to a case study, or to present a case study using ethnographic methods of data collection.

There were twenty-three students enrolled in the Field School in the summer of 2014 in addition to two instructors, two mentors, and two additional adult chaperones, who were both educators in local school systems. Student participants were entering either 8th or 9th grade, and had an interest in ecology or biology, based on their accepted applications to the Field School. The teacher participants had a variety of years teaching—the youngest mentor had just finished her first year of teaching, while the two older instructors had 22 and 28 years of teaching secondary and post-secondary classes. The adult chaperones had

also taught for a number of years, 10 and 15, respectively, at the middle school level as well.

Study participants, both teachers and students, were from a six-county district in the western part of Virginia, including three independent towns. The majority of the program takes place in the town of Clearview, a pseudonym for the independent town located in the central county of the six in the service area.

Participant Observer

Mesman (2007) notes two primary types of concerns with participatory observation: Methodologically, “Am I observing the right things?” and ethically, “Am I participating in the right way?”(p. 282). As a participant observer in this program, I observed classroom instruction and discussion, field instruction and discussion, and the interactions between students and teachers. I wrote descriptive field notes, electronically in the classroom, or by hand on backpacking trips, and I conducted interviews of participants throughout the program. I also participated in the backpacking trips as a back-up chaperone, an extra voice of outdoor experience, and as a trained Wilderness First Aid provider. Although I was present during classroom instruction, I took care to not influence classroom instruction or discussion through my own viewpoints.

My connection to this program is not coincidental. I was a participant in the Field School in 1995, as a high school freshman. Throughout my career in environmental science, experiential education, and science education, I have frequently referenced this field experience as the watershed moment of my life. Growing up, leaving, returning, and teaching in the rural service area of the Field School has had a profound influence on my ideals, not only as a teacher and researcher, but environmentally, politically, and

socioculturally. The work that the teachers and mentors do in the Field School is rarely championed, and seldom mentioned, much like the work of teachers in all rural areas. I feel that the least I can do is to understand and share their passion for environmental education, place, and their students, to bring their work to the forefront of rural science education.

Trust, access, and addressing bias

Researcher trustworthiness and access to participants are paramount in educational research (Rossman & Rallis, 2012), particularly involving teachers and their students. As a member of this rural community, I share many common social connections with students' parents, and I was formerly a colleague of one of the participating teachers. In fact, prior to becoming her colleague, one of the teacher participants was my instructor in the Field School program nearly twenty years ago. The teacher participants agreed to continue their participation in my study for a second summer and agreed to let me petition parents to include student data as part of the data set. To engage parent and student trust, in addition to mailed introductory recruitment materials including IRB forms, included in Appendix A, I made a short introductory presentation at the Field School's parent night regarding the nature of my research and was available for questions afterward.

Rossman and Rallis (2012) candidly encourage educational researchers to begin research by "being explicit about their purposes, and by being themselves." (p. 48). As a former student in the Field School program, a former student and teacher in the Field School service area, and an academic researcher interested in transformative rural science education, I have been honest and forthcoming with my frame of reference and my lens of critical pedagogy of place.

Recognizing that reflexivity is paramount in qualitative research (Becker, 1998), I continuously reflected on my experiences as a participant-observer, a former student of the Field School, and as a teacher. My reflexivity informed the semi-structured interviews with teachers and students, and their personal reflections iteratively informed my research and interview questions. Additional artifacts, such as field notes, analytical memos, photographs, digital media, and student work served as triangulation points, in addition to member checking, to minimize bias.

IRB Modifications

In the second year of data collection, I added student data to my collection protocols, including focus group interviews and student work. The fully amended and accepted IRB protocol follows in Appendix A. I made amendments to the original protocol to include student data in the study. The second year of data collection included student focus group interviews, or small group interviews of two to three students, and all student work throughout the course, in addition to teacher participant interviews, participant observations, and curriculum guides. Student work included lab reports, activity sheets, pre- and post-tests, journal entries, digital media, and participant observations.

Due to the protected class of participants, both parental permission (consent) and student assent forms were developed. Copies of both parent consent and student assent forms are provided in Appendix B, along with the teacher consent forms. At the suggestion of the IRB, student participants and their parents had the option of signing these forms electronically through a Qualtrics survey. Parents and students were informed of this option in the introductory letter to parents and students, included in Appendix C.

Additionally, I developed semi-structured interview questions for the student participants that were also approved by the IRB. These questions are discussed further in the following data collection section.

Participants and Sampling

Teacher participants were chosen for this study due to their interest in environmental education, and, in particular, their participation in Field School. The adult volunteers were also teachers in the surrounding school divisions, who chose to join the Field School as extra chaperones on their backpacking and camping trips. They were considered teacher participants, although their instruction was limited to field trip supervision.

Student participants were chosen for this study based on their application and acceptance to the Field School program for the 2014 session. Student assent and parent consent were ascertained prior to any data collection, and student participation in the study did not preclude their participation in the Field School curriculum. There were 23 potential student participants enrolled in the Field School program for the 2014 session. The potential student participant pool included all of the students for the program, because they were selected to attend the Field School. As this was a case study, while it would have been optimal to enroll all 23 students into the study, a group of 6-10 were sufficient to examine the student experience in the program.

The Field School program was open to 8th, 9th, and 10th grade students in the service district, and was offered as a supplemental enrichment program for any student interested in applying. Each school division handled a share of the program fees, with the community college picking up the balance of the expenses for students. Participants were

expected to work with their local school districts to obtain transportation to and from the program and are expected to furnish their own meals during the program.

The Summer 2014 Field School used a different format than in 2013, with two two-week sessions. The first session in 2014 included 16 students—10 girls and 6 boys. From the first session, four girls and three boys participated in the study. The second session included 15 students—7 girls and 8 boys. Five girls and three boys participated in the study. Thirteen students attended both sessions of the Field School, while three only participated in the first session, and two only participated in the second.

The student participants were a representative sub-section of the regional schools in the service district. The majority of students in the region are white, which was reflected in the student participants of the Field School, although two students identified as African American and one identified as Asian on their student application. Socioeconomic status data was not readily available, but as a former teacher in the region, my impressions of the student participants were that they represented the diverse socioeconomic realities of the area.

In this study, I will report on three instructors at the field school, and three student participants. The instructional staff at the Field School are Regina, Aster, Desmon, and The Doctor. The Doctor was the founder of the program and taught the summer program for nearly 25 years before retiring. Regina, a pseudonym derived from the Virginian queen snake, *Regina septemvittata*, joined the Doctor in the second year of the program as an instructor and has worked with the program for over 30 years. Aster, a pseudonym derived from the genus of flowering plants *Asteraceae*, joined the instructional staff when The Doctor retired, and is the co-director of the Field School with Regina. Desmon, a

pseudonym derived from the lungless genus of salamanders *Desmognathus*, was a student in the program in the early 90's, a college mentor-aid to the program, and later an instructor and curriculum writer for the program. Their words come from lengthy interviews over the course of two summers of field research with the program. Like Desmon, I was also a student in the program in the early 90's, although I never returned as an assistant or instructor.

During the Field School program in 2014, I interviewed a number of students throughout the program, individually and in small groups, and collected their field journal writings. Of the students I interviewed, a few stood out for their candor and interest in the program, Cy, Meg, Luna, and Daisy. Their pseudonyms are as follows: Cy, short for the constellation Cygnus, Meg, short for the extinct Megalodon shark species, Luna, a Latin derivation of the Moon, and Daisy, from the eponymous wildflower.

Data Collection

The data collected for this study were split into two different sections, based on student and teacher participants. Including student data and teacher data allowed me to triangulate these data among participants, and among my own observations. The data were collected during both intensive two-week courses, starting on June 16th, and ending on July 9th. This study included four field trips, two of which were multi-day backpacking trips, and the remainder of the program as 9-hour days in the classroom laboratory for instruction, assessment, and student lab work. The program timeline, including post-assessments and follow-up interviews follows in Figure 2.

Summer 2013 Study	Summer 2014 June 16-27	Summer 2014 June 30-July 9	Fall 2014-2016	Fall 2016-2018
<ul style="list-style-type: none"> •Teacher Interviews •Program Observations •Curriculum Guide collection •Follow-up interviews •Preliminary analysis and thematic code generation 	<ul style="list-style-type: none"> •Teacher/student interviews •Curriculum Guide collection •Student pre-assessments •Student/teacher observation •Salamander study observations 	<ul style="list-style-type: none"> •Teacher/student interviews •Student artifact collection •Student/teacher observations •Forest biodiversity study observations •Student post-tests 	<ul style="list-style-type: none"> •Follow up interviews with students and teachers •Teacher results from pre and post assessment instruments •Preliminary data analysis/reporting for member-checking 	<ul style="list-style-type: none"> •Interview transcriptions •Data analysis and iterative coding

Figure 2: Research Timeline

Data collected from teacher participants included course documents, curriculum guides, assessments, and supporting course information. Teachers agreed to three semi-structured interviews (Seidman, 2006), to be conducted throughout the program in 2014, and were very candid in their responses during the pilot study. The questions for the three semi-structured interviews are outlined in Table 2, and were designed to occur at the start, middle, and end of the program.

Table 2. Teacher Interview Questions

Interview 1	Interview 2	Interview 3
<p>How long have you been teaching your subject area? How long at this school?</p> <p>How did you end up in this area? How long have you lived here?</p> <p>Tell me about your teaching history—why did you decide to become a teacher?</p> <p>What drew you to science education?</p> <p>Tell me about your history with the Field School. How did you first get involved? What parts of the program do you feel are most important? What are your favorite to teach?</p>	<p>Going back to the Field School curriculum, describe the activities you incorporate in your lessons. How do your students respond?</p> <p>How do you teach resource conservation—what viewpoint do you take, and how do you identify this for your students?</p> <p>How does this curriculum relate to state (and national) standards?</p> <p>When teaching conservation of resources, do local environmental issues every come up without your mentioning them?</p>	<p>What challenges do you see in this community (environmental, economic, social, etc.)?</p> <p>Tell me about your environmental philosophy—how did you first become informed about environmental issues? Do you think this is evident in your teaching?</p> <p>What do you hope your students take away from their experiences here?</p> <p>What is your projection for the future of the Field School? Where would you like to see this program in another thirty years?</p>

Student data included pre- and post-tests used by the program to assess learning during the course, laboratory reports, journal entries, and other coursework assigned by the instructors. Additionally, student focus groups of two to three participants were used for three student interview sessions (Seidman, 2006). The use of focus groups was largely for convenience, as down time during the program was limited, and the largest number of participating students could be sampled. However, working with small groups of students encourages participation, and allows for students to listen to other views, and to talk through their own opinions (Rossman & Rallis, 2012).

Three sets of semi-structured interview questions were developed for the student focus groups and are listed below in Table 3. These questions were designed to explore what students are learning in the program, and to understand what connections they make to local and global environmental issues. The three interviews were designed to take place during the first two days of the program, after the salamander study and before or during the forest biodiversity study.

Table 3. Student Interview Questions

Interview 1	Interview 2	Interview 3
Why did you choose to attend the Summer Governor's School program?	Tell me about your experiences during the camping trip.	What do you hope to learn during the forest biodiversity study?
What do you hope to learn while you are here?	What have you learned about scientific inquiry?	Tell me about what you've learned about local ecosystems, and how these are influenced by global issues. (Or, tell me about global environmental issues and how these influence local ecosystems)
What is the activity you're looking forward to the most? Why?	What did you learn during the Salamander Study?	
What kind of activities do you enjoy outside?	How do you think this study might connect to the local environment?	How might this program help you in your future academic

	<p>What surprised you the most about the camping trip and the data you collected?</p>	<p>studies?</p> <p>Is science (this type of science—field studies) different or similar to what you expected it to be? (How does this compare to the way you’ve learned science before?)</p>
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Additional data sources included my field notes, analytical memos, and digital photography to augment and triangulate student and teacher data. Field notes were typed electronically during classroom instruction, hand-written during backpacking trips, and were used to “mediate between lived experience and ethnography” (Goodall, 2000, p. 87). Analytical memos were written periodically throughout data collection, as potential themes emerge from the data, connecting practice to theory, or vice-versa (Rossman & Rallis, 2012).

Data Analysis

Participant interview data were digitally recorded, transcribed into Microsoft Word, and coded using analytical software suite Dedoose. Using open coding (Strauss & Corbin, 1998), major themes were identified, and cross-referenced with field notes and reflexive participant journal entries. As themes emerged, member checking was used to validate themes, and to encourage participant reflexivity. Table 4 lists the research questions related to codes and data sources.

Table 4. Research Questions, Codes, and Data Sources

Research Question	Categories	Subcategories	Evidence/Data
What does a place-based environmental education program, designed to use scientific inquiry, look like in rural Appalachia?	Place	<ul style="list-style-type: none"> • What is place? • Ways we connect to place/nature • What it means to be rural/from here • Challenges to living/being here • Benefits to living/being here 	<ul style="list-style-type: none"> • Teacher interviews, • curriculum guides • Field notes • Photography
How do teachers use scientific inquiry in the place-based environmental education program?	Science Content/Inquiry	<ul style="list-style-type: none"> • How we do science • Science is • Biology/ecology content • Local Knowledge • Global Connections • Salamanders 	<ul style="list-style-type: none"> • Participant observations, • Teacher interviews • Curriculum guides • Photography
What motivations and commitments to place-based education and inquiry shape teacher decisions and instruction?	Environmental Stewardship	<ul style="list-style-type: none"> • Local actions • Environmental Issues • Importance of resources • Human effects on the environment 	<ul style="list-style-type: none"> • Teacher interviews
How do teachers connect scientific inquiry to local environmental issues, and to global environmental and socioeconomic topics?	Science Content/Inquiry	<ul style="list-style-type: none"> • How we do science • Science is... • Biology/ecology content • Local Knowledge • Global Connections • Salamanders 	<ul style="list-style-type: none"> • Teacher interviews • Curriculum guides • Student journal entries • Field notes
	Environmental Stewardship	<ul style="list-style-type: none"> • Local actions • Global Consequences • Importance of resources • Political positions • Human effects on the environment 	
What do students learn in the summer program designed to use scientific inquiry, which may provide opportunities to explore local environmental and social issues?	“Science is...”	<ul style="list-style-type: none"> • What scientists do • Citizen Science • I learned... • I can... 	<ul style="list-style-type: none"> • Student journal entries, • Lab work and activity sheets • Student focus group interviews • Participant observations
	Science Content/Inquiry	<ul style="list-style-type: none"> • How we do science • Biology/ecology content • Local Knowledge • Global Connections 	
	Outdoor Experiences	<ul style="list-style-type: none"> • Skill building • Real-world application of science • What is Nature? 	
How do students connect the scientific inquiry to local environmental issues, and to global environmental issues?	Environmental stewardship	<ul style="list-style-type: none"> • Local actions • Global Consequences • Importance of resources • Human effects on the environment 	<ul style="list-style-type: none"> • Student journal entries • Student focus group interviews
How do students and teachers reflect on their experiences in this program?	Place	<ul style="list-style-type: none"> • What is place? • Ways we connect to place/nature • What it means to be rural/from here • Challenges to living/being here • Benefits to living/being here 	<ul style="list-style-type: none"> • Participant interviews • Participant observations • Student journal

	Socioeconomic Imperatives	<ul style="list-style-type: none"> • Education for jobs • Economic challenges • Industry vs Environment 	entries
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Data analysis yielded four story lines nestled under the over-arching concept of place. These themes were as follows: Theme 1, for over three decades, an innovative science education program taught inquiry-based science through outdoor field research in a rural area with changing socioeconomic conditions. Theme 2, personal experiences as a student in this program led me to understand place and science through a lens of environmental stewardship. Theme 3, Economic challenges in rural areas have implications far beyond unemployment statistics, including environmental and educational dimensions. Theme 4, students make interesting personal connections to science, place, and environmental stewardship by participating in scientific inquiry in the field. The table below summarizes the connection to the categories from the coding chart.

Table 5. Summary of Themes and Categories

1. For over three decades, an innovative science education program taught inquiry-based science through outdoor field research in a rural area with changing socioeconomic conditions.	Science Content/Inquiry Outdoor Experiences Place Socioeconomic Imperatives
2. Personal experiences as a student in this program led me to understand place and science through a lens of environmental stewardship.	Environmental stewardship Place Science Content/Inquiry “Science is”
3. Economic challenges in rural areas have implications far beyond unemployment statistics, including environmental and educational dimensions.	Place Socioeconomic Imperatives
4. Students make interesting personal connections to science, place, and environmental stewardship by participating in scientific inquiry in the field.	Environmental stewardship Place Science Content/Inquiry “Science is”

The Appalachian region has a rich storytelling history, and based on evidence and interpretation, four particular storylines developed throughout the data analysis, from the

four themes. In the interest of “telling the story” I will present these findings in four vignettes, not unlike how Hass and Natchigal (1998) presented their findings of place in education and the environment.

Chapter 4 begins with a review the history of the program and how the curriculum has evolved over the last 30 years. Chapter 5 is a personal vignette about my own experiences with the program, growing as a scientist as a result of those experiences, and reflecting on my position as a researcher within the program. Chapter 6 outlines the economic and educational challenges in the community that were revealed during the course of my research, as the Field School, formerly a much-sought-after program, struggled to attract students. In Chapter 7, I share student data collected during the salamander study portion of the program—their reactions to the curriculum, the field studies, and the program in general. Student experience in the program is an important lens into understanding why this program has been so successful in the past three decades, and to understand what students are taking away from the program. The data includes interviews with instructors and students, curriculum guides supplied by the program, student journals, and field notes.

As a participant in my own research (Ellis, 2004) in addition to my own memory, I was aided by my own field notes from 1995 when I studied field biology at the Field School. My essay is pulled apart from the student responses as the project that was most transformative for me was a different study than what the students now complete—however, both are compelling in their own ways. The presentation of these essays is intended to flow chronologically—from the botanical beginnings of the Field School, its foundational curriculum, my experience as a student in the 10th year of the program, to the

current context of the Field School—its challenges, curriculum, and current student perspectives.

CHAPTER 4

THE HISTORY OF THE PROGRAM

The first summer of the Field School was in 1985. The Doctor, as he was widely known, was a biology and botany instructor at the local community college and saw an opportunity to engage local students in his field work. Having completed his Ph.D. in botany from A Commonwealth University in the mid 70's, The Doctor wanted to provide students with an opportunity to participate in scientific studies, to learn about the local forest ecosystems, and to assist in his ongoing forestry research. Twenty students joined the program that inaugural summer and participated in what would become the hallmark of the program—a forest ecotone study in southern Appalachian mixed-deciduous hardwood forests. Students also collected field data in different regional ecosystems, including the southernmost natural cranberry bog, vernal pools, and shale barrens. Students went on overnight camping trips and backpacked for a few miles to study botanical changes in elevations. They set up their own tents, learned to cook food on camp stoves, and were introduced to scientific botanical sampling protocols. They created their own pressed leaf collections and co-authored a short paper on their studies. They also received six hours of college credit in field biology for their participation in the time-intensive, three-week course.

Regina joined the program in the second year, when The Doctor was still running the program alone. At that point, there were only two adults for the 20 students, and all the material was graded for college credit. Because of the academic rigor needed to successfully complete the course for college credit, students were admitted to the program with a letter of recommendation from a teacher or guidance counselor, as well as a

transcript of their academic record and an application essay written by the student. Gifted and Talented programs weren't abundant in the early 80's, and there was never an emphasis on standardized test scores for entrance into the program. However, to complete the course for college credit at the community college level, students needed to be up for the challenge. That challenge extended to both The Doctor and Regina, because of the sheer volume of grading to complete. Regina explained:

So, we used to grade [student work] at one point, and The Doctor and I both hated that, and I mean, A, B, C, D, F, graded. It was terrible. Five to seven assignments a day, for twenty kids? To turn around for grading the next day, after a 9 or 10 hour day in the field? I'm glad we're beyond that. But like I used to tell the kids, The Doctor is a botanist, whose PhD was in Botany, and so, the program was solely plant research for many years.

In fact, as Regina said, for the first twelve years of the program, the field work was largely botanical. In the early 1990's, The Doctor and Regina worked with some field scientists from Commonwealth University and the Department of Natural Resources to incorporate "animals" into the curriculum. These included salamanders and aquatic macroinvertebrates, not typical "animals" one would think of, but amphibians and insects with interesting ecological habitats in the area. As Aster recalls,

The salamander study came about before my time. And that happened because the kids said, "We want to do something with animals," So Regina and The Doctor found some folks to help out and worked up this salamander study.

The salamander study started in 1993, as a collaboration between Commonwealth University, The Department of Natural Resources, and The Forestry Service. The

scientists involved in the project created a scientific sampling protocol, discussed in further detail in the curriculum section, and designated a tract of land in a designated wilderness area to sample the population of salamanders at various elevations. The collaboration lasted for nine years with three specific trails sampled in three-year cycles. As Aster describes the partnership;

When we finished nine years all together, each trail three times, the Forestry Service said, 'We're done. You can continue it but we think we've established what we needed to establish with this', and bowed out. So that's when we decided that we were never going to do Timber Ridge again because it's not a maintained trail. And so we alternate between Maple Run and Gum Spring Run. It's nice to do a loop instead of going up and down the same trail four times. And we're still getting data and comparing the same trail each year is an interesting thing to do.

The salamander study is a hallmark of the program, as they've continued this longitudinal analysis of salamander populations for nearly 25 years, even after the Forestry Service no longer needed the information. By maintaining this longitudinal data set for this long, Regina and Aster find the comparison to be an interesting scientific endeavor for the students and for their own curiosity.

There have been other additions to the program, although not so long-lived as the salamander study. In 1992, they incorporated aquatic macroinvertebrate studies into the curriculum, as part of a water quality unit, and for a few years, they even made a trip out to the Eastern Shore of Virginia to study wetland ecology. In 2014, Aster described the three-week program as a miniature field study experience.

Basically, we have three big studies that kind of make the focus of three different weeks--the salamander study, the forestry study, and the aquatic study. It covers a wide variety of field experiences. So it's a nice variety, gets you outdoors, but it has evolved the years. There are times when we've done some caving, that was—the kids enjoyed it but we got a lot of grief about the mess [laughter].

Critical thinking skills have always been a hallmark of the program, as The Doctor wanted to create a challenging and intellectual program for students. However, as Regina and The Doctor moved away from graded exercises, they needed a different way to assess student understanding. For many years, there were daily curriculum pages that students completed in their three-ring binders. There were open-ended questions, brainteasers, and critical thinking exercises that students were expected to complete each day. Every two days, the binders were collected for a check by The Doctor and Regina, then later Aster and Regina, and they would personally respond to queries in the binders—thanking students for sharing an interesting perspective, questioning a statement for further clarification, or offering an anecdote related to the writing. As the program evolved, so did the formative assessments. Aster describes the advent of the journaling section:

The journal, which I really love, is—that's 100% Desmon. He developed that. The original journal was incorporated into those day sheets. There was always some place on those daily sheets you had to write something. And Desmon said, “Why don't we take that out completely and just put it into a journal?” And then he presented this gorgeous product.

The journal has become as much a hallmark of the program as the salamander study and will be discussed in further detail in the curriculum section.

While Regina, Aster, and Desmon pride themselves on the low-technology field school experience they've maintained after The Doctor's initial program, they have been flexible in allowing the program to evolve over the decades. From the straight plant-based curriculum to a program that involved salamanders, aquatic insects, cave ecology, and even beach ecosystems, their flexibility in planning field experiences to meet the needs and interests of their students is impressive. With declining student numbers, Regina and Aster decided to change the format from the three-week program to two eight-day sessions, with Fridays free, allowing for three-day weekends.

Regina, Aster, and Desmon hoped that by splitting the commitment into two parts, where a student could participate for two weeks or four weeks (with three-day weekends), they could enroll more students into the program while still maintaining the integrity of the field studies. In reflecting on changing the program format, Regina said;

Nothing would please me more than to think that this program went on for years and years and years, you know. I just think I would just... [long pause]. Aster feels the same way. I bet that emotionally, she's at the same place I am as far as continuing the program in his honor. We feel such a loyalty to it on so many levels. You know, it's The Doctor, but it goes beyond that because we have so many years invested. And to think that it would continue, even though it would change, I mean, we get that—but that would be just be the greatest.

The Doctor passed away in 2009 from complications due to cancer. In the absence of The Doctor's leadership, Regina and Aster have both openly worried about protecting his program, honoring his legacy, and continuing to inspire new generations of students to explore the natural world around them, to advocate for science, and to become community

leaders. They are concerned that because they aren't the Doctor, don't necessarily have his academic background and connections, and aren't drawing the number of students they once did, that they've somehow failed to uphold his program in the way he would have wanted. Desmon disagrees with this sentiment and believes the work they've done for the program is exactly what the Doctor would have suggested.

And, you know, Regina a lot of times says that The Doctor would be rolling over in his grave if he knew [about the changes to the program] but knowing the Doctor, I'm not sure that he would. I think he would approve of the direction that the program is going because he understood that time has changed. My gosh, he lived in the '60s, you know. I mean he saw that, with his career, he saw tremendous shifts and I think he would feel the same way that I do. That, yeah, you're losing the caliber—I know he wouldn't want the caliber of the program to be diminished by the caliber of student that we were getting, but if we...could change the program and still get to meet society's needs and to go into the direction of where science and technology are going and still get that caliber, I think we'd have a perfect program, and I think he would approve.

As previously discussed, the curriculum of the Field School has changed over time, but there are many commonalities across the years. For the case study of this program, I examined the curricular materials from the summers of 2013 and 2014, with the majority of the curriculum reviewed, including student data, in 2014. Specifically, I examined the program as two distinctive units of study, salamanders and forestry, and examined the materials used in each unit of the program.

While the curriculum and scientific studies have remained stable, the political implications for teaching ecology and conservation have become more visible in the community. The instructional staff have always focused on the science of conservation and management of resources, due to the hunting culture and conspicuous paper mill in the community, and in 2013 and 2014 there was significant discussion at the state level about allowing fracking in the local national forests. Also, Regina and Aster felt that it was important to help students understand the implications of climate change on an individual level. As Regina describes it,

Now, as far as relating to topics like fracking and like climate change, that's come about relatively recently, you know that was not historically part of the curriculum. But I want to get students thinking about--I think the impact that a single person can make both positively and negatively, but especially in a positive way. And just the idea that what we do impacts so much more than, you know, in our family or even in our community that they can have global ramifications-- I think that's important. And I hope that they see that. You know we start with day one with interconnectedness and I guess if I were to think about the most important thing about the curriculum...it would be getting people to understand interconnectedness.

The Native Americans just naturally got it. And we've lost that.

Interconnectedness is an important theme within the curriculum that has spanned three decades of the program, and it's illustrated through the ecological quotes in the student handbooks, class discussions, field work, and the student journal.

While the journal as a separate entity has only existed for 10 years, these critical thinking and situational writing prompts existed in the early program days in the daily

activity sheets that students were given as the program progressed. This opportunity for guided reflection, in conjunction with critical readings, scientific field studies, class lectures, and group discussions, has formed the structure of the Field School since its creation in 1985.

CHAPTER 5

A RIVER USED TO RUN THROUGH IT

Midway through our interview session, Regina paused over the bottle of wine we were enjoying on her front porch and asked, “You were one of ours. Do you really think your attendance at the Field School is the reason you’re where you are?” I pondered for a minute. “It’s not the only reason.” “Right,” Regina said. “But it’s a pretty big reason,” I replied.

When I began writing this essay, I was dumbstruck by the analysis I kept seeing in my interviews about the economic and educational hopelessness of my hometown. In my time growing up there, in my time teaching there, and in my time embedded in research there, it never felt as downcast and dire as it did when I was analyzing participant interviews and reviewing my field notes. This is not the story that I wanted to tell.

The story I wanted to tell you was about a child, who may have been bright or just particularly well-behaved, who asked to go to a summer program about Field Ecology not too far from her home in a rural part of Western Virginia. This child liked school, performed well in nearly all of her classes, and never doubted that she would go to college somewhere. She liked science, but her parents were administrators in the school system—one had taught remedial reading before moving to a role in the central office, while the other had taught elementary math and social studies before assuming the role of elementary school principal. At that time in her life, science was about reading, worksheets, memorizing bits and pieces of information, maybe an “experiment” involving vinegar and baking soda. But she liked being outside, and relished the time spent in the summer evenings finding owl pellets, unusual rocks, used bird nests, and snake skins to make her

own natural history museum. She loved playing in the creek, using plant material to create different types of boats and rafts, watching as they swiftly navigated the riffles or succumbed to the eddies along the banks.

When I asked my parents to attend the Field School, I wanted to go because I was a product of my own intellectual boredom. There are only so many days in a summer that you can go to the county pool or local library. My usual summer reading would average 3-4 Agatha Christie books a week, by the time I was in 8th grade, often more. This program was kind of a big deal, locally—the news paper photographer would come to school, take your picture, and write an article about how you’d be attending the Field School with 18 other students from the surrounding schools. You had to write an application essay, have teacher recommendations, and in the 1990’s you’d also get college credit from the community college.

I liked science, but I was apprehensive about it because I didn’t feel very confident in math, and I knew there was a lot of math in science—or at least, that’s what I thought as a 13 year old. When I applied to the Field School, I knew I had some competition from my classmates, but they all ended up deciding not to go, so I was the lone representative from my school that summer. The possibilities were endless—a group of new peers who don’t know me, my family, my friends, my teachers? For a nerdy kid, it was an amazing opportunity to be intelligent--to be myself in an authentic way that I had never been able to.

The italicized sections that follow are memories that have crystallized in my mind, that I feel were instrumental in my personal and professional development—but I certainly couldn’t have known that at the time. Written in the style of autoethnographic “epiphanies”

(Bochner & Ellis, 1992) aided by my own journal entries from that time, I tell my story of learning science and becoming myself at the Field School. My experiences as both a student and participant observer with the Field School position me as a knowing other—an individual with the ability to understand the Field School, its curriculum, and its social, political, and ecological context, from the inside out.

Walking into the building on the first day of the program—it was my first time on the campus at the community college that housed the Field School. I checked my backpack for my lunch, and walked towards the low-slung brick edifice, surrounded by pin oaks and bushy hosta. We were having class on the second floor, in The Doctor’s biology lab—it was easy to find because of all The Far Side cartoons taped to the door and walls. I read The Far Side in the comics, and I thought some of them were funny, but I didn’t always get all of the jokes. It was the first time I’d ever seen proper lab benches. Long and shiny black with fluorescent lighting above the benches, and silver gas jets outlining the end caps. We were all welcomed into the lab by The Doctor, wearing a white lab coat, to find a squeaky adjustable lab chair to call our own, and sat down to a white binder with a drawing of a salamander on the cover.

Prior to my summer at the Field School, science was sitting through a lecture, taking notes, and if we were lucky in class, doing a cookbook experiment that strictly followed “the scientific method”. I was always frustrated by having to create a hypothesis about a lab before we did anything—it seemed unfair to have to guess at an outcome when so many things could go wrong to make that hypothesis incorrect. This was before the era of explicitly teaching the Nature of Science, and my experience as a good student meant

that being wrong was a very bad thing. While I may not have been good at prognosticating correct hypotheses, I was pretty good at memorizing information, so tests were usually very easy for me, if not somewhat high-stress from the memorization process.

The Field School was immediately different from my prior experiences with science. While we were using worksheets in our field notebooks for data collection, we were given background information about the study we were doing and encouraged to ask questions in our journals—what are the effects of weather on a stand of trees on a mountain top shale barren? Why are there fewer tree species at higher elevations? How can we compare growth patterns between two trees? These questions helped us frame the studies we completed at the Field School. We didn't "guess" any hypotheses, and most importantly, I didn't have to memorize anything for a paper test. Our assessments were tied to our field work, from learning to identify trees by leaf patterns, identifying salamanders by sight, or using a dichotomous key to identify aquatic insects.

We sat at the lab benches, each with our own stereoscope. I hadn't learned many microscope skills because I hadn't taken biology yet and trying to focus the eyepieces on the tiny macroinvertebrate made me anxious. The two researchers from Commonwealth College plopped a specimen into the petri dish on the microscope stage. They had glass mason jars full of aquatic insects in alcohol and were using forceps to fish out individual insects for us to identify using the dichotomous key we'd been given. The key was to order-level, and it only had two pages of branches, but it was overwhelming because of all the new words—stubby or fleshy prolegs? Caudal filaments? Bushy gills, extendable labium, elytron? There were figures and diagrams, but with my microscope slightly out of focus, it

made it hard to tell if what I was looking at was the same thing as the key. But, wait—I guessed Ephemeroptera on my sample and I was right! Because this one has three tails—that means it’s a mayfly! This one looks like it has hairy armpits—oh, that’s what a bushy gill looks like! That one must be a stonefly—I mean, Plecoptera!

Nearly 8 years later, while studying aquatic entomology as an undergraduate, by odd luck, my lab instructor was the same researcher who taught our macroinvertebrate class at the Field School. I often thought back to that first bug identification experience while I sat in my college Entomology lab, peering into my stereoscope, alcohol sublimating from sample jars, identifying insects to family and genus level with a 1158 page dichotomous key for my final insect collection. The confidence I felt in sight macroinvertebrate insect order identification was tremendous—it made separating my collection by order a quick process, and in field sampling, I only collected the insect families I needed, sparing many specimens an alcohol-soaked fate. Confidence goes a long way in science.

The cool 73-degree water rushes past my legs as I stand with a partner holding a meter-wide seine net in a particularly vigorous riffle on the Jackson River. Our third partner had measured the meter sampling area above the net, and we proceed to do the “macroinvertebrate shuffle” with our feet, picking up larger stones and running our hands across them in the current. The sediment we’ve kicked up spreads downstream where two other teams are sampling at different intervals in the riffles. The cigar-chewing researcher from Commonwealth College calls time, and we pull our nets out of the water and head to shore. With tweezers and ice

cube trays, we sift through the leaf detritus (a new word for insect habitat we learned) carefully separating tiny insects from the net and placing them into the wells of the ice cube trays. We excitedly pull a three-inch long hellgrammite from the net and ceremoniously place it in its own well. After a few more minutes examining the net, we wade back to the riffles to wash the remaining sediment and detritus out of the net. I've been tubing on this river before, but this is more fun, seeing stuff I never knew existed below the water. I just figured there were some kind of aquatic spiders that made the sediment filled nets I saw on the rocks, but they're actually a kind of Trichoptera, called a net-spinning caddisfly, and they use the nets as their homes and to catch food! We get back to the ice cube trays on the bank and discover that the huge hellgrammite we caught has escaped its ice cube well and has eaten almost half of the specimens in the tray! The researcher laughs at our bewilderment, tells us that the hellgrammite is big enough to eat a trout, and we head back to the riffles to collect another sample set, to be safe.

In our course binder, each daily sheet listed the objectives of the day, activities, and any necessary reminders for the next day. There were inspirational or environmental quotes, a section for weather observations that had to be completed each day to receive credit, “did you know?” factoids about environmental issues, environmental conservation tips, and “career of the day”. The careers were especially fascinating. On day 4-5 in my binder, the following careers were highlighted.

INVERTEBRATE ZOOLOGISTS—They are biologists who specialize in animals lacking a backbone. When studying the quality of a water system, pollution may be detected by the types of aquatic invertebrates that flourish in the water.

ANIMAL BEHAVIORISTS—They are biologists who study the behavior of animals. Behavior can help in understanding how organisms function.

Behaviorists also help zoologists create the best living environments for animals at zoos.

These are two of the thirteen different careers highlighted in the daily pages. I didn't always want to be a scientist, as evidenced in my journal here from the Field School, but I also never knew that there were people who could write about science and help disseminate scientific information to people through publications, or that there were park interpreters who worked for the National Parks Service to teach people about the world around them. The notion that there were so many careers in biology that weren't just...biology...was unbelievable to my 13 year old mind. People can make a living playing in streams and counting insects!

Our macroinvertebrate study was a comparative study above and below a local dam on a valuable trout fishing and recreation river. This particular dam was built as part of a flood control plan that included creating a recreational lake as well. It was completed in 1979, while the pumped storage hydroelectric plant was being built on a tributary upstream. The dam was designed as an underflow dam, where the water is released from below the surface of the lake, where the water temperatures are typically much colder, but also fairly stationary. The only consequence of this information was on hot days, it was better to swim below the dam, where the water was guaranteed to be ice cold.

When I asked Regina about the written report for this particular study, she said The Doctor didn't want to create a document that indicated the comparison of taxa above and below the dam, as he didn't want to get into local political issues. The dam wasn't going

anywhere soon, it was beneficial to the paper mill about 40 miles south on the river and had created a lot of tourism in the area for trout fishing and recreational boating. This is the same reason that Regina and Aster, for many years, completed a comparative macroinvertebrate study above and below the local paper mill—they didn't want to get too involved in local political issues, and it highlighted how far the mill had come in its efforts to remediate the effluent it was adding back into the river. If anything, it was a good example of how a corporation was actually taking steps to mitigate its effect on the local environment.

But our macroinvertebrate study didn't have such a rosy outcome. From my journal entries, in 1995:

Describe how we studied water quality in the Jackson River. What were the obvious differences (if any) in water and biota above and below the lake?

We studied the water quality with pH tests, a colorimeter, and some other tests. The colorimeter had to do with color and particles in the water. The pH test told us whether or not the water was neutral, base, or acidic. We also did tests on dissolved oxygen and CO₂. There were MAJOR differences between the two sites. Above the dam there was more diversity and the water was much warmer. Below the dam there was only one family that made up 99.9% of the taxa in the area—black fly larvae, I believe. We did find two green crawly things. The water was much colder below the dam also.

What results were you most surprised with? Why?

I wasn't really surprised with the results, although, I didn't think it was possible for so many little things (or critters if you will...) lived in a single square meter. Doing

this experiment has given me a new outlook on the dam. I never realized the implications that structure could make until now. I don't think now that they should have built it. Sure, it's good for the mill and fishermen (oops, Anglers...) and maybe some recreation, but is it worth altering a system like that? I was surprised by the diversity below the dam. I expected a FEW more bugs other than [black fly] larvae.

Looking back at this particular study, I can see that we were using a modified version of the Save Our Streams protocol, one that I've used many times since in teaching about stream ecology. We were collecting our data in simplified EPT tables—that is, counting the number of sensitive species, Ephemeroptera, Plecoptera, Trichoptera, along with Coleoptera, right-handed snails, and hellgrammites. We also tallied the crustaceans (sow bugs, crayfish and scuds), Megalopterans and Odonatas that were slightly more tolerant, and the most tolerant orders—Diptera and left-handed snails. Without the data tables we created in 1995, I can only summarize my remembrances. Above the dam, the water was about 65F, with moderate tree cover—about 60-75%. The sediment load was excellent—it was easy to see the rocks in the stream bed, and the pH was slightly acidic as you'd expect a river running through limestone to be. Below the dam, these parameters were largely unchanged. The sediment load was excellent, as was the pH, and the tree cover was similar. The water from the underflow of the dam, however, was probably 55F or lower, due to the colder water temperatures at the bottom of the lake.

We had learned some basics about water quality and understood that cooler water allowed for more oxygen to be dissolved as it passed through riffles. That was a big reason why tree cover was so important on a river—because it kept the water temperature lower

and provided leaf litter (detritus) for the macroinvertebrates that subsisted on plant matter. As our teams stepped into the cold waters below the dam, the last thing we expected were nets full of one single species—black fly larvae. As a nascent scientist and environmentalist, I knew that diversity was an important aspect of ecological health, and here we stood, pulling hundreds of black fly larvae out of our nets—no other species, except two mysterious green things that were probably terrestrial inch worms, to be found.

Trout fishing is a high tourist commodity in my hometown. Because the Commonwealth of Virginia recognizes King's Grant ownership of rivers in our corner of the state, it basically means you need to have the landowner's permission to fish in the river. There aren't many places in my hometown that are open to the public—you literally have to know someone to find the best fly fishing on our rivers. The exception, of course, is right below the dam. As the water flows through the underflow dam, it enters a steep riffle bed with rip-rap and boulders on the edges of the river to lessen erosion when the dam releases excess water. This chilly water, newly re-oxygenated, topples downhill through a few still eddies and pools where it becomes the perfect habitat for native trout and the stock from the local trout hatcheries.

Trout love cold water. Their diet consists of any aquatic insect they can fit in their mouths, which makes them particularly susceptible to the expertly tied lures of local fishermen. While they'll try to eat just about anything, they do love black fly larvae. The Virginia Department of Game and Inland Fisheries website boasts wild rainbow trout and brown trout populations below the dam, as well as several species of bass (DGIF website). As a budding environmentalist, I struggled to understand how putting a dam on a perfectly good trout stream with the purpose of creating flood control and recreation was worth the

environmental cost of water degradation downstream—especially when that water eventually flowed to the intake at the paper mill, where it was further degraded both chemically and thermally.

This was my ecological allegory. On this tiny river in the mountains of western Virginia, I learned about biodiversity from tiny bugs living in the cobbles and riffles. I learned what good water quality looks like and what good habitat can support, from the complex food webs of aquatic systems to the greater food webs of the terrestrial mammals that depend on the rivers for food. I saw firsthand the implications of a man-made structure on the river, and based on this evidence, came to my own conclusions about the environmental ethics of this project. As a teenager, for a brief moment in time, I was a scientist—and the possibilities of this simple observation were endless.

I look back on my time at the Field School as a watershed moment in my intellectual and personal development. Without the opportunity to try on the identity of a scientist, to freely engage in the intellectual trappings of field biology, to collect and analyze data and make my own conclusions from it, while learning about the world on my doorstep, I don't know that I would be the person that I am now. As I told Regina in our interview, this program isn't the only reason I'm where I am today—but it's a pretty big reason.

CHAPTER 6

THE FALL

While growing up in the rural western part of Virginia has been a big part of my personal and academic development, I always knew that to grow or to be something better, I needed to leave home. The upperclassmen in high school were a source of amazement and mystery when they left town to go to college. Those that didn't leave had unskilled jobs in tourism or the paper mill—and there was a dire warning from both my parents and teachers about settling for that. Not that there was anything wrong with it, but that I could do more. And I had no reason to believe otherwise:

Nothing in my education prepared me to believe, or encouraged me to expect, that there was any reason to be interested in my own place. If I hoped to amount to anything, I understood, I had better take the first road east out of town as fast as I could. And, like so many of my classmates, I did. (Gruchow, in Hass and Nachtigal, 1998)

The mountains and valleys that make up the eastern ridge of the Appalachian Mountains in Virginia have an easy, almost rhythmic, undulation on a topographic map. The creeks and rivers that carved the valleys meander their way across the region, occasionally meeting to form more significant confluences, roll their way towards the Piedmont of Virginia, and ultimately to the Chesapeake Bay. For most of the state, particularly students in Earth and Space Science, they know this terrain as the Valley and Ridge Geologic Province. When viewed on a map, this particular stretch of the state is denoted in green, as part of the National Forest districts in Virginia and West Virginia.

Those who call it home live in a place (or ecosystem) characterized by mixed deciduous hardwood forests, mountain top shale barrens, open glades, and the occasional Karst landform of a sink hole or cavern mouths. They also know it as the home of a gigantic paper mill, a Super Wal-Mart, and an assortment of shuttered Main Street shops. Residents know it as a place where the community revolves around the school, from football games to disciplinary issues, and where the politics are hyper local. Wins, in both football and politics, are celebrated for decades, while losses reverberate through the community for generations.

Lately, there have been more losses than wins in this part of the state. With outmigration from economic slowdowns, shuttered businesses, the housing bubble of 2008, and declining population, there is a palpable anxiety in the community. Teachers in this area have witnessed economic decline for years and are seeing the effects in their classrooms. Desmon explained:

This is my home. This is where I'm happy. This is where I feel comfortable.

Recently, I'm embarrassed to live here, to work here. We used to be known as the miracle in the mountains, but it's no longer the case...whether it was a change in the leadership, downfall in the economy, we are no longer. But, I was always going to come back here. I can't...I would not be happy anywhere else.

The idea of home, of place, in this small corner of Virginia, is complex. It's a difficult relationship with this community, because Desmon, Regina, and Aster love their home. It's familiar, it's known. It's predictable. Yet, Desmon foreshadows the rest of his interview. "We used to be." He is correct. According to Desmon, we used to be a lot of things, up in this forgotten corner of the state. We used to be a quiet region with a few

four-star resorts, some famous golfers, two regional hospitals, a large billowing paper mill, and a tremendous timber resource. We used to have first-class schools, adult education programs, and economic opportunities for those with high school diplomas and associate degrees from the local community college. Fifteen years ago, roughly 33% of the students attending local districts qualified for free and reduced lunch (“VDOE Community Eligibility Program Reports,” n.d.). Today, more than half of students qualify, and the local districts qualify for the USDA Community Eligibility Provision, which allows high poverty districts to serve breakfast and lunch at no cost to all students (“USDA National School Lunch Community Eligibility Provision,” n.d.; “VDOE Community Eligibility Program Reports,” n.d.). Today, one regional hospital hangs on by a thread. Health care options are scarce, and it can take weeks to schedule an appointment with a primary care physician. The four-star resorts are catering to a different clientele, heavily discounting their rates to fill rooms, while actively resisting unionization of their employees. As wages stay low, without significant economic improvement, people choose to move two or three hours away to larger cities where there are more jobs and opportunity.

Regina and Desmon have taught in this district for over 40 combined years. Aster’s children grew up here in the local school system, as did Desmon. There used to be something to be proud of here. According to Desmon:

[But today] we have a declining population of young people. The students we graduate from [local districts], they’re going and they’re not coming back, and that’s been a trend that has accelerated. You know, it’s been a coming trend for a while. The turning point was when I was teaching. It was when Hercules closed in Alcova, and that’s when the mass exit happened.

TPF and Hercules left in 2008. Both were medium to light industrial operations that produced industrial-grade plastics. Hercules came to the area in the mid 60's as part of the plastics boom, producing polypropylene fiber. In 1964, the New York Times reported that by 1965, the Alcova plant would be producing 45 million pounds of polypropylene fiber, almost 70% of the total industry capacity at the time.

The decades that followed the plastics boom also created a population boom in the surrounding area. In addition to plastics and the paper mill, a large hydroelectric storage facility was built in the late 70's that brought an additional estimated 2,000 students to the surrounding counties, doubling the enrollment of many schools. Knowing this was a temporary population increase, the school district built trailers to house classrooms that were removed in the late 90's, as student enrollment began to decline due to natural population fluctuation. School populations stabilized during the late 90's into the early 2000's, but the 2007 recession created a noticeable decrease in student enrollment. Regina explains:

You know what they say about the enrollment in our schools? They say we ain't seen nothing, that you have to look at the 5th grade [enrollment] now, and you'll see the dramatic decline. And it started when we lost that Hercules Plant and TPF [a plastics plant], something with initials. And the Mill is way down in employees too. We've seen a big drain in our schools.

There has been a paper mill in this valley since the early 1890's. With easy access to timber, rail and waterways, it was a natural decision. However, with corporate mergers and narrowing bottom lines for businesses, the mill has been shedding jobs gradually for the last decade or so, particularly as more of their operations moved to international

locations. These economic losses are generally brushed aside by folks in the area as bad luck, but Desmon describes the economic effect on the local school systems as a sort of death spiral:

That's when the economy—you know, our school divisions had a lot of money, and after that happened (the Plastics Plant closed) ...so, we have a declining population and the enrollment is the biggest money maker the school division has. We get \$6,000 from the state per kid. And that's significant when we lose...since 2008, we've lost over 500 students as far as enrollment goes. That's half of Mountain Valley High School.

According to Desmon's back-of-the-envelope calculations, his district is facing a three million dollar shortfall in state revenue from school funding. Desmon continues:

And with it goes teachers because we don't have students, so there's no need for teachers, and you know, the budget just continues to shrink. That's the biggest challenge I see for schools and it's not going to change. We might level off (with enrollment) but we're not going to get those kids back because once you start something on a downhill slide, it's very hard to climb back up. Again, poverty is like the economy. Once you're there (he points to the floor) it's hard to get out of.

In 2009, the local school district sponsored a professional development session based on the work of Ruby Payne, Ph.D, whose "best-selling book" *A Framework for Understanding Poverty* would transform instructional practices and enable teachers to better work with students in poverty. The general synopsis from the training was that children who grow up in poverty have different values from children who grow up in middle and upper class families, and the distinction between poverty and privilege is the

question of “did you get enough to eat?” instead of “how was the food?” meaning that those from poverty valued the amount of food over the quality. This insight is not offered to condone Payne’s version of poverty education, but rather to underscore how desperately this school district, and others in the region, were looking for help. Schools in this area struggle to attract and retain high-quality teachers, and many who do come to the area are either from the region or are brought here by economic necessity. Most of the teachers do not have the experience of working with children from generational and situational poverty.

As the teachers and administrators in local school districts struggled to meet higher annual yearly progress goals with fewer resources, the political landscape of the local school districts became increasingly contentious. In this region, county school systems are directed by elected officials comprising School Board members, who have the authority to appoint the district Superintendent. Because government is run at the county level, instead of municipal, each voting district also elects a board member to the Board of Supervisors, who have control over the county budgeting process. The Board of Supervisors holds the purse strings for local funding of educational enterprises—everything from after-school activity busses, to transporting students home from sports practice, to textbook purchases, technology investments, and salaries. The School Board creates their yearly budget, based on the previous fiscal year, and submits it for approval to the Board of Supervisors. It’s therefore up to the Supervisors to allocate revenue to the school board. In good times, with boards that work well together, it’s a seamless process. When there’s contention between personalities, a significant budgetary shortfall, or a significant increase in the operating budget, as when the School Board asked to adjust teacher salaries to account for inflation

over a 5-year period of mandatory salary freezes, a stalemate can lead to lawsuits and decreased school funding in the future, out of spite. Aster explains the conflicts she experienced with salary issues in the schools.

Something I've learned is that it all boils down to politics, and all politics boils down to money. It always comes down—no matter what, it always ends up talking about money. Education, it ends up talking about money. And as long as you're in the public sector, you're never going to get paid a decent salary and people are always going to think you're overpaid. Especially when you get to a rural place, like around here. There are people on the board of supervisors who really thought that \$30,000 a year was an outrageously high salary and they were dead set [against raises] because they were only making 22 (thousand dollars) themselves. And, so why should a teacher make \$30,000 a year starting salary?

Aster highlights one of the biggest challenges in attracting teachers to the area. While other counties are able to offer starting salaries in the \$35-38,000 range, plus a bonus for Master's degree, and an additional one-time bonus for critical shortage teachers in Math, Science, and Special Education, salaries in the school districts in the region have stagnated. When the housing bubble burst in 2007, the Board of Supervisors forced the School Board to freeze all instructional staff salaries, meaning that even after five years of service, a teacher wouldn't see their customary salary bump, much less a 3% cost-of-living adjustment.

The school board salary freezes and spending structure supports the economic-education death spiral that Desmon talked about. While he specifically talked about the federal and state funding tied to student enrollment, Aster speaks more broadly about the

implications for the region. Indeed, without good paying jobs and a thriving school system, it is difficult to attract engineers, doctors, nurses, accountants, teachers, and other “pillar citizens” to the community. With white-collar jobs dwindling, and well-paying blue-collar jobs in decline, the number of people on unemployment has skyrocketed, and more people rely on timber or other resource extraction, like mining and mineral rights, to make ends meet.

Regina and Aster both talk about the “Fox Party Line” that their students come from at home. Largely conservative and Christian, the greater community relies heavily on these Fox News narratives to make meaning of the world in which they live. This particular issue of politics and science is revisited in other sections, but Regina specifically brings up the point of religion and poverty, particularly the challenge facing families whose primary source of income was the plastics plant, or the paper mill, and now relying on mineral rights or other resource extraction, like timber or natural gas, for income.

I know there’s talk of re-training (the workforce) which of course is the answer, but I’m not sure what industry is going to come in and take the place of coal like it has in the State of West Virginia. People are going to be offered \$30,000 for the mineral rights on their 50 acres or whatever, and they’re going to take it in a heartbeat and it doesn’t matter, because short-term, it feeds the kids. And they’re going to cross their fingers and go to church and hope their water stays drinkable, potable.

Water quality is a common thread in the curriculum, discussed in a later section, but as Regina mentions, the short-term financial needs for families in the area outweigh the long-term financial or environmental considerations. Aster, in contrast, discusses the predatory

tactics of energy corporations and the deleterious effects these corporations can have on property assets.

[Energy] extraction, I mean...It's just not the kind of industry I want to be associated with. There is so much—I don't know if it's corruption--but preying on naïve people. That's what happened with coal in West Virginia. People sell off their mineral rights and don't realize that they've sold off their surface rights too because they haven't understood. It has to do with the power of the coal companies or the energy companies that, if you have minerals underneath there, and you've sold the mineral rights, then they have the right to do whatever they need to do to go down there and pick it up. And if it causes subsidence and your house collapses, well, that's tough. It's not their responsibility. And I don't know how you can let corporations get away with that. I really don't.

While there are few instances in the region about house subsidence from indirect mining tactics, there are serious questions about fracking, natural oil and gas pipeline locations, and environmental impacts to landowners. Aster is concerned about duplicitous energy corporations and the few laws that protect landowners or individual citizens from predatory tactics, while Regina continues to talk about the greater issue of poverty in the region.

The biggest problem is—it doesn't matter what community you're talking about—when I think about Appalachia...It's the idea that there's no economy, and that these things, like coal mining, whether it's strip mining or mountain top removal, or whatever, and fracking are going to win out because of the poverty, and it's so sad. And I don't know, I don't know what the answer is...

It's like people have no spirit anymore. I don't know if they ever did, but if you're not willing to try, then, you know, you're not going to be successful and you're not going to come together, which is what they need to do. And the store fronts, I mean, they're all just closed.

Regina talks frequently about how the spirit of the community seems broken and fractured. A pessimistic, distrustful world view permeates local newspaper editorials, and even the school system. Regina and Desmon both mention the challenge in working with increasingly antagonistic school leadership and apathetic parents.

The purpose of this study was not to examine the economy of the local region, but to explore a local educational program, focused on field ecology, with a 30-year history of success. However, in studying the program, it was evident that there had been a shift—from an extremely competitive summer program, where there were rare openings, they now struggled to fill 10 of their 20 open spots. The students who do attend aren't as interested in science, leadership, or being outside—and it's a challenge to encourage them to want to do so. It's difficult to motivate students to spend their summer in an enrichment program within a community with a waning interest in education, or little motivation from their parents. As Regina explained,

It's amazing. The brightest of the bright at our schools could not touch the brightest of the bright that I've had in the past. We don't have those kids any more. Their engineering parents are all gone.

Aster, on the other hand, looks to the greater picture of the community as an indication of where their student population has gone.

It really pains me to see this community lose population like it has. I really love living here. It has frustrated me no end that the mill can't get engineers to live here. You know, they'll work here but they won't live here. The hospital can't get doctors to live here. They all take a look and say, "Oh, I don't want to live here," and I don't know why because there's lots and lots of opportunity, there's lots of cheap housing. (she pauses to pull out a post card from 1920 and reads it) "Cheap iron, cheap coal, cheap timber, cheap living. If you want to be thrifty and live to a ripe old age, come to [Clearview], Virginia.

Aster and Regina are very open about their love for the community and the natural resources surrounding them. Regina specifically speaks about the importance of the natural world when she thinks about what "home" means to her, and about the interconnectedness between abiotic and biotic communities, and the human community inhabiting the same place. Interconnectivity is a large part of her philosophy about education and the environment, and one that both she and Aster aim to incorporate frequently in the curriculum, and to impart to students.

Desmon pinpoints the declining student applications in the program around the time the plastics plant closed but noted that there was waning interest for many years. When Desmon and I attended the program, it was highly competitive, requiring both a teacher recommendation and an application questionnaire, in addition to a school ranking of each student. Each school was allotted 2 students with one alternate. Desmon describes it in this way:

You know, we started taking more bodies probably in 2009 when there just wasn't the interest. We didn't have the pool of applicants that we had in the past to choose

from, so we were just taking everybody even alternates just to fill some slots to get to 20 because that was being pushed down our throats. You know, you got to fill the [program to] capacity; otherwise, they were going to cut the program.

Regina laments the dwindling applicant pool:

We're to the point with 10 kids, we take in anyone. I can't remember turning someone away and it's been so long. Gosh, I can't remember. Aster said she can remember 40 applications for 20 spots. Back then, those selections were weighted so that each division got their top one or two, with an alternate. It was such a sought-after thing that it never came down to where the alternate was able to attend.

With fewer students in the surrounding school systems, losses of local school funding, and less interest in education and environmental issues, Regina, Aster, and Desmon were all concerned about the future of the program. As Desmon mentioned, without a full program of 20 students, the local community college that hosts the program is less likely to continue to partially offset costs that local schools aren't able to pay. While Aster and Regina appreciate having smaller numbers of students, for logistic reasons, it makes their field study components more challenging with fewer people.

Desmon also notes other reasons for the decline—over-testing in public schools has led to apathy towards education, and sports are an important aspect of life in a rural area.

In his own words, Desmon stated:

Another thing that happened as far as us not getting the caliber of student that we used to get is that we're competing with all kinds of stuff. We're competing with sports camps. That used not to happen. We're competing with not wanting to do

anything in the summer because public schools are such a drag. You know, let's just have a break and I get that. I very much get that, so the interest is not there. For instructors with a deep level of investment in the program, it's difficult to see the caliber of students, as they put it, decline so markedly. Aster and Regina also believe there are other competing interests for students in the summer, but they also believe that, at a fundamental level, students should be interested in learning about the region in which they live. People should be interested in what's in their back yards, and in what's going on globally, particularly with climate change, that might threaten their local community. As Aster puts it;

And I think we feel very strongly that we want the students...to appreciate and understand the resources and the local things that they have here, the really amazing things they have around here that some people don't even know about. And that you don't have to go to exotic locales to really take advantage of it. [I]t amazes me that so [many] kids here are so disconnected from the environment. I can expect that if you grew up in Richmond or Northern Virginia or New York City, you might not be too connected to the environment but here, where, you know, you can roll out of your bed and pick up a gun and go hunting if you want to or, you know, any of the other outdoor recreation here.

Regina, Aster, and Desmon all want to see the program continue to thrive, as it has for the past 30 years. Their level of professional and emotional investment in this summer program is tremendous. As their application numbers have decreased, they have looked critically at the program and have started to make some programmatic changes to attract

students, which will be discussed in another section. When asked what he wanted the most for the program, Desmon sat thoughtfully for a moment, and offered the following:

The biggest thing is I want it to be—I want it to go back to where the quality control is there. It is a program for gifted students. I’m not sure that the program is reaching its full potential long term because, when I was in the program, when you were in the program, you had 20 people who could change the world within that program, who had the intelligence and the wherewithal to do so, and if they didn’t change the world, they could change their communities.

Although Desmon identified the program as targeting “gifted” students, at its core, this program was created to help students “learn science by doing science” (Field School Website, 2018). As the popularity of the program increased, along with academic rigor, the target audience became students who were up for the academic challenge of scientific field work—many participants in the history of the program had been identified as gifted through the school system, although it wasn’t a specific requirement for joining the program. The important aspect of the program was allowing students to develop their ideas about what science is and how science works by participating in field ecology studies. An unintended consequence of this field school was leadership development—teaching students how to work together, how to take charge, how to organize and build consensus, all important aspects of scientific endeavors, but also important to developing the next generation of community leaders. As Desmon mentioned, students in this program believed they would change the world. Even if they didn’t, they could certainly affect their community in a positive way. Reflecting on his time with the program, Desmon stated:

You know, it was a program of leaders and I would like to see the program get back to that because I don't think it's reaching its full potential with the students that we're getting. We can't bring in the 20 kids who are leaders anymore. And educate them about the environment, and ecology, and make them excited about it because the drive is not there either. You know, this is a drag for some kids. The program had to be changed because the kids were changing.

In nature, the only constant is change. From the seasons to climate patterns, from evolution to erosion, change surrounds us. So it should be no surprise that the students who might join the Field School, over the past three decades, have changed as well.

CHAPTER 7

OF SALAMANDERS AND STUDENTS

In the early years of the program, the curriculum focused on botany, The Doctor's specialty. This focus persists even today, with students creating 20-piece pressed leaf collections, learning tree identification, and completing a forestry study. Students, however, weren't as excited about botany as the instructors were. In response, The Doctor and Regina introduced a salamander study at the request of the students, who wanted to do some work outside of botany. Regina recalls the decision to include a herpetological study.

We did, you know, change our focus [from botany] based on students' requests, and that came from my experiences in ecology in college. Because eons ago when I had ecology in college, we did this really cool salamander assessment. So, he said, "OK. We'll do salamanders."... So, it's back in those days, we—The Doctor, being so well-known and respected as a Ph.D, he had connections and so, you know, we did have the guys from Commonwealth College who helped us...and an area herpetologist.

With The Doctor's professional networking, the salamander study started in 1994 in collaboration with the Department of Conservation and Recreation and researchers from a nearby university.

The collaboration between the researchers, scientists, and educators resulted in a standardized salamander sampling protocol. The June 2013 student-written Salamander Diversity and Abundance paper, included in Appendix D, describes the protocol as follows:

On June 18, 2014, the Field School established an elevational transect on Locust Spring Run. A total of eight sites was sampled along the transect with sites established at every 30 m (100ft) in elevation. Based on the method of Crump and Scott (1994), a group of three to four persons thoroughly searched within a single quadrant for salamanders for 15 minutes. Four groups searching at each sampling site gave a total of $4 \frac{3}{4}$ person-hours of search time per site, or 38 person-hours along the entire transect. Habitats, such as rocks, logs, and leaf litter on the adjacent banks and slopes were overturned to reveal, capture, identify, and record any salamanders.

Displaced objects were carefully replaced to prevent disruption of the natural environment. Also included in our search area were the waters of Locust Spring Run where stones in the streambed and along the bank were overturned to reveal any salamanders. In the days prior to the field study, students became familiar with the identifying characteristics of the different species common to this area. Each salamander captured was recorded by its habitat and species. After collecting the data, measures were taken to ensure that each salamander was returned to its original location of capture.

An important aspect missing from this description is the notation that this particular trail, Locust Spring Run, is part of a network of trails in a nearby wilderness area where the Field School has been continuously sampling salamander populations since 1996. While the salamander sampling protocol was developed by adults, it's important to note that

beyond the protocol, the students are responsible for the vast majority of the field work—even learning to set up a tent and cook a meal over a camp stove.

Preparation for the salamander study begins on the first day of the program. In the 7 hours of class time on the first day, in addition to a pre-test, getting-to-know-you activities, and an introduction to the 7 days of the program, students learn how to write scientific field journal entries, study the salamander protocol, learn about salamander habitats and ecological niches, practice using a dichotomous key to identify salamanders, test their sight identification of salamanders, practice setting up a tent in their tent groups, discuss digital photography basics, review packing lists for the two-night backpacking trip, learn about leave-no-trace camping practices, and begin writing responses in their reflection and field journals. The reflection and field journals are collected on the second day of the program, after Regina and Aster have had an opportunity to respond in writing to some of the student journal entries.

At this level of observation, the salamander study is an exercise in scientific inquiry—semi-structured with a given procedure but with an outcome that is investigated by the students. The students collect and analyze the data and make meaning from it. With a longitudinal data set of this size, students are challenged to draw conclusions from their data as compared to the whole data set. The results from the 2013 study were surprising in the lack of salamanders found during sampling. In 17 years of salamander sampling, the lowest sampling year yielded 171 individuals while the highest yielded 402, for an average of 299. In 2013, only 73 salamanders were found. The following year, in 2014, the salamanders saw a rebound to 229 specimens, leading to speculation about the cause for scarcity in 2013. Regina and Aster believe it may have been largely due to lack

of enthusiasm of sampling from the Summer 2013 group, but there are no specific data, aside from their observations, to support this.

It is important to note that this type of scientific inquiry differs significantly from what the students experience in their home schools. While there are assessments embedded in the program, for example, the ability to sight identify a species of salamander is an important skill when in the field, students are actively engaged in the role of field scientist—they do what many graduate students do to collect field data. They put up tents, they cook meals in remote locations, they struggle to set up a transect in the rain, they get tired and frustrated as the data collection doesn't go as planned, they become reinvigorated after an especially elusive salamander is captured or a rare species is identified. They take on the role of field scientist, at the age of 13. Aster describes the philosophy of the field studies in her interview this way.

Oh, we try to make them as hands-on as possible. You know, that's the great thing about field work and this program, is because you're not just sitting there in a classroom, saying you know, we can tell how healthy the stream is by what bugs live in it. You actually go out there and do it. And I think it's valuable for them to see that science is not just all like it is in the movies, the discovery every day. You know, there's a lot of grunt work. I used to tell kids that, you know, when I was in grad school, I spent half my time washing dishes. [she laughs] I was a chemist.

An interesting aspect of the curriculum at the Field School is that while the course materials focus on the science, or specifically, the study at hand, the instruction itself is deeply student centered. A glance through the course materials only hints at the student-centered instruction, but the way the scientific study unfolds allows for students to create

their own meaning and understanding from the materials presented, much like scientists do. In addition, the journal that students complete each day allows an opportunity for reflection on a variety of topics, from the scientific studies to greater ecological and ethical issues. This combination of reflection, with periodic comments from the instructors, gives students a space to explore their thoughts on different environmental topics in a more creative way than classroom discussion alone can provide.

Aster also discussed the challenge in teaching climate change in a politically conservative climate. However, in both 2013 and 2014, Regina and Aster didn't encounter a significant pushback from students about climate change in verbal discussions as they had in the past. Aster described it this way.

This year's students were far more environmentally aware than the vast majority we've had in the last few years. They really took [class discussions about climate change] to heart far more than other classes. Most just toed the Fox News party line straight down. I mean, this is the first year we've had students who said, "Yeah, global warming probably is happening." Usually, we get, "Global warming is a big farce foisted by scientists upon the public to get more grant money." [laughter] But in the past, we've had plenty who just said it's a total hoax.

This isn't to say that students didn't challenge some aspects of climate science in their journals or in their interviews. Rather, the students were much more respectful in their discussions with Regina and Aster, and in their conversations with each other about climate science, instead of openly arguing against climate change, or shutting the conversation down completely by calling it a hoax. "They may not have changed their political view on

it,” by the end of the program Aster said, “but at least they’re aware that there is another side”.

This awareness of “the other side” of environmental conservation is evident throughout the curriculum. From class discussions, background readings from scientific journals and newspapers, to the student journal prompts, Aster and Regina work to raise student awareness of environmental issues from deforestation, climate change, species extinction, sea level rise, water conservation, recycling, fracking, and renewable and non-renewable energy resources. A sample reflection prompt from the journal asks:

Naturalist John Muir is quoted “When we tug at a single thing in nature, we find it attached to the rest of the world.” Think about this quote. What do you believe are the most detrimental human behaviors that affect global ecosystems? How do YOU negatively impact natural ecosystems on a local level?

Other responses in the student journal invite students to think critically about complex ecological issues and the implications for human health and safety. An example prompt following a day trip to investigate a local vernal pool sets up a scenario for students to think through. In the scenario, a drought hits the region, and over ten months, only a third of annual rainfall is measured. This particular period is part of a longer three-year drought but is much worse than the previous two years’ drought. The scenario poses the following question:

As late April approaches, residents in the region notice that the spring peeper (a nocturnal tree frog) chorus has significantly diminished as compared to years past. As the days become warmer in the month of May, residents also observe a

noticeable decrease in the number of gnats and mosquitoes. Should residents be concerned? Can or should something be done? What do you think?

Both prompts are emblematic of the critical thinking questions posed throughout the program—these just happen to be open to student response in their journals. While Regina and Aster work to give significant feedback to students on their written journal responses, to guide student’s writing and to improve the depth of responses throughout the program, it also gives them a formative assessment opportunity to understand what students are thinking throughout the program without high-stakes testing.

As both sample prompts note, students are given an opportunity to write about what they know about the topic. In the Muir quote, Regina and Aster are looking to understand how students are looking at not just food webs or ecological niches, but at the greater idea of interconnectedness throughout the ecosystem, to include the human community as well. This particular quote appears in the journals after the salamander study, when students have had time to experience field work and data collection, and to experience the interconnected environment first-hand in the field. In the drought-stricken vernal pools, Aster and Regina are wondering if students will equate fewer nuisance mosquitoes with a greater ecological issue, although “natural” in the sense that a drought is a temporary situation. Will students make a connection that drought can be a natural phenomenon, but with climate change, weather fluctuations will be much more common and less predictable? What about the connection to human health, with fewer mosquitoes, or the consequence of fewer peepers with scarce habitat?

During the Field School program in 2014, I interviewed a number of students throughout the program, individually and in small groups, and collected their field journal

writings. Of the students I interviewed, a few stood out for their candor and interest in the program, Cy, Luna, and Daisy. Their pseudonyms are as follows: Cy, short for the constellation Cygnus; Meg, short for the extinct Megalodon shark species; Luna, a Latin derivation of the Moon; and Daisy, from the eponymous wildflower. The interviews and journal entries shared here are vignettes of the experiences of these students in their own words.

Cy was a quiet student on the first day but was quick to note in his field journal that he “thinks I can put a smile on people’s faces if they are having a hard time” when asked what skills or talents he thought he could contribute to the group over the course of the program. Aster and Regina would describe Cy as a typical participant—smart, interested in the subject, but without much background in field science. At the end of a strenuous first day, learning about salamanders, the field sampling protocol for the salamander study, writing good scientific notes, the basics of backpacking and camping, and setting up and taking down a very large tent, Cy had this to say about his initial thoughts about field work:

At first, I thought it would be a hassle to keep up with the field journal, but then I really thought about it and realized that if I see something amazing and don’t write it down, there is no proof that it happened. I can just look back in my field journal and have an awesome memory all over again.

Once the groups had set up their tents at the wilderness area where the salamander study was conducted, students had an opportunity to work on their field journals and make some observations about the wilderness area that would be home for the next two nights. When prompted to use his prior knowledge of a typical Virginian field and forest that he’s used to, to observe and describe the wilderness area, Cy remarked “it seems like everything

is natural and at its home. Everything is like it's untouched and hasn't seen humans in a while. Every little organism is unique in its own way.”

The salamander study is a strenuous day for the entire group. The trail is four miles downhill, with a return trip back up—eight miles in total. This includes the salamander sampling protocol, described previously, which is particularly strenuous. Between hiking, moving rocks and logs, delicately catching and identifying salamanders, releasing salamanders, and gently replacing the moved rocks and logs, it takes a lot of effort and makes for a long day. When asked to describe his group's work ethic for the duration of the study, Cy summarized it in this way:

In the beginning we were work [sic] great together. Sites 1, 2, 3, and 4 ran like a well-oiled machine, but 5, 6, and 7 we didn't look as efficiently. We were just sitting or standing around. Honestly, I just wanted to go to sleep in my tent. The last site, I saw everyone working their hardest to find salamanders. Over all we worked enough to find over 200.

Meg, one of Cy's classmates, summarized her salamander sampling protocol with the following drawing in her field journal, describing the sampling process. According to her field journal, the first step was to assign roles and prepare sample bags with leaves and water. The second step was to start timing, and look for movement under rocks, logs, and leaves. Third, carefully grab the salamander, including the leaves and earth around it. Fourth, place the salamander in a bag for identification—unless it's a Spring Salamander, which should be kept separate. Fifth, tell the recorder the type of salamander and its habitat (stream or woods). Sixth, after the time has elapsed, gently return the salamanders

to their original habitats. The seventh step is to repeat the process again at a different elevation. Meg's drawing is included below in Figure 3.

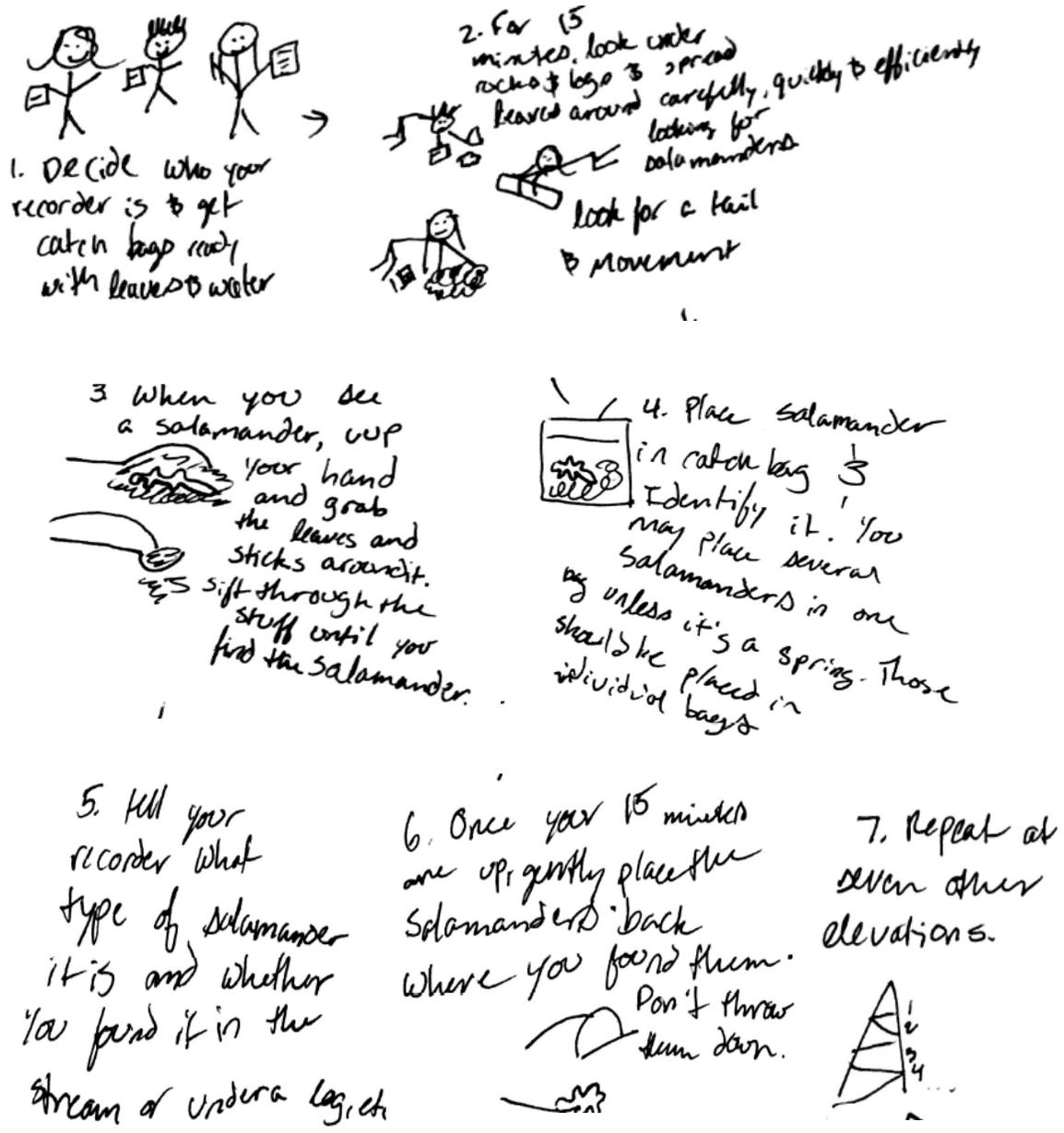


Figure 3: Meg's explanation of the salamander sampling protocol

After a week in the program, including two days of classroom instruction, two days of field instruction and field work, two nights of camping, and a very long bus ride, students return on Monday to begin analysis on their salamander data. This is the primary focus of classroom time on Monday—debriefing the study, reviewing some basic statistic analysis, identifying the important parts of a scientific report, and dividing the report up among the groups for writing and editing tasks. However, all students participate in the data analysis in two groups, to compare their math and to act as an independent check on the analysis. The closing reflection on this day is the John Muir writing prompt, described earlier, which asks students to identify detrimental human behaviors that affect global ecosystems, and to identify personal negative impacts on local ecosystems. Cy identified three specific things that relate to the local environment but lead to global consequences, and one major personal negative impact.

I think when humans log without [re]planting, and when factories dump chemicals in the river. If factories found a better way to dispose of the chemicals. It would be a major positive act to save river life. The only way I affect the environment negatively is running the lawn mower, weed eater, and motors that run off of gas.

Cy's response is similar to others in the program, who note factory water pollution and logging as major environmental issues with global consequence. It's important to note that by this point in the program, students have not discussed fracking or non-renewable energy resources.

On the second to last day of the first session, the class visits a vernal pool after working on their paper edits. This short local field trip gives the students an opportunity to

explore an ephemeral habitat close to home that many have seen, but not identified as a habitat. In his field journal, Cy describes his observations of the vernal pool like this:

My first impression was that it was just an overgrown pond. Then when I put the waders on and got down in it, everything came to life. There were hundreds of little frogs, big frogs, and dragonflies all together. My impression changed from negative to positive in a matter of seconds. Seeing all the wildlife go “home” was an awesome experience.

This particular field trip was punctuated by a mass hatching of small frogs—they were literally everywhere, and it was almost impossible to even step on the ground without encountering one. The ground seemed to be alive with tiny frogs, which was an impressive sight for the students. Even more exciting, as Cy mentioned, was the opportunity to put on hip waders and get into the pool. Cy talked about watching the wildlife “go home” in his journal, as a way of describing how the insects and amphibians were interacting with the ecosystem. From the large bullfrog perched on the fallen log across the pond, to the dragonflies hovering and swooping to collect lunch mid-air, to the tiny frogs covering the leaf litter, it was the first time he had considered this ecosystem to be a home to such a variety of wildlife.

One of the final journal entries for the salamander study session asked students to choose their most memorable experience and describe it. Cy wrote, “My most memorable experience was the day of the salamander study. Even though we had to hike 8 miles, it was memorable. It felt like an accomplishment.” During our interview, I asked Cy to talk about some things that he learned throughout the program, and he responded that he

“learned that pretty much all the stuff is like right in our backyards and we don’t really notice it too much.” I asked him why he thinks we don’t notice, and he said,

Because we’re too busy doing other stuff like being inside and just bored. We don’t go out and do stuff. Like even the stream that runs by my house probably has salamanders and everything in it, and I’ve just never really knew that anything was there. I’ve looked for them a couple of days ago and there were. I found a spring salamander and a couple of seal salamanders... And I think it’s pretty cool that I’m able to like identify stuff now, like I mean, I’ve been catching salamanders a lot and now, I can actually like tell what they are and yeah, it’s pretty cool. And like I’m not perfect [at tree identification] but I know trees all right, I guess.

I followed up on that question by asking Cy why it’s important to know about the things in his backyard, and he responded:

Well, I can pass it on to other people and they could pass it on to other people and then it could become a big thing and people would start like, “oh, they’re killing—they’re killing animals and stuff,” and that doesn’t look too good on a company or something. And I mean, it could stop pollution in the river, it could stop pollution in the air just because there’s a unit of people who know about this stuff. And you’re telling other people, and then, they might become [part of] that unit and as it gets bigger, it’ll be more controlling, I guess. So more people know about it and appreciate it and can take action.

Cy’s responses to go the greater aim that Regina and Aster have for the program—basic awareness that moves towards environmental interest, and eventually advocacy.

When asked about how he thinks this program might help him in his academic future, Cy laughed, and said, “I seem to like science a lot more now!” Asking for more clarification, he offered, “Yeah, I’ve never done anything like wade in a vernal pool or anything like that before. And I really had fun doing that stuff. So, I’ll probably do something science-y someday, probably.”

At the close of the interview, I asked Cy why he thought Regina and Aster had been working on this program for so long. He paused for a second to think, and responded:

I think it would probably be fun watching kids do this type of thing, like watching us almost like grow as...like at first, we were just—didn’t know what to do and now, we know what to do. So I think it would be pretty cool to just keep doing it and keep giving these people experiences that they don’t really have anywhere else. So I think—I’m glad. I was kind of like, before the salamander study or anything, I was kind of iffy about it—but I’m 100% glad that I came.

Luna was a frequent contributor on the first day of class, eagerly answering questions and providing evidence of her knowledge of the natural world. She was also a talented sketch artist whose entry for the annual t-shirt contest design won handily.

However, Luna was an interesting student from her perspective on climate change. In response to the John Muir “when you tug at nature” quote in her journal, Luna offered the following:

Continuing our lecture on global warming, humans burning fossil fuels greatly contributes to the temperature changes of the Earth. Even though global warming is just a theory that some (like me) don’t believe in, other things are taking place,

like releasing of toxic gas into the environment. By driving cars and having bonfires, we personally contribute to harm nature.

Aster added post-it notes in commentary to Luna's journal (they offer their thoughts via post-it notes now, as they feel it is less intrusive to write in the journal with the students—the post-its offer Regina and Aster the opportunity to respond without making permanent comments in the journal, which they hold sacred to the student.). “Actually, a “theory” is a well-established explanation for a natural phenomenon. “Just a theory” doesn't exist in science. If you don't “believe” in climate change, how do you account for the changes that we are seeing? (Glaciers melting, sea level rise, etc.)”. Due to the fast turnaround time of the journal and the quick pace of the program, there's not often time for students to react to the commentary from the instructors.

I highlighted this particular response from Luna because of a conversation she, Daisy, and I had during our interview session. Luna stood out from other students in the class who flatly denied climate science because she noted that humans did contribute to “harming nature” in her words but specified that climate change was “just a theory”. In our conversation, we had been talking about renewable energy sources, like solar energy, when I asked Daisy and Luna about how what they've been learning related to bigger global environmental issues. Having just told me about the effect of increased sunlight on an open patch of forest floor, Daisy offered the following, “Well, we saw like just with that little spot how little more sun, a little more warmth can change a lot. And so like on a global scale with all the climate changing, that's going to change everything like all of our species and...” Luna interrupted her:

Well, I don't know, like my family, we don't believe in global warming and I mean it's still -- it's still a theory, so we think that it's just, you know, there was an ice age. I mean the temperature has been fluctuating over many years, so probably after like the peak of the global warming it's probably going to go back down again.

I pushed her a little further to ask if she thought that this might negatively impact humans in the process, to which Luna responded:

Yeah, I think it -- yeah, it could, not only -- well, it will definitely affect the crops which would in turn impact the humans as their source of food. But like everyone keeps talking about fossil fuels, but for example, one volcanic eruption has so much more depth -- so much more, I guess, damaging power than like hundreds of years of like fossil fuels coming into the atmosphere.

Daisy listened thoughtfully throughout the exchange, while I brought up the journal entry about John Muir and the question about if humans should intervene if a species were to go extinct. Luna was quick with her answer. "Oh, I put that -- I disagreed that -- I disagreed that humans should interact because, well, I mean, the extinction of species is just a part of evolution. So, I mean that evolution without the extinction and like mutations of different species there would -- we wouldn't be here. Nothing would really be here." Daisy disagreed and noted "I think that I agree with [Muir], and I think that we are in charge of most of what's happening because we're wrecking the habitat and like not only the extinction, but [human] overpopulation at the same time. And eventually if we keep moving this balance and we're going to be in trouble. That's going to be our fault."

It's important to note that the girls were from different schools and became fast friends during the course of the Field School. Their sharply disagreeing views didn't keep

them from remaining friends throughout the program—in fact, they were tent partners for both of the studies, and could often be found playing together or working together in small groups. I didn't openly challenge Luna on climate change because that wasn't my place in the field. But it was interesting to observe her interactions with Daisy, Regina, and Aster during discussions on climate change, which were extremely cordial, inquisitive, and open, despite disagreement. Luna is emblematic of the polite dissent that Aster noted from the discussions on climate change during the summer of 2014.

Daisy joined the program for the Forestry Study second session because of a schedule conflict with the first session but was an enthusiastic and cheerful participant throughout the two weeks. Cy and Luna also participated in the forestry study, but Daisy's journal entries only include the night camping sessions related to the tree identification studies and Bluebrier National Forest. That being said, Daisy was particularly talented at describing her surroundings. During the night sounds journal prompt, students were instructed to find a spot near the picnic shelter at the Bluebrier National Forest campground, and as part of a guided exercise, turn off their flashlights, observe the twilight, then briefly close their eyes, and listen to the sounds of twilight and night. Daisy described her experience like this:

In the start (right when the sun begins to set) the white pine needles seemed softer overhead in the dusky light than they did in the day. As the twilight began the raindrops glistened everywhere and paired with the fireflies making the night seem light. The sky turned from blue to yellow to orange to purple. As I watched, many insects scuttled or flew by me on their nocturnal journeys. I saw the moon advance into the sky and glow a deep gold. The whip-or-wills swirled out of the dark and

let me know that night is not silent, but as full of life and activity as the day.

During these twilight hours the forest seems to close in, but also open up at the same time. Night is truly an overlooked treasure.

Sitting silently in the picnic shelter during this exercise, we were treated to the unique experience of Eastern Screech Owls calling back and forth—a surreal sound of a horse neighing, if you're unprepared for it. A few minutes later, still sitting in silence, some barred owls began calling out from a distance as well. I looked over to Regina, Aster, and Desmon, who were practically jumping from their skin at the fortune of two different owl calls, and out to the students all sitting silently, but alert, in the approaching darkness. As soon as Desmon called an end to the twilight experience, the students bolted from their positions around the forest floor to the lights of the picnic shelter we'd just turned on, exclaiming about everything they'd seen and heard in the silence of the twilight.

This is the magic of the Field School, and, I believe, in environmental education as a whole. The serendipitous learning moments that nature provides, without prompting, to instill appreciation, awareness, and awe in those willing to sit and listen. When I asked Regina what she hoped students have taken away from the program, she said, "One thing I think will happen with the kids we have this summer is that as years go by, they'll realize how cool what they did was." From Cy, Luna, and Daisy, and my own personal experience, as the years have gone by, we've been extremely fortunate to have the opportunity to become field scientists for this short time.

CHAPTER 8

ANALYSIS

In this chapter, I will revisit the research questions from Chapter 3 and discuss my findings, results, and conclusions in relation to the four themes and literature. These themes, from Chapter 3, are:

Theme 1. For over three decades, an innovative outdoor field research program in a rural area engaged high school students in scientific research to promote environmental literacy within the context of the local community and environment.

Theme 2. My personal experiences as a student in this program led me to understand place, science, and privilege through a lens of environmental stewardship.

Theme 3. Economic challenges in rural areas include environmental and educational dimensions that are connected to the global economy and climate change.

Theme 4. Students are able to understand and critique their own responsibility to the environment through connections to science, place, and environmental stewardship by participating in scientific inquiry in the field.

Each research question is followed by the relevant themes related to the analysis.

1. How do teachers use scientific inquiry in the place-based environmental education program? (Theme 1)

Inquiry is embedded from the first day of the program. Students discovered the ecological community surrounding them, both biotic and abiotic, through projects and research questions designed to center the student as the scientist. The salamander study is

an excellent case—students need to have common background knowledge about what amphibians are, how salamanders are related to amphibians, salamander identification, salamander habitat, and salamander capturing without injury. They need to plan ahead to think about weather and other environmental constraints while they spend three days in the field completing this survey—what will they eat? How will they stay warm or dry? Can they carry everything they need for three days in a backpack, including their salamander sampling tools?

While the sampling protocol is standardized, students have to re-mark the trail each year, and have to measure and locate best sites for sampling. The students are driving the data collection, and their responsibility in collecting salamanders shows from the population numbers and biodiversity numbers. They are scientists, field scientists, responsible for not only data collection but also for the group's success in backpacking and camping. After the trip, they return to the lab to write up their study results, run some basic statistics on their population data, and discuss their findings in the annual salamander paper. They are responsible for comparing their data to the longitudinal data set, started in the early 90's. They work together, as a community, to produce and edit the report, much like a scientific lab or community comes together to publish a paper.

This is a home-grown example of a hands-on, minds-on, experience in scientific inquiry for these students. It goes beyond the classroom to help connect the students to their ecological community through meaningful, authentic science. The instructors model inquiry throughout the program, asking questions, responding to student journal reflections, pushing students to think about an issue in a different ways, or appreciating how a student chooses to respond to a question. By nurturing this inquisitive spirit in their

students, and modeling this behavior, the instructors embody the spirit of scientific engagement with their demeanor and their ability to capitalize on the innumerable possibilities for learning that occur in the field.

2. What motivations and commitments to place-based education and inquiry shape teacher decisions and instruction? (Theme 1, Theme 3)

Regina and Aster have a deep personal commitment to the founder of the program, to the relationships they've built over the decades, and to the students they serve each summer. This is evidenced in their many conversations with me, and each other, about how much they value the opportunity to work in this program that The Doctor created. They both want nothing more than for the program to continue in perpetuity, just to see The Doctor's dream realized through each summer session.

While they struggle with having to make changes to the program, as Desmon notes, The Doctor would approve of the reformatting of the program, because it's about getting students into the field, getting them interested and excited about the natural world. Regina and Aster echo this sentiment—at the end of the day, their belief in the program and the work they do is evidenced in what they see from the students. The excitement in finding their first salamander, the pride of setting up a tent on their own for the first time, or just being amazed by a swarm of tiny frogs near a vernal pool. Awakenning this awe in their students underpins their dedication to The Doctor's vision, to the program, to each other, and to the future of the program.

Aster and Regina both discuss their belief that students learn by doing, reflecting, and then doing more. Not only is it a foundational ethos of The Field School, from the mission statement, but it's a foundational belief that students should know about the world,

the community, they live in, and they should care about all of the creatures that inhabit it. This takes the biotic and abiotic studies at the Field School into account and is demonstrated by the classroom discussions throughout the program. While John Muir is a favorite quote, many other writing prompts ask students to think about the human impacts on the environment, and the technological innovations that should (or shouldn't) be used. By asking students to reflect on the delicate balance of nature, and what human responsibility is to the local environment, Regina and Aster set students up to consider the implications of action and non-action around issues like climate change, fracking, and even subsurface mining.

By keeping the focus on local field ecology and biology, Regina and Aster maintain their commitments to place-based education and inquiry-based instruction through their hands-on field studies, reflection journals, lively classroom discussions, and rigorous curriculum.

3. How do teachers connect scientific inquiry to local environmental issues, and to global environmental and socioeconomic topics? (Theme 1, 2, 4)

Aster and Regina connect scientific inquiry to local environmental issues through their studies, like the salamander study. This hyper-local study examines the habitat and population density of salamanders on the slope of a mountain in Western Virginia. This connection, between inquiry and a local salamander population, is a natural association. Aster mentions this in her interviews when she discusses how she believes it's important for students to know about the places they live, and about the other organisms that inhabit this community with them.

Using this local study as a starting point, the teachers are able to extend scientific inquiry to include global environmental issues, like climate change. This is most notable in the exchanges with Aster and Regina in Luna’s journal responses, but also in class discussions. Using the local study as a framework for asking questions, collecting and analyzing data, coming to conclusions, and sharing their data with their peers, Regina and Aster model how scientists peer-review data for larger scientific studies. Providing students with a model for comparing data, Regina and Aster are able to challenge students who profess to “not believe” in climate change, and to engage the class in discussion about what it means to be an informed consumer of information.

While connections to socioeconomic issues were subtle, Aster and Regina connect environmental issues to economic issues through journal prompts, like the question about drought and vernal pools, and the question about what things students can do to personally help the environment. Student responses to these questions typically focus on the environmental implications of burning fossil fuels, or large-scale corporate waste. However, these environmental implications have economic impact, which Cy, Luna, and Daisy recognize—simple acts like driving less, buying less, and recycling are small things they can do with a positive impact on the environment.

This ultimately leads to creating advocates for the environment, a goal of both Aster and Regina, throughout their time at the Field School. Students who can tell their parents about the interesting thing they’ve learned, who can push back against the dominant anti-science rhetoric with facts and reason, who tell others about the environmental issues they’ve been studying and how others can help—that’s an advocate

for the environment for life. Cy and Daisy both stand out in this area, in their marked movement from curiosity to interest to advocacy.

4. What do students learn in the summer program designed to use scientific inquiry, which may provide opportunities to explore local environmental and social issues? (Theme 2, Theme 4)

Throughout the program, students are reflecting on their experiences in their field journals, and it provides an interesting insight into their thoughts and emotions. Cy was incredibly candid in his journal responses, and in his interviews, that he was just looking for a fun thing to do for a few weeks in the summer, but he wasn't really sold on the whole experience at the start. "Before the salamander study or anything, I was kind of iffy about it—but I'm 100% glad that I came." Students find themselves focusing less on the rote learning skills of the classroom, and more on the necessary skills of field research—planning, note taking, asking questions, taking measurements, collecting data, and the whole experience of learning about the woods just beyond their own back yards.

There's an interesting distinction between what students learn from the program, compared to what they walk away from the program with. As a teenager, I could list the things we learned about—macroinvertebrates, water quality, salamanders, tree identification, forest ecotones, and backpacking. But more importantly, I walked away from the program with an amazing set of experiences in the natural world, a new peer group of like-minded students, and a genuine love for science and the outdoors that persists today, nearly 25 years after my summer in the Field School.

I see many parallels between my own experiences and those of Cy, Meg, Luna, and Daisy. In our discussions and in their journals, they focus on the experiences they've had

in the program—hiking 8 miles, trying to capture an elusive salamander, time spent in the camp playing games, the solitude of a dusky evening interrupted by Barred owls. What will Cy, Meg, Luna, and Daisy remember from their own experiences 25 years from now, reflecting on the brief time they spent at the Field School?

To me, the experiences that Regina and Aster are able to create through the curriculum at the Field School create the most durable learning. Even today, I can feel myself wading through the riffles to collect macroinvertebrates, just like I can feel the sun on my shoulders in sharp contrast to the cool water around my legs. The experience of seeing a whole world, previously invisible in the river, filled me with amazement and curiosity—to know that this is what scientists do, these are the things they can see, hidden just under a rock covered by water, made me feel like I’d been inducted into a secret society of knowledge that few people had. Cy echoes my experience, when he describes the stream near his house, “never really knowing anything was there”. But upon finding spring salamanders and some seal salamanders, “I think it’s pretty cool.”

5. How do students connect the scientific inquiry to local environmental issues, and to global environmental issues? (Theme 2, Theme 4)

The students engaged in inquiry throughout the many field studies, but especially during the salamander and forestry study. The connection that students made from their local studies to local issues was evident especially with Cy, who noted that knowing about the salamanders, and about the habitat, could help him help others understand why companies shouldn’t pollute the water, notable given the close proximity to the large paper mill in town.

Making connections to global issues is trickier, largely because Regina and Aster try to focus on the science and, while not afraid to speak their minds about socioscientific issues, like climate change, they are also cognizant of the politics of the area. But that's not to say that students don't discuss global issues in class. Luna and Daisy are an excellent example of students thinking deeply about global issues and being able to disagree with each other.

In this exchange, the two girls were discussing a quote from Muir and determining, based on their own ideas and research, if it's up to humans to intervene for the loss of a species. Luna disagreed that humans should intervene with extinction and suggested a much more hands-off approach, which demonstrated her knowledge and understanding of the process of natural selection and evolution. Daisy, on the other hand, took into account what she had learned about human interactions in the environment, as well as evolution and natural selection, and considered that humans are contributing more to species collapse, necessitating taking responsibility for repairing the balance. As she said, "eventually if we keep moving this balance...we're going to be in trouble. That's going to be our fault."

In a more metropolitan area, it wouldn't be surprising to hear students having this debate about laissez-faire environmentalism or directive environmental conservation, but for a rural area with limited social capital in the Appalachian mountains of Virginia, it's a powerful conversation. Thinking about the world beyond the small mountainous region, indeed, thinking globally about issues of environmental concern, is a new source of inquiry for these students. In my own time at the Field School, I experienced this local to global

phenomenon as described in Chapter 5, studying macroinvertebrates above and below a dam.

The dam had always been there as long as I could remember, just like the paper mill downstream. It wasn't until I had the opportunity to examine the river health above and below the dam that I started to be able to question why the structure had been built. The long story had always been about flood control downstream, but the reality was the water temperature of the river by the time it reached the mill—ready to use. Sure, the flood control was helpful, and the cold trout waters were a draw for fishermen and tourism. But I never thought to look downstream until I had the chance to study what was in my own back yard, and how that impacted the water quality for other people. The dam study was my ecological allegory—a small, local scientific study that gave me a framework for understanding a much bigger issue within the watershed. From understanding how a dam affects not just a local trout stream, but a larger regional body of water, I could extend my understanding to think more broadly about dams and rivers—like understanding the issues surrounding the Tellico Snail Darter and the Tennessee Valley Authority, once I was in college. The salamander study and the forestry study, along with the reflective journal, give students the opportunity to create their own environmental allegories, which will be discussed further in the next section.

6. How do students and teachers reflect on their experiences in this program?

(Theme 1, Theme 2, and Theme 4)

This question, I believe, gets to the heart of the program itself—what does it mean to work with students in their own backyards, teaching and learning about the local environment? What can you learn about yourself, your community, and your world, from

an encounter with a Northern slimy salamander? In short, you can learn a tremendous amount.

Students get to do these amazing things—they get to be scientists, and they get to see how important field biology, and science, are right in their hometown. As Cy said in our interview, “we don’t [usually] go outside and do stuff. The stream near my house—I looked and found a spring salamander and seal salamanders, and it’s cool that I can identify those now.” Two weeks earlier, Cy wouldn’t have been able to describe the best habitat for a salamander, nor would he likely have been able to identify one beyond a general order. Now, armed with this new knowledge, he’s exploring his own backyard in a different way, seeing things he’s never seen before. That’s the power of a program like the Field School.

Earlier, in talking with both Regina and Aster, they talk about the importance of environmental advocacy. The pathway to advocacy begins with awareness, then interest, ending in advocacy. For Cy, he can tell other people about environmental issues, and get them interested as well, to grow a base of advocates. “So more people know about it and appreciate it and can take action”, he said in our interview.

In the hours that I spent interviewing Aster and Regina, they had so many thoughts and reflections about their teaching experiences learning experiences through the years of the program. But I felt that Aster summarized her reflections best when she offered in our interview;

And I think we feel very strongly that we want the students...to appreciate and understand the resources and the local things that they have here, the really amazing

things they have around here that some people don't even know about. And that you don't have to go to exotic locales to really take advantage of it.

The treasure of the region's ecological diversity and richness, both biotic and abiotic, is important to both Aster and Regina, and they feel very strongly about helping students understand just how valuable these forests and salamanders and rivers are—not just from an ecological or environmental perspective, but also from a social and cultural perspective.

The challenge is that the process of building an environmental steward or advocate isn't something that happens over a short two or three weeks in a summer. It takes time, and a variety of experiences and exposures to conservation work, science, arguments, data, evidence, and field work. This program provides the foundation for that possibility—that a student in this program could grow to become anything, really, but primarily an advocate for their hometown, and for their environment.

When I asked Regina what she hoped students have taken away from the program, she said, "One thing I think will happen with the kids we have this summer is that as years go by, they'll realize how cool what they did was." This, at least in my own experience, has been the case, and I hope that in telling their stories, I'm able to help others take away this framework to enable other students to move from awareness to advocacy—and to become scientists along the way.

Connecting Themes to Theory

This section relates the themes back to the theoretical literature that supports this study.

Theme 1. For over three decades, an innovative outdoor field research program in a rural area engaged high school students in scientific research to promote environmental literacy within the context of the local community and environment.

Place-based education, and programs like the Field School, can easily trace their philosophical roots back to Dewey. The model for learning through lived experience is evident in the curriculum and projects that Regina and Aster present throughout the program. Their emphasis on learning real-life skills and content that directly relate to an upcoming project, like identifying salamanders or tree species, is an excellent example of Dewey's philosophy from his laboratory school (Smith and Sobel, 2010), rather than memorizing ideas for an abstract test. Students have a tangible reason to learn to identify salamanders—they need to do it in the moment, on a mountainside, potentially in the rain, and there's no high-stakes test attached, only data collection. Mis-identified salamanders are part of the data discussion that students write, but also, students take identification quizzes to make sure that are all proficient in salamander identification before going into the field, and Regina and Aster often serve as secondary checks in this process.

This experiential field-based curriculum helps students see the relevance of science to their local ecological community. Extending from Dewey to Sobel, this type of program seeks to “reclaim the heart in nature education” by creating “an opportunity to bond with the natural world, to learn to love it, before being asked to heal its wounds.” (Sobel, 1996,

p. 10). That is, in a world of increasingly mandated arbitrary testing, the instructors and students in this program have an opportunity to engage in scientific inquiry together, exploring the natural world around them, to develop an appreciation and interest in the environment, before learning how to best become stewards of their ecological community.

Greunewald states that “ecological place-based educators...are committed to fostering ecological literacy in a citizenry capable of acting for ecological sustainability” (2003b, p. 7). My interpretation of this statement is about the importance of the commitment the educators have to each other, the local environment, and nurturing ecological literacy and sustainability in their students. This commitment to ecological literacy and sustainability is evident across all areas of the curriculum at the Field School, through the instruction that Regina and Aster provide, and from the reflection journals that Desmon created. As Regina pointed out, from day one, they focus on interconnectedness, and how all of our actions are connected to ecological and social consequences. This dedication to ecological literacy and sustainability is the direct connection to place for this research study.

Theme 2. My personal experiences as a student in this program led me to understand place, science, and privilege through a lens of environmental stewardship.

Earlier in Chapter 1, I discussed my personal privilege in growing up in a family of educators, being given educational choices, opportunities for growth, and having parents supportive (if not somewhat baffled) by my interests. This privilege extends into my educational story, including my time as a doctoral student and researcher. Having the opportunity to learn about critical theory, being able to interrogate unquestioned doxa

(Bourdieu, 1977) in my hometown, even having the vocabulary to describe and name these phenomena (Freire, 2007) is part of that privilege as both a researcher and former student of the program.

With a privileged lens of critical pedagogy and critical pedagogy of place, I am able to complicate and reflect on my own participation in my memories of my time at the Field School. My developing self-awareness helped me to understand how my own journey towards environmental advocacy and stewardship. Invoking Sobel, Greunewald (2003b) notes that “Sobel (1996) describes a developmental framework for PB curriculum that begins with fostering empathy for the familiar, moves out toward exploration of the home range, and leads to social action through reinhabitation” (p. 8). This is precisely the framework that I observe in my own experience, being able to extend this understanding to other places. To me, to reinhabit a place means to recommit to its possibility, its reality, and its situationality.

In this research, I’ve tried to do just that, through a lens of critical pedagogy and critical pedagogy of place. McLaren and Giroux state that “at the most general level...a critical pedagogy must be a pedagogy of place, that is, it must address the specificities of the experiences, problems, languages, and histories that students and communities rely upon to construct a narrative of collective identity and transformation” (1990 p. 163). This specificity of place is evident throughout the data, in addition to my own experience. While I describe how my experiences helped me construct my own narrative of identity and transformation as a rural student, this pedagogy of place is necessary for understanding the data throughout my research.

My research lens is based on this idea of reinhabitation. Returning to my hometown as a teacher, as well as my own experiences in this program as a child, allowed me to examine the Field School with the understanding of both student, teacher, and researcher simultaneously. Through my upbringing and schooling in this rural area, to my experiences in teaching in this rural area, then into higher education, the cultural capital (Bourdieu, 1977) I amassed throughout my career lends a particular lens to my research in rural education. When I reflect on my own experiences as a student in this program, I can easily compare the same experiences that students in my research study have, and the level of empathy I have for their excitement and learning is tremendous.

Theme 3. Economic challenges in rural areas include environmental and educational dimensions that are connected to the global economy and climate change.

Nespor, a leading critic of Gruenewald's critical pedagogy of place, notes "places change even when we "stay put" and such continuities as they have are shaped by class, gender, and racial dynamics organized through extra-local relations of power" (2008, p. 481). That is to say, a place like Clearview is not stable, bounded, or homogenous in either theory or practice. The extra-local relationships of manufacturing jobs, timber sales, and resource extraction are connected at trans-global level not easily viewed by local citizens.

I feel confident in saying this because I was a local citizen, and I taught in those same schools during and immediately after the 2008 economic downturn. This theme was not an expected outcome of my research, and it was the hardest data chapter to write—but it was also the first, because the theme was so clear from my conversations with Desmon, Aster, and Regina. At a local level, we were all aware of the job losses at the industrial

park and at the mill, because we knew people who worked there, or whose children were in our classes. We saw the slow but steady drain from our schools, both students, but also federal and state funding. But it took analysis of our conversations about the region and the community to shock me into the recognition of the global implications of a local economic crash. For example, several major paper manufacturing lines closed at the paper mill during that time and were opened at another plant in South America with access to cheaper resources and labor. A loss of paper jobs in Clearview led to a gain of jobs in South America, and also a loss of timber resources there.

Again, I go back to Bourdieu's (1977) doxa and the unquestioned way of doing things. There's a subtext of helplessness and hopelessness in some of the teacher interview data—not on the part of the participants, but in how they see the people in the community adapting to economic reality. Dominant narratives in the community go unquestioned, from what you're expected to do once you finish high school (either work at the mill, the hotel, or leave and go to college), to economic anxiety about job losses at the mill or industrial park. No one questions these narratives—when the jobs leave, folks just drive further for work in another town. When children graduate, it's expected that they leave if they want to find a better life. This hopeless, pessimistic narrative is largely unchallenged, and the staff of the Field School see this first-hand in their interactions with the larger community. Flipping this narrative is not easy, and Regina and Aster seek to change student opinions of the community by connecting them to the amazing natural resources just outside of their doors. Through connecting with the local (Sobel, 1996), students begin to think about how their ecological and social community is connected to the region and the rest of the world through their reflective journal prompts and classroom discussion.

Ultimately, this research theme resonates with the complicated and problematic nature of critical pedagogy of place that Nespor (2008) describes. Throughout the essay, Regina, Aster, and Desmon describe the challenges of teaching and living in a place that they love, but that faces severe economic issues. While most of Gruenewald and Sobel's writing creates a positive if not heart-warming narrative about place and nature, Nespor notes that these places aren't as simple and easily bounded by geographic or social boundaries. Clearview is an example of the complicated, messy, trans-global community, and as a research context it speaks to the folks Nespor (2008) describes as "liking their stories less simple" (p. 489).

4. Students are able to understand and critique their own responsibility to the environment through connections to science, place, and environmental stewardship by participating in scientific inquiry in the field.

Gruenewald says that "the best place-based education...emerges from the particularities of places, the people who know them best (including people with indigenous roots), and the people who wonder about all the opportunities that might arise from action-oriented place study" (2008, p. 339). The opportunity that Aster and Regina provide for students comes from their own particularities of place and their history in the program and the ecological community. In this case, Regina has been working with the Field School for over 30 years and teaching biology in the local school systems for nearly 40 years. Her understanding of the local ecological community, developed through years of working alongside The Doctor, is only matched by her understanding of the community in which she lives and works. Aster, similarly, has been living in the region for over 30 years and

raised two children in the local school system. A former school board member, chemistry teacher, and avowed naturalist, she also understands the social and ecological dimensions of their community.

The model of the Field School extends the work of Sobel (1996) by helping students understand their connections to the local environment and to grapple with the challenges of environmental ethics. The meaning that students create about local issues, like the salamander study, serve as their anchor to “fostering the familiar” (Sobel, 1996), and helping them extend and “transfer their learning to a different context” (Sobel, 2010, p. 32), like thinking about the effects of climate change. Not only do students begin to think about their own personal responsibility as stewards of the environment, they begin to think critically about what their impact might be in the future, as exemplified in the conversation between Luna and Daisy about climate change.

Connecting this study of critical pedagogy of place to ecojustice is evident when considering how Martusewicz et al. describe an ecojustice framework “as situational, local, and supportive of all living systems” (2010 p. 22). Students spend hours in the field learning about the living systems of their ecological communities, examining the ways their local community and values interact with the biotic and abiotic environment. As Glasson (2011) notes, ecojustice education doesn’t have to focus on global environmental crises, but should focus on the local community, and should be culturally mediated. To read through the journal entries and transcripts of interviews with students, it’s evident that they are learning from an ecojustice framework supported through critical pedagogy of place. This ecojustice framework looks more like a moral discussion about the implications of local species extinction rather than a radical ecojustice of direct action, like

occupying tree canopies to prevent logging or physically attaching oneself to a large piece of excavation machinery to prevent gas pipeline construction. There is certainly an argument for the former ecojustice education over the latter.

Perhaps this is the best example of the practice of critical pedagogy of place. Gruenewald states that critical pedagogy of place “means making a place for the cultural, political, economic, and ecological dynamics of places whenever we talk about the purpose and practice of learning” (2003b, p. 11). While students in the program don’t explicitly take up politics, they do end up discussing political and economic dimensions of personal responsibility to the natural world. I’d like to think this is what Sobel (1996) means when he talks about “reclaiming the heart of nature education”, that students are able to learn not just about their local ecosystems but also to deeply care about the ecological and social communities in which they are situated.

The Field School, through its curriculum and instructors, is an excellent example of a critical pedagogy of place within the context of a place-based environmental education program. Not only do the data illustrate Sobel’s (1996) “fostering the familiar” for students through specific scientific studies, but student reflections help extend this understanding beyond their own communities, to the global implications of local action. This study takes Gruenewald’s critical pedagogy of place (2003b), and critique by Nespor (2008), and shows the importance and complexity of these types of studies—place is not neatly bounded in our global economy, but we need a starting place to help children understand the importance of where they stand, and why. Through the lens of critical pedagogy of place, recognizing the complexities of the social and ecological interactions on the local and global scales, we can begin to help children (and even adults) untangle

these complex interactions to understand the environmental and social challenges of the present and future.

CHAPTER 9

DISCUSSION AND IMPLICATIONS

There are few opportunities to engage in real-world applications of science as children, particularly in rural areas with limited socioeconomic means and geographic isolation. My time with the Field School, highlighted in the prior chapters, illustrates the power of rural place-based educational programs, despite economic hardship in the area. As I mentioned in *The Fall*, not having studied economics and not being particularly well-equipped to dissect the particularities of a national economic downturn that hit rural Appalachia especially hard, it doesn't take an expert to see how the community and school systems have been affected. But the unifying concept that I saw, and felt, throughout the essay analysis was a deep connection to place.

Place is a difficult construct to unravel on many levels. From the PBE literature, it can take on a nearly transcendental aura, almost Lake Wobegon-like, where above-average children engage in critical thinking about social justice issues, both local and global, while tending a community garden that also serves as a butterfly habitat and rain garden to mitigate storm runoff. Similarly, the work of PBE can be read through the lens of self-reliant Walden Pond, where immersion in nature is the anecdote to modern maladies, and through nature both children and adults are able to reconnect to the Earth in spiritual and physical ways.

Sobel (2004), who arguably writes the standard for PBE states “Emphasizing hands-on, real-world learning experiences, this approach to education increases academic achievement, helps students develop stronger ties to their community, enhances students’ appreciation for the natural world, and creates a heightened commitment to serving as

active, contributing citizens.” (p.4). In the world of PBE, one can’t help but feel positive and upbeat, hopeful about the future of both the children in the classroom program and of their communities and the environment they will inherit. Similarly, Greenwood’s work (2008; Gruenewald, 2003b, 2003a) in critical pedagogy of place complicates the simplicity of place-based education, and emphasizes the importance of culture, community, and the commons as it relates to both education and the environment. While Greenwood’s outlook may be slightly less rosy than Sobel’s, one can’t help but feel as if the world would be a better place if only more education programs embraced critical pedagogy of place.

My research does not aim to romanticize the notion of place-based education, or critical pedagogy of place. Rather, what I have found is quite the opposite—in an economically struggling community, dependent on resource extraction, a summer program to teach children about field biology and ecology through inquiry-based teaching and real-world scientific application is often just that—a summer program. A summer program, struggling to attract students, to maintain financial solvency, to survive both subtle and cataclysmic shifts in culture and politics, is hardly the standard bearer of modern place-based education practice reflected in the literature. It is not glamorous work in the field. There are mosquitoes, ticks, cockleburs that stick to everything, blisters, sudden afternoon rainstorms, tired and cranky students, wet tents, aging field equipment, and critters splashing in the creek at 2 am. These details are often left from the literature on place-based education or critical pedagogy of place programs, in favor of higher-minded goals like teaching democracy or fighting social injustice.

But I argue that this is exactly the kind of critical pedagogy of place and place-based education program that rural communities need, and that should be more broadly

reflected in the literature. In geographically isolated areas, like western Virginia, access to high-quality science education programs are extremely limited. Parents with the financial means to send their children away to summer camps with STEM or environmental science programs will continue to do so, but a community-based program, like the Field School, serves a critical need in an area with limited financial resources and an abundance of natural resources.

In this study, dedicated instructional staff were able to navigate the community beliefs and politics in a subtle and masterful way—while maintaining scientific integrity and dependence on factual claims, evidence, and reasoning. In fact, I argue that the staff of the Field School are one of its greatest assets. As Gruenewald (2003b) states, educators must “reflect on the relationship between the kind of education they pursue and the kind of places we inhabit and leave behind for future generations” (p.3). This reflection is evident throughout the curriculum and the teaching practices of the instructors at the Field School.

Regina and Aster are truly masters of both teaching and subversion. That is, they lead instruction with counterpoints to their own arguments, common pitfalls that students may find in an argument against, say, climate change, and bring the conversation back to factual analysis—challenging students to refute with evidence. Aster and Regina are not quiet about their scientific knowledge or conservation beliefs, and particularly in community circles rife with hunters, their strategy of bringing “the other” to the table is centered in conservation biology—a well-managed deer herd is healthier, more robust, and better for the environment than an overpopulated, starving, diseased herd. The consequence of this round-table approach to teaching conservation and environmental science through place-based education, is that it tends to create less animus by sharing

what's important to all stakeholders and building consensus, by extension, modeling the community ideals of science.

It's important to note that science is not a value-neutral enterprise, but that in a democratic society, science should be open to all voices, should include multiple sources of evidence, and should represent multiple social values. Instead, we often see science as an enterprise dominated by special interests and financial gain, where evidence is presented by the wealthy or the privileged without opportunity for refutation. Place-based education, by situating science in a local issue, forces participants to include the community values in the discussion of the evidence.

The Field School didn't start out with a place-based ethos, and as such, the meaning of place within the context of the curriculum is not explicit—instead, it's a subtext that runs throughout the program, invisible to those without the interest or knowledge of place-based education. The notion of place is not a cultural concept or tied to a specific educational outcome. Instead, the concept of place is an ecological allegory—as students learn about the environmental context of the local salamander population, they learn about indicator species, habitat, niche, and other scientific concepts related to the field study. This local study is then used as a case to understand the local effects of climate change, without explicitly teaching climate change science. Instead, climate change is taught inductively in this way, using student-driven data and evidence from the study as part of the evidence toward anthropogenic climate change.

In the years since I collected my data, climate change has become even more prevalent in national discussions, although perhaps not to the proportion that those of us in environmental education would have hoped. The model of the Field School, however,

provides a compelling progression of learning about climate change from a data-driven, local perspective. While not all communities (ecological or otherwise) will have access to salamanders, there are a number of biotic and abiotic factors that students can study at the local level that will ultimately be affected by climate change.

In the Field School, instead of being at the foreground of instruction, the notion of place is held as an intermediary space between the scientific concepts being taught and the sociocultural implications of climate change. Place—the backyard of the students—is the factor that allows students to make the jump from a single year of salamander counting to the longitudinal data analysis to evidence of climate change within the last 20 years. The idea that the salamander study can be an ecological allegory for global climate change is this—if a student can collect evidence about salamanders in their hometown, on their mountain, and compare this data to the studies other students have done here, and see changes in population density and elevation over time, and they can map those changes to weather patterns over the same time, and they can create their own understanding of how climate change affects their hometown. With this student-centered approach, where students are making the meaning from the data themselves, the scientific story they create about the salamanders becomes allegorical for other indicator species in other places around the world. It creates a framework for them to look at data from other studies related to climate change and make meaning from it.

This framework functions in much the way that Zeidler (2016) describes socioscientific reasoning, or SSR, in that the Field School makes possible the “transformative shifts in students’ core epistemic beliefs” (p. 16). This is the brilliance of

the Field School—planting the seeds of environmental conservation, environmental ethics, and ecojustice through reflective learning experiences couched in scientific field studies.

Programs like the Field School are able to plant the seeds of scientific inquiry, curiosity, conservation ethics, and environmentalism, while using the social, biotic, and abiotic communities that the students know to deepen student understanding about ecological communities and the interconnectedness of humans and nature. At a superficial level, this is the best of conservation education and field work combined. Viewed at a deeper level, this is an elegant model of the possibility of critical pedagogy of place and ecojustice education in rural Appalachia.

Karrow and Fazio (2010) note that “the aim of ecojustice is to develop an understanding of the tensions between cultures and the needs of the Earth’s ecosystems” (p. 210). This recognition and careful examination of the tension between society and the environment is a hallmark of the Field School curriculum, and evidence of the commitment to ecojustice. It’s also important to note that ecojustice doesn’t have to be radical to be transformative, as is the case with the curriculum at the Field School. Because the instructors are so conscious of the political climate of the region, their ecojustice curriculum goes unchallenged precisely because it is not seen as radical.

Greunewald (2003b) states that “place...foregrounds a narrative of local and regional politics...attuned to the particularities of where people actually live, and that is connected to global development trends that impact local places.” (p.3) While place is not in the explicit foreground of the Field School, it is substantially part of the curriculum, and the instructors take great care to note the particularities of the community in which their students reside. The elegance of the Field School is the ease with which the instructors are

able to entwine ecojustice narratives with local politics and the local environment, without doing so explicitly. It is no surprise that students create their own conservation ethics or begin to think about environmental advocacy in this way.

It is important to revisit Nespor's (2008) critique of critical pedagogy of place and place-based education, largely because the theoretical constructs of both PBE and CPP tend towards narratives of place bounded by geographical or temporal boundaries. This is convenient, theoretically, to orient education in a place or about a place in such a way as to define the learning objectives and community-based outcomes. However it's important to recognize that local places have global implications, and vice-versa.

The argument that people are place-ignorant is an important part of Nespor's critique of PBE and CPP, as most assumptions in PBE and CPP are grounded in needing to learn about place in order to value it. As Nespor (2008) puts it:

Instead of following a PBE narrative that constructs people as unconscious of their immediate environments, we could give people the benefit of the doubt and assume that all of us think and care about the places we stand, but that most of us have trouble understanding how these places have come to be or might be changed. This is not because we are inattentive to them or do not have good roots, but because the other places to which they are connected, and in relation to which they are constituted, are hidden from our view, segregated from our everyday concerns, by circuits of communication, representation, and education. (p.487)

The context of Clearview and the Field School is an excellent example of this—of course people care about the places they live. However, they may not have a complete understanding of how their place connects to the places of others, or the history of the

place, the people who are no longer represented by the place, or the representations of the place that are not widely communicated.

The paper mill in Clearview is a primary example of a local issue with global implications. Aster shared with me the postcard touting the clear water and timber resources of the region, and noted that a paper mill had been in the area since the 1800's. As the US economy shifted from timber to steel, the mill shifted from timber to paper products. As global trade markets flourished, paper products became an important part of the local economy—items shipped for export to other countries. This hyper-local example of the paper mill highlights what Nesor means when he talks about giving folks the benefit of the doubt, that people care about where they live, but they don't often have the opportunity, the experience, or even the vocabulary to describe the global implications for their local place.

Nesor (2008) goes on to state, “[T]he question, then, is not whether or not we are place conscious, it is the places of which we are conscious.” (p. 487). How does one become conscious of a place, or of the multiple dimensions of place? My opinion is that without interrogating a place, without examining what may have been hidden from our view, what discourse may have been unchallenged, it is impossible to create a concept of place. This notion of doxa, from Bourdieu (1977) is easily applied to Nesor's argument. Without uncovering the unquestioned, without challenging the dominant discourse, without seeking to answer who, what, where, why, and to what aim, it is difficult to become place-conscious. The Field School gives students an opportunity to become conscious of their local environment in a different way, to create a different discourse couched in science, and to challenge dominant sociopolitical discourses (Aster's “Fox Party Line”) with evidence.

Implications

The work that the staff at the Field School do is invaluable to the region they service. Opportunities like this are extremely important for all children, but particularly for students living in geographically isolated, natural-resource rich areas, where access to authentic STEM education may be limited. An unfortunate side effect of increased emphasis on testing and data-driven instruction, students rarely have an opportunity to take their learning outside into local community or environmental contexts during the regular school year. Learning opportunities like the Field School are only possible in most public K12 settings during the summer—at a time when most students are either looking to escape “learning” focusing on sports camps, or working summer jobs.

Place-based education, combined with critical pedagogy of place, offers rural teachers the opportunity to explore their communities in a much more nuanced way, helping students value the natural and cultural resources of their hometowns. While my study focused on environmental science, place-based pedagogy is widely applicable across the curriculum and can serve an important point of connection between the school community and the local community—an area in which relations can sometimes be strained.

As the Field School enters into a 35th year in 2020, perhaps a different set of questions should be posed—what has the cumulative effect of the Field School been over the past three and a half decades? Who were the students, and what are they doing now? How did their time at the Field School influence their career choices, or their non-professional interests? What do they remember most from their experiences at the Field School, and why has this been important? As a program already running on a shoestring

budget, an analysis of the past program participants could encourage greater financial participation from the local community college and other school districts.

In concluding, I think back to the long afternoon Regina and I spent on her porch, talking about the past thirty years of the program. The sun was setting behind the mountain, crickets were chirping, and the first lightning bugs of August were blinking in the tall grass. “You were one of ours. Do you really think your attendance at the Field School is the reason you’re where you are?” I pondered for a minute. “It’s not the only reason.”

“Right.” Regina said.

“But it’s a pretty big reason.” I replied.

REFERENCES

- About the No Child Left Inside Act. (2011). Retrieved from <http://www.cbf.org/ncli-federal-microsite/pages/ncli---solution---about-act>
- Avery, L. M., & Kassam, K. (2011). Phronesis : Children ' s Local Rural Knowledge of Science and Engineering. *Journal of Research in Rural Education*, 26(2), 1–15. Retrieved from <http://jrre.psu.edu/articles/26-2.pdf>
- Barton, A. C., & Tan, E. (2010). We Be Burnin'! Agency, Identity, and Science Learning. *Journal of the Learning Sciences*, 19(2), 187–229. <https://doi.org/10.1080/10508400903530044>
- Becker, H. (1998). *Tricks of the trade; How to think about your research while you're doing it*. Chicago: University of Chicago Press.
- Billings, D., & Blee, K. (2000). Introduction. In *The road to poverty: The making of wealth and hardship in Appalachia* (pp. 3–24). Cambridge: Cambridge University Press.
- Bingman, M. B. (1993). Stopping the bulldozers. In S. L. Fisher (Ed.), *Fighting back in Appalachia: Traditions of resistance and change*. Philadelphia: Temple University Press.
- Bochner, A., & Ellis, C. (1992). Personal narrative as a social approach to interpersonal communication. *Communication Theory*, 2(2), 165–172.
- Bourdieu, P. (1977). *Outline of a theory of practice. (Esquisse d'une théorie de la pratique)*. Transl. by Richard Nice. (Repr.). Retrieved from <http://books.google.com/books?id=WvhSEMrNWHAC&pgis=1>
- Bowers, C. a. (2008). Why a critical pedagogy of place is an oxymoron. *Environmental Education Research*, 14(3), 325–335. <https://doi.org/10.1080/13504620802156470>

- Campbell, A. M., & Yates, G. C. R. (2011). Want to be a country teacher ? No, I am too metrocentric. *Journal of Research in Rural Education*, 26(4).
- Davies, B., & Saltmarsh, S. (2007). Gender economies: literacy and the gendered production of neo-liberal subjectivities. *Gender and Education*, 19(1), 1–20.
<https://doi.org/10.1080/09540250601087710>
- Dewey, J. (1969). *School and Society*. Chicago: University of Chicago Press.
- Dopico, E., & Garcia-Vazquez, E. (2010). Leaving the classroom: a didactic framework for education in environmental sciences. *Cultural Studies of Science Education*, 6(2), 311–326. <https://doi.org/10.1007/s11422-010-9271-9>
- Duncan, C. (1999). *Worlds Apart*. New Haven: Yale University Press.
- Elder, J. (Ed.). (1998). *Stories in the land: a place-based environmental education anthology*. Great Barrington, MA: Orion Society.
- Ellis, C. (2004). *The Ethnographic I*. Walnut Creek, CA: AltaMira Press.
- Fisher, S. L. (Ed.). (1993). *Fighting back in Appalachia: Traditions of resistance and change*. Philadelphia: Temple University Press.
- Freire, P. (1998). *Pedagogy of Freedom*. Lanham, MD: Rowan and Littlefield.
- Freire, P. (2007). *Pedagogy of the Oppressed* (30th Anniv; D. Ramos, Myra Bergman, Macedo, Ed.). New York: Continuum.
- Giroux, H. A. (2009). Critical Theory and Educational Practice. In Antonia Darder, M. P. Baltodano, & R. D. Torres (Eds.), *The Critical Pedagogy Reader* (Second Edi). New York: Routledge.
- Glasson, G. E. (2009). Revitalization of the shared commons: education for sustainability and marginalized cultures. *Cultural Studies of Science Education*, 5(2), 373–381.

<https://doi.org/10.1007/s11422-009-9243-0>

Glasson, G. E. (2011). Global environmental crisis: is there a connection with place-based, ecosociocultural education in rural Spain? *Cultural Studies of Science Education*, 6(2), 327–335. <https://doi.org/10.1007/s11422-011-9321-y>

Goodall, H. L. (2000). *Writing the new ethnography*. Lanham, MD: Rowman and Littlefield, Inc.

Greenwood, D. (2008). A critical pedagogy of place: from gridlock to parallax. *Environmental Education Research*, 14(3), 336–348.

<https://doi.org/10.1080/13504620802190743>

Gruenewald, D. A. (2003a). Foundations of place: A multidisciplinary framework for place-conscious education. *American Educational Research Journal*, 40(3), 619–654. Retrieved from <http://aer.sagepub.com/content/40/3/619.short>

Gruenewald, D. A. (2003b). The best of both worlds: A critical pedagogy of place. *Educational Researcher*, 32(4), 3–12. Retrieved from

<http://edr.sagepub.com/content/32/4/3.short>

Hutchison, R. (2012). Stop the bombs: Local organizing with global reach. In S. L. Fisher & B. E. Smith (Eds.), *Transforming Places: Lessons from Appalachia*. Chicago: University of Illinois Press.

Kincheloe, J. L. (2008). *Critical Pedagogy Primer* (2nd ed.). New York: Peter Lang.

Kobak, S. E. (2012). OxyContin flood in the coalfields: “Searching for Higher Ground.” In S. L. Fisher & B. E. Smith (Eds.), *Transforming Places: Lessons from Appalachia*. Chicago: University of Illinois Press.

Lave, J., & Wenger, E. (1991). *Situated learning: legitimate peripheral participation*.

Retrieved from

<http://books.google.com/books?hl=en&lr=&id=CAVIOrW3vYAC&pgis=1>

Lim, M. (2010). Historical consideration of place: inviting multiple histories and narratives in place-based education. *Cultural Studies of Science Education*, 5(4), 899–909.

<https://doi.org/10.1007/s11422-010-9276-4>

Louv, R. (2005). *Last child in the woods: Saving our children from nature-deficit disorder*.

Chapel Hill: Algonquin Books.

Massey, D. (1994). *Space, Place, and Gender*. Minneapolis: University of Minnesota

Press.

McLaren, P. (2009). Critical Pedagogy: A Look at the Major Concepts. In A. Darder, M.

Baltodano, & R. Torres (Eds.), *The Critical Pedagogy Reader* (Second Edi). New

York: Routledge.

McLaren, P., & Giroux, H. (1990). Critical Pedagogy and Rural Education : A Challenge

From Poland. *Peabody Journal of Education*, 67(4), 154–165.

Mellor, M. (1997). *Feminism and Ecology*. New York: New York University Press.

Mesman, J. (2007). Disturbing Observations as a Basis for Collaborative Research. *Science*

as Culture, 16(3), 281–295. <https://doi.org/10.1080/09505430701568685>

Mueller, M. P. (2011). Ecojustice in science education: leaving the classroom. *Cultural*

Studies of Science Education, 6(2), 351–360. [https://doi.org/10.1007/s11422-011-](https://doi.org/10.1007/s11422-011-9333-7)

9333-7

Nespor, J. (2008). EDUCATION AND PLACE : A REVIEW ESSAY. *Educational*

Theory, 58(4), 475–490.

Nganga, L., & Kamutu, J. (2009). Teaching for democracy and social justice in rural

- settings: Challenges and pedagogical opportunities. In S. L. Groenke & J. A. Hatch (Eds.), *Critical Pedagogy and Teacher Education in the Neoliberal Era* (pp. 191–204). <https://doi.org/10.1007/978-1-4020-9588-7>
- Orr, D. (1992). *Ecological literacy: Education and the transition to a postmodern world*. Albany: State University of New York Press.
- Outward Bound History. (2013). Retrieved from <http://www.outwardbound.org/about-outward-bound/history/>
- PLT, Who we are. (n.d.). Retrieved from <http://www.plt.org/who-we-are>
- Reid, H., & Taylor, B. (2002). Appalachia as a global region: Toward critical regionalism and civic professionalism. *Journal of Appalachian Studies*, 8(1), 9–32.
- Rossman, G., & Rallis, S. (2012). *Learning in the field* (Third). Thousand Oaks, CA: Sage.
- Satterwhite, E. (2011). *Dear Appalachia*. Lexington: The University Press of Kentucky.
- Satterwhite, E. (2013). Intro to Appalachian studies: Navigating myths of Appalachian exceptionalism. In T. Burriss & P. Gantt (Eds.), *Appalachia in the Classroom: Teaching the Region*. Athens: Ohio University Press.
- Scott, R. R. (2010). *Removing Mountains*. Minneapolis: University of Minnesota Press.
- Seidman, I. (2006). *Interviewing as Qualitative Research* (Third). New York: Teachers College Press.
- Semken, S., & Freeman, C. B. (2008). Sense of place in the practice and assessment of place-based science teaching. *Science Education*, 92(6), 1042–1057.
<https://doi.org/10.1002/sce.20279>
- Shapiro, H. D. (1978). *Appalachia on our mind: The southern mountains and mountaineers*

- in the American consciousness, 1870-1920*. Chapel Hill: The University of North Carolina Press.
- Shearer, R. (2012). RAIL Solution: Taking on Halliburton on the home front. In S. L. Fisher & B. E. Smith (Eds.), *Transforming Places: Lessons from Appalachia*. Chicago: University of Illinois Press.
- Silber, N. (2001). What does America need so much as Americans? In J. Inscoe (Ed.), *Appalachians and Race: The mountain south from slavery to segregation*. Lexington: University Press of Kentucky.
- Smith, B. E. (1999). Legends of the fall: Contesting Economic History. In B. J. Leonard (Ed.), *Christianity in Appalachia* (1st ed., pp. 1–17). Knoxville: University of Tennessee Press.
- Smith, B. E. (2004). De-Gradations of Whiteness: Appalachia and the complexities of race. *Journal of Appalachian Studies*, 10(1 and 2), 38–57.
- Smith, G., & Sobel, D. (2010). Place- and Community-based Education: Definitions and Antecedents. In *Place and community based education in schools*. New York: Routledge.
- Sobel, D. (1996). *Beyond ecophobia: reclaiming the heart in nature education*. Great Barrington, MA: Orion Society.
- Sobel, D. (2004). *Place-based education: connecting classrooms and communities*. Great Barrington, MA: Orion Society.
- St. Pierre, E. a. (1997). Nomadic inquiry in the smooth spaces of the field: A preface. *International Journal of Qualitative Studies in Education*, 10(3), 365–383.
- <https://doi.org/10.1080/095183997237179>

- Steinberg, S. R., & Kincheloe, J. L. (2012). Second International Handbook of Science Education. In B. J. Fraser, K. Tobin, & C. J. McRobbie (Eds.), *Second International Handbook of Science Education* (pp. 1485–1500). <https://doi.org/10.1007/978-1-4020-9041-7>
- Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Thousand Oaks, CA: Sage.
- USDA National School Lunch Community Eligibility Provision. (n.d.). Retrieved September 19, 2018, from <https://www.fns.usda.gov/school-meals/community-eligibility-provision>
- van Eijck, M., & Roth, W.-M. (2010). Towards a chronotopic theory of “place” in place-based education. *Cultural Studies of Science Education*, 5(4), 869–898. <https://doi.org/10.1007/s11422-010-9278-2>
- van Eijck, M., & Roth, W.-M. (2013). Place and Chronotope. In *Cultural Studies of Science Education: Vol. 7. Imagination of Science in Education*. <https://doi.org/10.1007/978-94-007-5392-1>
- VDOE Community Eligibility Program Reports. (n.d.). Retrieved September 23, 2018, from <http://www.doe.virginia.gov/support/nutrition/statistics/index.shtml>
- Walls, D. (1978). Internal Colony or Internal Periphery? A critique of current models and an alternative formulation. In H. M. Lewis, L. Johnson, & D. Askins (Eds.), *Colonialism in modern America: The Appalachian case* (pp. 319–349). Boone: Appalachian Consortium Press.
- What is Project WET? (n.d.). Retrieved from <http://projectwet.org/water-education-project-wet/water-education-project-wet/>

WILD Through the Years. (n.d.). Retrieved from

<http://www.projectwild.org/ProjectWILDChronology.htm>

Wood, H. (2013). NOLS History. Retrieved from

http://www.nols.edu/about/history/nols_history.shtml

Zeidler, D. L. (2016). STEM education: A deficit framework for the twenty first century?

A sociocultural socioscientific response. *Cultural Studies of Science Education*, 11(1),

11–26. <https://doi.org/10.1007/s11422-014-9578-z>

APPENDICES

Appendix A

IRB Protocol (Amended) Institutional Review Board

Research Protocol

Once complete, upload this form as a Word document to the IRB Protocol Management

System: <https://secure.research.vt.edu/irb>

Section 1: General Information

1.1 DO ANY OF THE INVESTIGATORS OF THIS PROJECT HAVE A REPORTABLE CONFLICT OF INTEREST?

(<http://www.irb.vt.edu/pages/researchers.htm#conflict>)

No

Yes, explain:

1.2 WILL THIS RESEARCH INVOLVE COLLABORATION WITH ANOTHER INSTITUTION?

No, go to question 1.3

Yes, answer questions within table

IF YES

Provide the name of the institution [for institutions located overseas, please also provide name of country]:

Indicate the status of this research project with the other institution's IRB:

Pending approval

Approved

Other institution does not have a human subject protections review board

Other, explain:

Will the collaborating institution(s) be engaged in the research?

(<http://www.hhs.gov/ohrp/policy/engage08.html>)

No

Yes

Will Virginia Tech's IRB review all human subject research activities involved with this project?

No, provide the name of the primary institution:

Yes

Note: primary institution = primary recipient of the grant or main coordinating center

1.3 IS THIS RESEARCH FUNDED?

No, go to question 1.4

Yes, answer questions within table

IF YES

Provide the name of the sponsor [if NIH, specify department]:

Is this project receiving federal funds?

No

Yes

If yes,

Does the grant application, OSP proposal, or "statement of work" related to this project include activities involving human subjects that are not covered within this IRB application?

No, all human subject activities are covered in this IRB application

Yes, however these activities will be covered in future VT IRB applications, these activities include:

Yes, however these activities have been covered in past VT IRB applications, the IRB number(s) are as follows:

Yes, however these activities have been or will be reviewed by another institution's IRB, the name of this institution is as follows:

Other, explain:

Is Virginia Tech the primary awardee or the coordinating center of this grant?

No, provide the name of the primary institution:

Yes

1.4 DOES THIS STUDY INVOLVE CONFIDENTIAL OR PROPRIETARY INFORMATION (OTHER THAN HUMAN SUBJECT CONFIDENTIAL INFORMATION), OR INFORMATION RESTRICTED FOR NATIONAL SECURITY OR OTHER REASONS BY A U.S. GOVERNMENT AGENCY?

For example – government / industry proprietary or confidential trade secret information

No

Yes, describe:

1.5 DOES THIS STUDY INVOLVE SHIPPING ANY TANGIBLE ITEM, BIOLOGICAL OR SELECT AGENT OUTSIDE THE U.S?

No

Yes

Section 2: Justification

2.1 DESCRIBE THE BACKGROUND, PURPOSE, AND ANTICIPATED FINDINGS OF THIS STUDY:

Environmental Education in Appalachia is an under-researched area, due to the paucity of research in Rural areas, especially in science education. There are a number of significant environmental issues in the Appalachian region, from deforestation to coal mining, that significantly impact these rural areas in environmental, social and economic contexts. My purpose in this study is to understand how teachers in rural areas teach about resource conservation, their purposes for doing so, how their students typically respond, and to understand their lived experiences teaching environmental education (or science/resource conservation) in rural areas. I also want to investigate what students learn in these classes, and how it informs their understanding of their local community, and their global connections to environmental issues.

I anticipate finding that teachers in these areas are passionate about their students and their communities, and seek to find middle ground between the economic interests of extractive resource consumption, and environmental stewardship, educating their students to be critical citizens in their communities. I also anticipate finding that students who participate in these environmental programs are able to describe local environmental issues in greater detail, and have an enhanced understanding of the scientific and societal issues in their communities.

2.2 EXPLAIN WHAT THE RESEARCH TEAM PLANS TO DO WITH THE STUDY RESULTS:

For example - publish or use for dissertation

The results from this study will be used for my dissertation work, and potentially for publication in educational journals or at academic conferences.

Section 3: Recruitment

3.1 DESCRIBE THE SUBJECT POOL, INCLUDING INCLUSION AND EXCLUSION CRITERIA AND NUMBER OF SUBJECTS:

Examples of inclusion/exclusion criteria - gender, age, health status, ethnicity

The subject pool will contain science teachers in Appalachia, and their students, either secondary or middle. Teachers and students should be located within rural areas as identified by Virginia State standards, and should fall within the ARC definition of Appalachia. The expected subject pool will be 5-7 teachers and 15- 22 students.

3.2 WILL EXISTING RECORDS BE USED TO IDENTIFY AND CONTACT / RECRUIT SUBJECTS?

Examples of existing records - directories, class roster, university records, educational records

No, go to question 3.3

Yes, answer questions within table

IF YES

Are these records private or public?

Public

Private, describe the researcher's privilege to the records:

Will student, faculty, and/or staff records or contact information be requested from the University?

No

Yes, visit the following link for further information: <http://www.policies.vt.edu/index.php>
(policy no. 2010)

3.3 DESCRIBE RECRUITMENT METHODS, INCLUDING HOW THE STUDY WILL BE ADVERTISED OR INTRODUCED TO SUBJECTS:

Subjects will be recruited through personnel connections in school systems, and teacher participants will receive an introductory email detailing the study and asking for their participation. To recruit student participants, once a teacher has been identified as a participant, an introductory letter will be sent to the parent/guardian of their students informing them of the opportunity to participate in this research study.

3.4 PROVIDE AN EXPLANATION FOR CHOOSING THIS POPULATION:

Note: the IRB must ensure that the risks and benefits of participating in a study are distributed equitably among the general population and that a specific population is not targeted because of ease of recruitment.

The teachers in this subject pool were chosen on the basis of their interest in teaching environmental education and science/resource conservation in rural areas of Appalachia. There are numerous studies that reference teachers of environmental education or environmental science in the general population, but none focus on the experience of teaching this science in rural areas, nor do they focus on student experiences of learning science in rural areas. Appalachia is considered to be a high-need and under-served area, and the experiences of these teachers and students are an under-researched segment of the school population.

Section 4: Consent Process

For more information about consent process and consent forms visit the following link:

<http://www.irb.vt.edu/pages/consent.htm>

If feasible, researchers are advised and may be required to obtain signed consent from each participant unless obtaining signatures leads to an increase of risk (e.g., the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting in a breach of confidentiality). Signed consent is typically not required for low risk questionnaires (consent is implied) unless audio/video recording or an in-person interview is involved. If researchers will not be obtaining signed consent, participants must, in most cases, be supplied with consent information in a different format (e.g., in recruitment document, at the beginning of survey instrument, read to participant over the phone, information sheet physically or verbally provided to participant).

4.1 CHECK ALL OF THE FOLLOWING THAT APPLY TO THIS STUDY'S CONSENT PROCESS:

Verbal consent will be obtained from participants

Written/signed consent will be obtained from participants

Consent will be implied from the return of completed questionnaire. Note: The IRB recommends providing consent information in a recruitment document or at the beginning of the questionnaire (if the study only involves implied consent, skip to Section 5 below)

Other, describe:

4.2 PROVIDE A GENERAL DESCRIPTION OF THE PROCESS THE RESEARCH TEAM WILL USE TO OBTAIN AND MAINTAIN INFORMED CONSENT:

Teacher participants will be provided with a consent form after agreeing to participate in the study. The consent form will be given to the participant in person, prior to any data collection, and will be explained by the researcher. Student participants will be provided with an assent form, and their parents/guardians will be provided with a permission/consent form. Forms will be mailed to student participants with an introduction letter including a URL for electronic completion of the forms in Qualtrics, and will be collected prior to any data collection. Parents and students have the option of returning the forms in person, by mail, or completing the Qualtrics survey.

4.3 WHO, FROM THE RESEARCH TEAM, WILL BE OVERSEEING THE PROCESS AND OBTAINING CONSENT FROM SUBJECTS?

Jessica Stephenson will obtain and maintain all consent forms. George Glasson will oversee the process and provide guidance as needed.

4.4 WHERE WILL THE CONSENT PROCESS TAKE PLACE?

Teacher consent will take place on-location and in person, at the convenience of the teacher participant, prior to any data collection. Student assent/parental consent will take place prior to data collection, with on location and in-person follow-up.

4.5 DURING WHAT POINT IN THE STUDY PROCESS WILL CONSENTING OCCUR?

Note: unless waived by the IRB, participants must be consented before completing any study procedure, including screening questionnaires.

Consent will be provided by teachers, parents and student participants prior to any data collection or interview.

4.6 IF APPLICABLE, DESCRIBE HOW THE RESEARCHERS WILL GIVE SUBJECTS AMPLE TIME TO REVIEW THE CONSENT DOCUMENT BEFORE SIGNING:

Note: typically applicable for complex studies, studies involving more than one session, or studies involving more of a risk to subjects.

Not applicable

Section 5: Procedures

5.1 PROVIDE A STEP-BY-STEP THOROUGH EXPLANATION OF ALL STUDY PROCEDURES EXPECTED FROM STUDY PARTICIPANTS, INCLUDING TIME COMMITMENT & LOCATION:

Study procedures from participants include two to three semi-structured interviews, approximately thirty minutes each. The interviews can take place at a time and location convenient to the participants. For teacher participants, this may be out of school. For student participants, all interviews will be conducted during normal program hours. Additionally, the researcher may observe up to five classes as a participant observer during teaching sessions about resource conservation.

5.2 DESCRIBE HOW DATA WILL BE COLLECTED AND RECORDED:

Field notes will be typed on computer or written on paper, depending on location. Interviews will be recorded electronically using a digital recorder, and will be uploaded to a computer for transcription.

Additional paper artifacts, including class handouts, activity sheets, journal entries, lab materials, and classroom itineraries, may be collected as well.

5.3 DOES THE PROJECT INVOLVE ONLINE RESEARCH ACTIVITIES

(INCLUDES ENROLLMENT, RECRUITMENT, SURVEYS)?

View the “Policy for Online Research Data Collection Activities Involving Human Subjects” at <http://www.irb.vt.edu/documents/onlinepolicy.pdf>

No, go to question 6.1

Yes, answer questions within table

IF YES

Identify the service / program that will be used:

www.survey.vt.edu, go to question 6.1

Blackboard, go to question 6.1

Center for Survey Research, go to question 6.1

Other

IF OTHER:

Name of service / program: **Qualtrics**

URL: **<http://tinyurl.com/vt2014vt>**

This service is...

Included on the list found at: <http://www.irb.vt.edu/pages/validated.htm>

Approved by VT IT Security

An external service with proper SSL or similar encryption (<https://>) on the login (if applicable) and all other data collection pages.

None of the above (note: only permissible if this is a collaborative project in which VT individuals are only responsible for data analysis, consulting, or recruitment)

Section 6: Risks and Benefits

6.1 WHAT ARE THE POTENTIAL RISKS (E.G., EMOTIONAL, PHYSICAL,

SOCIAL, LEGAL, ECONOMIC, OR DIGNITY) TO STUDY PARTICIPANTS?

There are minimal risks to participation in this study. Risks to participant are no greater than the risks associated with normal class instruction or participation. In addition, participants have the right to withdraw from the study at any time by notifying the researcher of your desire to withdraw.

6.2 EXPLAIN THE STUDY'S EFFORTS TO REDUCE POTENTIAL RISKS TO SUBJECTS:

Subjects will be identified only by pseudonyms, and all data collected will be anonymized to location and general context. No identifying characteristics of the participant will be revealed in data reporting.

6.3 WHAT ARE THE DIRECT OR INDIRECT ANTICIPATED BENEFITS TO STUDY PARTICIPANTS AND/OR SOCIETY?

There are no direct benefits for participation in this study. Indirect benefits may include additional reflection time for teaching activities and teaching philosophy for teachers.

Section 7: Full Board Assessment

7.1 DOES THE RESEARCH INVOLVE MICROWAVES/X-RAYS, OR GENERAL ANESTHESIA OR SEDATION?

No

Yes

7.2 DO RESEARCH ACTIVITIES INVOLVE PRISONERS, PREGNANT WOMEN, FETUSES, HUMAN IN VITRO FERTILIZATION, OR MENTALLY DISABLED PERSONS?

No, go to question 7.3

Yes, answer questions within table

IF YES

This research involves:

Prisoners

Pregnant women Fetuses Human in vitro fertilization

Mentally disabled persons

7.3 DOES THIS STUDY INVOLVE MORE THAN MINIMAL RISK TO STUDY PARTICIPANTS?

Minimal risk means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily activities or during the performance of routine physical or psychological examinations or tests. Examples of research involving greater than minimal risk include collecting data about abuse or illegal activities. Note: if the project qualifies for Exempt review (<http://www.irb.vt.edu/pages/categories.htm>), it will not need to go to the Full Board.

No

Yes

IF YOU ANSWERED “YES” TO **ANY ONE** OF THE ABOVE QUESTIONS, 7.1, 7.2, OR 7.3, THE BOARD MAY REVIEW THE PROJECT’S APPLICATION MATERIALS AT ITS MONTHLY MEETING. VIEW THE FOLLOWING LINK FOR DEADLINES AND ADDITIONAL INFORMATION: <http://www.irb.vt.edu/pages/deadlines.htm>

Section 8: Confidentiality / Anonymity

For more information about confidentiality and anonymity visit the following link:

<http://www.irb.vt.edu/pages/confidentiality.htm>

8.1 WILL PERSONALLY IDENTIFYING STUDY RESULTS OR DATA BE RELEASED TO ANYONE OUTSIDE OF THE RESEARCH TEAM?

For example – to the funding agency or outside data analyst, or participants identified in publications with individual consent

No

7

Yes, to whom will identifying data be released?

8.2 WILL ANY STUDY FILES CONTAIN PARTICIPANT IDENTIFYING INFORMATION (E.G., NAME, CONTACT INFORMATION, VIDEO/AUDIO RECORDINGS)?

Note: if collecting signatures on a consent form, select “Yes.”

No, go to question 8.3

Yes, answer questions within table

IF YES

Describe if/how the study will utilize study codes: Pseudonyms will be used for audio recording codes, and for any interview transcriptions.

If applicable, where will the key [i.e., linked code and identifying information document

(for instance, John Doe

= study ID 001)] **be stored and who will have access? Only research team members**

will have access to the pseudonym key, which will exist as a document separate from

interview data on a secure drive.

Note: the key should be stored separately from subjects' completed data documents and accessibility should be limited.

The IRB strongly suggests and may require that all data documents (e.g., questionnaire responses, interview responses, etc.) do not include or request identifying information (e.g., name, contact information, etc.) from participants. If you need to link subjects' identifying information to subjects' data documents, use a study ID/code on all data documents.

8.3 WHERE WILL DATA BE STORED?

Examples of data - questionnaire, interview responses, downloaded online survey data, observation recordings, biological samples

Data will be stored electronically on a password protected computer, with password protected backup.

Hard copies of any artifacts will be stored in a binder in a secure location.

8.4 WHO WILL HAVE ACCESS TO STUDY DATA?

Only the research team will have access to the study data.

8.5 DESCRIBE THE PLANS FOR RETAINING OR DESTROYING THE STUDY DATA

Data will be kept for five years after study completion. After five years beyond the study completion date, all hard copies and electronic copies of data will be deleted.

8.6 DOES THIS STUDY REQUEST INFORMATION FROM PARTICIPANTS REGARDING ILLEGAL BEHAVIOR?

No, go to question 9.1

Yes, answer questions within table

IF YES

Does the study plan to obtain a Certificate of Confidentiality?

No

Yes (Note: participants must be fully informed of the conditions of the Certificate of Confidentiality within the consent process and form)

For more information about Certificates of Confidentiality, visit the following link:

<http://www.irb.vt.edu/pages/coc.htm>

Section 9: Compensation

For more information about compensating subjects, visit the following link:

<http://www.irb.vt.edu/pages/compensation.htm>

9.1 WILL SUBJECTS BE COMPENSATED FOR THEIR PARTICIPATION?

No, go to question 10.1

Yes, answer questions within table

IF YES

What is the amount of compensation?

Will compensation be prorated?

Yes, please describe:

No, explain why and clarify whether subjects will receive full compensation if they withdraw from the study?

Unless justified by the researcher, compensation should be prorated based on duration of study participation.

Payment must not be contingent upon completion of study procedures. In other words, even if the subject decides to withdraw from the study, he/she should be compensated, at least

partially, based on what study procedures he/she has completed.

Section 10: Audio / Video Recording

For more information about audio/video recording participants, visit the following link:

<http://www.irb.vt.edu/pages/recordings.htm>

10.1 WILL YOUR STUDY INVOLVE VIDEO AND/OR AUDIO RECORDING?

No, go to question 11.1

Yes, answer questions within table

IF YES

This project involves:

Audio recordings only

Video recordings only

Both video and audio recordings

Provide compelling justification for the use of audio/video recording: Interviews are an integral part of understanding the lived experience of teachers and students in rural areas. Participants' own words are very powerful and are more meaningful than an interpretation of their words based on field notes.

How will data within the recordings be retrieved / transcribed? Data will be transcribed by the research team using MS Word. Recordings will be uploaded from digital recorders to the data drive, and will be retrieved electronically.

How and where will recordings (e.g., tapes, digital data, data backups) be stored to ensure security? Digital data will be stored on a password protected computer, with password protected backup. Who will have access to the recordings? Only members of the research team. Who will transcribe the recordings? Members of the research

team will transcribe the interviews. When will the recordings be erased / destroyed?

Digital Recordings will be erased after all have been fully transcribed.

Section 11: Research Involving Students

11.1 DOES THIS PROJECT INCLUDE STUDENTS AS PARTICIPANTS?

No, go to question 12.1

Yes, answer questions within table

IF YES

Does this study involve conducting research with students of the researcher?

No

Yes, describe safeguards the study will implement to protect against coercion or undue influence for participation:

Note: if it is feasible to use students from a class of students not under the instruction of the researcher, the IRB recommends and may require doing so.

Will the study need to access student records (e.g., SAT, GPA, or GRE scores)?

No

Yes

11.2 DOES THIS PROJECT INCLUDE ELEMENTARY, JUNIOR, OR HIGH SCHOOL STUDENTS?

No, go to question 11.3

Yes, answer questions within table

IF YES

Will study procedures be completed during school hours?

No

Yes

If yes,

Students not included in the study may view other students' involvement with the research during school time as unfair. Address this issue and how the study will reduce this outcome:

The student participants in this research are part of a summer enrichment program, extracurricular to their normal school year (and outside the purview of their home schools).

Missing out on regular class time or seeing other students participate may influence a student's decision to participate. Address how the study will reduce this outcome:

Focus group interviews will only occur during the down time and in-between activity time during a very busy summer enrichment program. Additional times for focus group interviews could be during bus rides for field trips, or during down time during camping trips, but will not impact instructional time during the summer program

Is the school's approval letter(s) attached to this submission?

Yes

No, project involves Montgomery County Public Schools (MCPS)

No, explain why:

You will need to obtain school approval (if involving MCPS, click here:

<http://www.irb.vt.edu/pages/mcps.htm>).

Approval is typically granted by the superintendent, principal, and classroom teacher (in that order). Approval by an individual teacher is insufficient. School approval, in the form of a letter or a memorandum should accompany the approval request to the IRB.

11.3 DOES THIS PROJECT INCLUDE COLLEGE STUDENTS?

No, go to question 12.1

Yes, answer questions within table

IF YES

Some college students might be minors. Indicate whether these minors will be included in the research or actively excluded:

Included

Actively excluded, describe how the study will ensure that minors will not be included:

Will extra credit be offered to subjects?

No

Yes

If yes,

What will be offered to subjects as an equal alternative to receiving extra credit without participating in this study?

Include a description of the extra credit (e.g., amount) to be provided within question 9.1 (“IF YES” table)

Section 12: Research Involving Minors

12.1 DOES THIS PROJECT INVOLVE MINORS (UNDER THE AGE OF 18 IN VIRGINIA)?

Note: age constituting a minor may differ in other States.

No, go to question 13.1

Yes, answer questions within table

IF YES

Does the project reasonably pose a risk of reports of current threats of abuse and/or suicide?

No

Yes, thoroughly explain how the study will react to such reports:

Note: subjects and parents must be fully informed of the fact that researchers must report threats of suicide or suspected/reported abuse to the appropriate authorities within the Confidentiality section of the Consent, Assent, and/or Permission documents.

Are you requesting a waiver of parental permission (i.e., parent uninformed of child's involvement)?

No, **both** parents/guardians will provide their permission, if possible.

No, **only one** parent/guardian will provide permission.

Yes, describe below how your research meets **all** of the following criteria (A-D):

Criteria A - The research involves no more than minimal risk to the subjects:

Criteria B - The waiver will not adversely affect the rights and welfare of the subjects:

Criteria C - The research could not practicably be carried out without the waiver:

Criteria D - (Optional) Parents will be provided with additional pertinent information after participation:

Is it possible that minor research participants will reach the legal age of consent (18 in Virginia) while enrolled in this study?

No

Yes, will the investigators seek and obtain the legally effective informed consent (in place of the minors' previously provided assent and parents' permission) for the now-adult subjects for any ongoing interactions with the subjects, or analysis of subjects' data? If yes,

explain how:

For more information about minors reaching legal age during enrollment, visit the following link:

<http://www.irb.vt.edu/pages/assent.htm>

*The procedure for obtaining assent from minors and permission from the minor's guardian(s) must be described in **Section 4** (Consent Process) of this form.*

Section 13: Research Involving Deception

For more information about involving deception in research and for assistance with developing your debriefing form, visit our website at

<http://www.irb.vt.edu/pages/deception.htm>

13.1 DOES THIS PROJECT INVOLVE DECEPTION?

No, go to question 14.1

Yes, answer questions within table

IF YES

Describe the deception:

Why is the use of deception necessary for this project?

Describe the debriefing process:

Provide an explanation of how the study meets all the following criteria (A-D) for an alteration of consent:

Criteria A - The research involves no more than minimal risk to the subjects:

Criteria B - The alteration will not adversely affect the rights and welfare of the subjects:

Criteria C - The research could not practicably be carried out without the alteration:

Criteria D - (Optional) Subjects will be provided with additional pertinent information after

participation

(i.e., debriefing for studies involving deception):

By nature, studies involving deception cannot provide subjects with a complete description of the study during the consent process; therefore, the IRB must allow (by granting an alteration of consent) a consent process which does not include, or which alters, some or all of the elements of informed consent.

The IRB requests that the researcher use the title “Information Sheet” instead of “Consent Form” on the document used to obtain subjects’ signatures to participate in the research.

This will adequately reflect the fact that the subject cannot fully consent to the research without the researcher fully disclosing the true intent of the research.

Section 14: Research Involving Existing Data

14.1 WILL THIS PROJECT INVOLVE THE COLLECTION OR STUDY/ANALYSIS OF EXISTING DATA DOCUMENTS, RECORDS, PATHOLOGICAL SPECIMENS, OR DIAGNOSTIC SPECIMENS?

Please note: it is not considered existing data if a researcher transfers to Virginia Tech from another institution and will be conducting data analysis of an on-going study.

No, you are finished with the application

Yes, answer questions within table

IF YES

From where does the existing data originate?

Provide a detailed description of the existing data that will be collected or studied/analyzed:

Is the source of the data public?

No, continue with the next question

Yes, you are finished with this application

Will any individual associated with this project (internal or external) have access to or be provided with existing data containing information which would enable the identification of subjects:

Directly (e.g., by name, phone number, address, email address, social security number, student ID number), or

Indirectly through study codes even if the researcher or research team does not have access to the master list linking study codes to identifiable information such as name, student ID number, etc or

Indirectly through the use of information that could reasonably be used in combination to identify an individual (e.g., demographics)

No, collected/analyzed data will be completely de-identified

Yes,

If yes,

Research will not qualify for exempt review; therefore, if feasible, written consent must be obtained from individuals whose data will be collected / analyzed, unless this requirement is waived by the IRB.

Will written/signed or verbal consent be obtained from participants prior to the analysis of collected data? -select one¹³

This research protocol represents a contract between all research personnel associated with the project, the University, and federal government; therefore, must be followed accordingly and kept current. Proposed modifications must be approved by the IRB prior

to implementation except where necessary to eliminate apparent immediate hazards to the human subjects. Do not begin human subjects activities until you receive an IRB approval letter via email. It is the Principal Investigator's responsibility to ensure all members of the research team who interact with research subjects, or collect or handle human subjects data have completed human subjects protection training prior to interacting with subjects, or handling or collecting the data.

-----END-----

Appendix B

Parent, student and teacher consent/assent Forms

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Parent Permission Form

Title of Project:

Environmental Education in Appalachia: Classroom Investigations

Principle Investigator:

Dr. George Glasson, Virginia Tech Faculty

Jessica R. Stephenson, Virginia Tech Graduate Researcher

I. Purpose

The purpose of this study is to observe the ways science teachers in rural areas of Appalachia teach about environmental issues and resource conservation, and how students in their classrooms learn about environmental issues and resource conservation. This observation includes the ways teachers use existing curriculum materials, create or incorporate new materials, teach content to students, and student responses to instruction. As part of this study, the ideas and experiences of teachers and students are important regarding the way they view themselves as science teachers, science students, community members, and environmental advocates.

II. Procedure

Your child (the participant) is expected to participate in normal classroom activities planned by the teacher, and to complete assignments that occur as a normal part of this course. This study will involve the collection of:

- A. Observations of classes
- B. Audio recording of two to three focus group interviews
- C. Collection of student work as part of the normal administration of the class

Participants will be asked to complete two to three thirty-minute focus group interviews to be scheduled during normal program hours.

III. Risks

There are minimal risks to participation in this study. Risks to participant are no greater than the risks associated with normal class participation. In addition, you and your child have the right to withdraw from participation at any time by notifying the researcher in writing or your desire to withdraw.

IV. Benefits

There are no direct benefits to your child for participation in this study. No promise or guarantee of benefits has been made to encourage you to participate. Indirect benefits may include additional reflection time for learning activities, and observing how social science research is conducted.

V. Extent of Anonymity and Confidentiality

The researcher will keep all data collected confidential. Information gathered from the study may be used in reports, presentations, and articles in professional journals. However, the participant's name will not be used in any report, presentation, or article and identifying information will be changed so that data cannot be connected to individual. Pseudonyms will be used. No identifying characteristics of the participant will be revealed in any reporting of the data. Despite efforts to preserve it, anonymity may be compromised.

The researcher will catalogue and code the data, including audio recording of the participant interviews. The audio recording will then be transcribed for further analysis.

Only the research team will have access to the audio and transcription of the interview.

All data, including the audio-recorded interviews, will be retained for a period of not more than five years in secure locations under the supervision of the primary researcher. After that time, all data, including the audio recordings, will be destroyed.

It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation

The participant will not be compensated for participating in this study.

VII. Freedom to Withdraw

The participant is free to withdraw from this study at any time without penalty, and you are free to withdraw them from the study at any time without penalty. Your child is free to not respond to any research situations that they choose without penalty. You and your child are free to request that any discussion transcript of yours be removed from the data set without penalty. There may be circumstances under which the investigators may determine that your child should not continue to be involved in the study.

VIII. Subjects' Responsibilities

I voluntarily agree to allow my child to participate in the research project. I understand that my child has the following responsibilities: to participate in two to three audio recorded focus group interviews of no more than thirty minutes each.

I hereby acknowledge the above and give my voluntary consent for the collection and analysis of the following materials (please initial all that apply):

_____ classroom observations

_____ student work (materials completed during normal participation in the course)

_____ three thirty-minute interviews

Name of child (printed)

Parent/Guardian Signature (for minors under age 18)

Date

Should I have any questions about this research or its conduct, I may contact:

Jessica Stephenson	540-679-9298	jesteph3@vt.edu
Dr. George Glasson	540-231-8346	glassong@vt.edu

If I should have any questions about the protection of human research participants regarding this study, I may contact Dr. David Moore, Chair Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email moored@vt.edu

You will be provided with a complete or duplicate of the original Informed Consent.

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Student Assent Form

Title of Project:

Environmental Education in Appalachia: Classroom Investigations

Principle Investigator:

Dr. George Glasson, Virginia Tech Faculty

Jessica R. Stephenson, Virginia Tech Graduate Researcher

What the study is about:

This purpose of this study is to understand what environmental education programs look like in rural areas, how teachers introduce local environmental issues, and what students learn as a result of the program. We will be investigating what kinds of assignments you are completing, what you are learning, and what your experiences are during the program. Your participation in this research project is entirely by choice, and we will not ask you to complete additional work beyond what is expected of you in the classroom.

Why you qualify for the study:

Your instructors have chosen to participate in the teacher study that looks at how they teach about environmental issues. Because you have been accepted to participate in this summer program, you qualify as a participant in this research project looking at student experiences in their environmental education classroom.

The voluntary nature of the study:

Your participation in this study is completely by choice, and by permission of your parents. You can choose to withdraw from the study at any time after talking with your parents and submitting a letter in writing, asking to withdraw. You can choose not to answer research questions during interviews, and you can also choose to have your data removed from the study without penalty.

The data that will be collected:

We will be looking at “classroom artifacts” throughout the program—these include pre- and post-tests, lab assignments and written work. Your grades on these assignments will not be recorded, and your pseudonym (or pen-name) will only be used to identify you in our records. You will be asked to participate in two to three focus group interviews with two of your peers, which will take place on campus and during normal program hours. These interviews will be digitally audio-recorded and transcribed (or written up) using Microsoft Word. You are not expected to do any additional classwork outside of the expectations of the program.

Potential benefits & potential risks:

There are very few risks to participating in this study. Risks to you are no greater than normal classroom participation. There are no direct benefits to participating in this study.

Equal Treatment:

The choice to participate in this study is entirely yours. If you choose not to participate (or your parent chooses not to give their permission for you to participate), there are no consequences. Your data will not be collected, and you will not be asked to join a focus group interview. Because there are several students in these focus groups, it is not likely that your peers will notice that you are not participating. You will still be responsible for all assignments given by your teachers, and you will still be responsible for participating in classroom discussions as every other student will be.

An invitation to ask questions:

You may ask questions about the study to the researchers at any time. These questions may be in person, by phone, or by email. If you are unsure about participating, or if you would like more information about the study, please contact Jessica, whose contact information is below.

Student Agreement:

I voluntarily agree to participate in the research project. I have the following responsibilities: to participate in two to three audio recorded focus group interviews of thirty minutes each.

I hereby acknowledge the above and give my voluntary consent for the collection and analysis of the following materials (please initial all that apply):

_____ classroom observations

_____ student work (materials completed during normal participation in the course)

_____ three thirty-minute interviews

Student Participant Name (printed)

Student Participant's Signature

Date

Should I have any questions about this research or its conduct, I may contact:

Jessica Stephenson	540-679-9298	jesteph3@vt.edu
Dr. George Glasson	540-231-8346	glassong@vt.edu

If I should have any questions about the protection of human research participants regarding this study, I may contact Dr. David Moore, Chair Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email moored@vt.edu;

You will be provided with a complete or duplicate of the original Informed Consent.

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Teacher Participant

Title of Project:

Environmental Education in Appalachia: Classroom Investigations

Principle Investigator:

Dr. George Glasson, Virginia Tech Faculty

Jessica R. Stephenson, Virginia Tech Graduate Researcher

I. Purpose

The purpose of this study is to observe the ways science teachers in rural areas of Appalachia teach about environmental issues and resource conservation. This observation includes the ways teachers use existing curriculum materials, create or incorporate new materials, and teach content to students. As part of this study, the ideas and experiences of teachers are important regarding the way they view themselves as science teachers, community members, and environmental advocates.

II. Procedure

You are expected to provide instruction and assistance, which occur as a normal part of this class. This study will involve the collection of:

- A. Participant observations of classes
- B. Audio recording of interviews

Participants will be asked to complete three to four thirty minute interviews beyond the normal teaching time constraints.

III. Risks

There are minimal risks to participation in this study. Risks to participant are no greater than the risks associated with normal class instruction. In addition, you have the right to withdraw from participation at any time by notifying the researcher in writing or your desire to withdraw.

IV. Benefits

There are no direct benefits to you for participation in this study. No promise or guarantee of benefits has been made to encourage you to participate. Indirect benefits may include additional reflection time for teaching activities and teaching philosophy.

V. Extent of Anonymity and Confidentiality

The researcher will keep all data collected confidential. Information gathered from the study may be used in reports, presentations, and articles in professional journals. However, the participant's name will not be used in any report, presentation, or article and identifying information will be changed so that data cannot be connected to individual. Pseudonyms will be used. No identifying characteristics of the participant will be revealed in any reporting of the data. Despite efforts to preserve it, anonymity may be compromised.

The researcher will catalogue and code the data, including audio recording of the participant interview. The audio recording will then be transcribed for further analysis.

Only the research team will have access to the audio and transcription of the interview.

All data, including the audio-recorded interview, will be retained for a period of not more than five years in secure locations under the supervision of the primary researcher. After that time, all data, including the audio recordings, will be destroyed.

It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation

The participant will not be compensated for participating in this study.

VII. Freedom to Withdraw

The participant is free to withdraw from this study at any time without penalty. You are free to not respond to any research situations that you choose without penalty. You are

free to request that any discussion transcript of yours be removed from the data set without penalty. There may be circumstances under which the investigators may determine that you should not continue to be involved in the study.

VIII. Subjects' Responsibilities

I voluntarily agree to participate in the research project. I have the following responsibilities: to participate in three audio recorded interviews of thirty minutes each.

I hereby acknowledge the above and give my voluntary consent for the collection and analysis of the following materials (please initial all that apply):

- _____ three classroom observations
- _____ three thirty-minute interviews

Participant's Signature _____
Date

Should I have any questions about this research or its conduct, I may contact:
Jessica Stephenson 540-679-9298 jesteph3@vt.edu
Dr. George Glasson 540-231-8346 glassong@vt.edu

If I should have any questions about the protection of human research participants regarding this study, I may contact Dr. David Moore, Chair Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email moored@vt.edu;

You will be provided with a complete or duplicate of the original of the signed Informed Consent.

Appendix C

Parent/Student Recruitment Letter

Dear Parents and Students of the 2014 DSLCC Governor's School for Field Biology;

Greetings! My name is Jessica Stephenson, and I'm a Doctoral Candidate at Virginia Tech in Science Education. I will be collecting data for my dissertation during the Governor's School this summer. I'm interested in what environmental education looks like in rural Appalachia, how students perceive local science issues, and what students learn in programs like this Governor's School.

This Governor's School is not new to me—I was a participant like your students, nearly 20 years ago. Largely influenced by my experiences in this program, I majored in Environmental Science, worked in industry, and returned to school for my Master's Degree in Science Education. After graduation, I taught outdoor and experiential education at an outdoor school in Connecticut and lead environmental education programs for a non-profit. I returned to the classroom at Alleghany High School in 2008, where I taught Algebra and Physics before returning to graduate school. I currently hold a Virginia Post-Graduate Professional License in Earth and Space Science, and Algebra I. I am also trained in Wilderness First Aid and CPR.

The issues we all face in education are especially important when we look at the rural area we call home. My goal with my dissertation work is to describe the teaching experiences of teachers like those at the Governor's School, the learning experiences of students like yours, and the ways in which these inform students about local environmental issues in rural settings. My study will focus on the teachers, students, and volunteers at

this Governor's School, and I will be present and volunteering through the program myself (as an alumnae of this Governor's School, I can tell you that it means a lot to me, and that I'm honored to be participating).

Pending Virginia Tech Institutional Review Board (IRB) status, I will be collecting data from both teachers and students participating in this Governor's School. These data may include focus group interviews, written reflections, assessments, and written journals. There is no class work or time commitment outside of the regular program day. Supporting data may include course documents and other artifacts that are available to the public. As with any research project, names, locations, and affiliations are anonymous, and pseudonyms are always used if direct quotes are necessary. Again, personal identifying information will not be collected, and participant responses remain anonymous.

Following this letter you will find a parent consent form, a student assent form, and a self-addressed return envelope. For your convenience, you may complete both forms online at <http://tinyurl.com/vt2014vt> which will link you to a short two-page VT Qualtrics survey form. The parent consent form is first, and requires three check boxes, student name, and parent name. The student assent form is next, and requires three check boxes, and the student name. If you complete the electronic forms, the copies in this letter are for your records. If you would prefer to sign and mail the forms back to me, I will provide you with copies on the first day of the program.

I look forward to participating in this summer Governor's School with your students, as a long-time science teacher, avid backpacker, and environmental steward. Should you have any further questions about my research project, the types of data I will

be collecting from the participants, or my presence during the program, please don't
hesitate to contact me. I look forward to meeting you and your students!

Sincerely,

Jessica

Appendix D

2014 Student Studies

Observations & Investigations
2014 Edition

Observations

Investigations

Salamander Diversity and Abundance Along [REDACTED] Run Trail in [REDACTED], [REDACTED], Virginia

ABSTRACT

The purpose of this research was to determine species diversity and abundance of salamanders along [REDACTED] Run Trail. Salamanders were captured and tallied at eight elevations (884 - 1097 m) and five habitats. A total of 229 salamanders representing nine species were captured, identified, and released. Red-backed salamanders (*Plethodon cinereus*) were the most abundant (33%), followed by mountain dusksies (*Desmognathus ochrophaeus*) (28%). The greatest number of salamanders was caught at an elevation of 1097 m (47 individuals). The fewest number of salamanders was caught at an elevation of 945 m (12 individuals). Species richness varied from four to seven. Substantially fewer salamanders were found in aquatic habitats (13%) than in terrestrial habitats (87%).

INTRODUCTION

[REDACTED] is located in western Virginia on the West Virginia state line. The northwest corner of the county, located in the George Washington National Forest, is referred to as [REDACTED]. The vegetation here resembles that of southern Canada due to the high elevations (875-1160 m) that result in a cool, moist environment year round. Temperatures are often 5-10 °C cooler than in nearby areas and are more characteristic of New England or Canada than Virginia. The dominant tree species in this area include northern hardwood species, such as yellow birch (*Betula lutea*), sugar maple (*Acer saccharum*), and black cherry (*Prunus serotina*). Such an aggregation of Northern species is rare elsewhere in Virginia where oak forests typically predominate. Laurel Fork is more diverse than other Appalachian forests because it has both boreal and hardwood components. The dominant trees in the boreal forest include red spruce (*Picea rubens*) and hemlock (*Tsuga canadensis*). Wildlife abounds: beaver, white-tailed deer, grouse, turkey, black bear, and bobcat are common. The snowshoe hare and fisher are known to inhabit the area. There even have been occasional reports (though none "official") of mountain lions in the area. This region may represent the largest expanse of uninhabited "wilderness" located in Virginia and is certainly the largest roadless area in the Commonwealth.

The unique environment of this area attracts many different species of salamanders and also makes it one of the most diverse areas in the world. Pague and Mitchell (1987) reported nineteen species of salamanders in Highland County. Eight species of salamanders, not including the red-spotted newt/red eft (*Notophthalmus viridescens*), were reported from the Laurel Fork area (Young, 1993).

In North America, two of the three major amphibian groups (Anura - frogs, toads; Caudata - salamanders) occur. Salamanders are distributed mainly in temperate regions of North America (Petranka, 1998). Forty-nine out of the 120 species in North America occur in Virginia (Mitchell and Reay, 1999).

Salamanders require a moist environment in which to live and reproduce. Some species are terrestrial and live under rocks, logs, and leaf litter, while others are entirely aquatic. All salamanders require significant moisture and/or water to sustain life.

At first glance, salamanders resemble lizards. Salamanders, however, have slender bodies, long tails, distinct body regions, and their front and hind legs are usually the same size. They have moist, smooth skin and lack ear openings or claws. By comparison to reptiles, salamander eggs are relatively soft. The coloration and markings of salamanders can differ greatly from species to species, and the mountain dusky (*Desmognathus ochrophaeus*) salamander can closely mimic other species.

Welsh and Droege (2001) cite several reasons why salamanders are important creatures to study. Salamanders are uniquely sensitive to their environment. They provide an ecological connection between aquatic, terrestrial, and soil ecosystems and are a crucial link in the middle of the food web (Davic and Welsh, 2004). Also, Milanovich et al. (2010) predict that global climate change will cause a loss in salamander diversity. For these reasons, our multi-year (1996 – present) study of salamander population and diversity in the Laurel Fork area provides a unique data set for monitoring the southern Appalachians.

Participants of the 2014 [REDACTED] continued a long-term study of salamanders in the [REDACTED] area of [REDACTED], focusing this year on salamander diversity and abundance along [REDACTED] Run Trail. The purpose of the research was to investigate the relationship of diversity and abundance along an elevational gradient. The objectives were to (1) determine diversity and abundance of salamanders in this region of Virginia, (2) determine whether variation exists in species and abundance along the elevational gradient, and (3) describe the habitat preference for each species. For the slimy salamander (*Plethodon glutinosus*) complex and the mountain dusky salamander complex, we followed the taxonomy in Beane, et al. (2010).

METHODS AND MATERIALS

On June 18, 2014, [REDACTED] established an elevational transect on [REDACTED] Run Trail. A total of eight sites was sampled along the transect with sites established at every 30 m (100ft) in elevation. Based on the method of Crump and Scott (1994), a group of three to four persons thoroughly searched within a single quadrant for salamanders for 15 minutes. Four groups searching at each sampling site gave a total of 4 3/4 person-hours of search time per site, or 38 person-hours along the entire transect. Habitats, such as rocks, logs, and leaf litter on the adjacent banks and slopes were overturned to reveal, capture, identify, and record any salamanders. Displaced objects were carefully replaced to prevent disruption of the natural environment. Also included in our search area were the waters of Buck Run where stones in the streambed and along the bank were overturned to reveal any salamanders.

In the days prior to the field study, students became familiar with the

identifying characteristics of the different species common to this area. Each salamander captured was recorded by its habitat and species. After collecting the data, measures were taken to ensure that each salamander was returned to its original location of capture.

RESULTS AND DISCUSSIONS

A total of 229 salamanders were identified. Table 1 shows the data by species and elevation. Figure 1 summarizes the species richness and total salamander count by elevation. The most abundant species was the red-backed salamander (*P. cinereus*), which accounted for (33%) of all salamanders captured. The mountain dusky salamander was the second-most abundant (28%). Northern dusky salamanders (*D. fuscus*), spring salamanders (*Gyrinophilus porphyriticus*), Wehrle's salamanders (*P. wehrlei*), two-lined salamanders (*Eurycea bislineata*), and red-spotted newts/red efts were the least abundant. The greatest abundance of salamanders (47 individuals) was captured at 1097 m. The fewest number of salamanders (12 individuals) was captured at 945 m. Species richness varied from four to seven.

The lack of red efts/red-spotted newts was unusual. In the past, these had been relatively abundant, especially at the highest elevations. The loss of beaver ponds at these elevations may be reducing the reproduction of this adult-aquatic species. The lack of seal salamanders (*D. monticola*) at the higher elevations is most likely due to the lack of aquatic environments on our transect at these elevations.

As shown in Table 2, 87% of all salamanders (199 individuals) were found in terrestrial habitats. The majority of terrestrial salamanders (55%) was found under logs. The red-backed and mountain dusky salamanders were the dominant terrestrial species. Only 13% of all salamanders (30 individuals) were found in aquatic habitats.

CONCLUSIONS

1. A total of 229 salamanders were captured and identified.
2. Most salamanders (47 individuals) were collected at 1097 m; the fewest (12 individuals) were collected at 945 m.
3. The most abundant species were the red-backed salamander (75 individuals) and mountain dusky (64 individuals).
4. The least abundant species were the northern dusky (one individual), the spring and Wehrle's salamanders (three individuals each), the red-spotted newt/red eft (four individuals), and the two-lined (seven individuals).
5. Species richness varied from four to seven.
6. Red-backed and slimy salamanders were found at every elevation. Mountain dusky were found at all elevations except 1067 m.
7. Most salamanders were found in terrestrial habitats (under rocks, logs, or in leaf litter) rather than aquatic habitats (stream or seep).

8. Red-backed, red-spotted newts/red efts, slimy, and Wehrle's salamanders were found exclusively in terrestrial habitats.
9. Although found in some prior years, no spotted salamanders (*Ambystoma maculatum*) were found this year.

LITERATURE CITED

- Beane, Jeffrey C., Alvin L. Braswell, Joseph C. Mitchell, William M. Palmer, and Julian R. Harrison III. 2010. *Amphibians and Reptiles of the Carolinas and Virginia*, 2nd Ed. The University of North Carolina Press, Chapel Hill. 274 pp.
- Crump, M. L. and N. J. Scott. 1994. "Visual encounter surveys." pp. 84-92 in Heyer, et al., ed. *Measuring and monitoring biological diversity, standard method for amphibians*. Smithsonian Institution Press, Washington. 364 pp.
- Davic, Robert D., and Hartwell H. Welsh Jr. 2004. "On the Ecological Roles of Salamanders." *Annu. Rev. Ecol. Evol. Syst.* 35: 405-34.
- Milanovich, Joseph R., William E. Peterman, Nathan P. Nibbelink, and John C. Maerz. 2010. "Projected Loss of a Salamander Diversity Hotspot as a Consequence of Projected Global Climate Change." *PLoS ONE* 5, no. 8: 1-10. Academic Search Complete, EBSCOhost (accessed June 27, 2011).
- Mitchell, J.C. and K.K. Reay. 1999. *Atlas of Amphibians and Reptiles in Virginia*. Special Publication Number 1, Wildlife Division, Virginia Department of Game and Inland Fisheries.
- Pague, C.A. and J.C. Mitchell. 1987. "The status of amphibians in Virginia." *Virginia Journal of Science* 38: 304-318.
- Petranka, J.W. 1998. *Salamanders of the United States and Canada*. Smithsonian Institution Press, Washington and London. 587 pp.
- Welsh, Hartwell H., and Sam Droege. 2001. "A Case for Using Plethodontid Salamanders for Monitoring Biodiversity and Ecosystem Integrity of North American Forests." *Conservation Biology* 15, no. 3: 558-569. Academic Search Complete, EBSCOhost (accessed June 27, 2011).
- Young, D.A. 1993. "An annotated checklist of reptiles and amphibians from Highland County, Virginia." *Catesbeiana* 13: 3-8

Table 1. Salamander species and abundance along an elevational gradient on Buck Run Trail.

SPECIES	ELEVATION (meters)									Total	
	884	914	945	975	1006	1036	1067	1097			
<i>Desmognathus fuscus</i>	0	0	0	0	1	0	0	0	1	0.4%	
<i>D. monticola</i>	10	7	1	6	9	0	0	0	33	14%	
<i>D. ochrophaeus</i>	12	14	6	11	14	2	0	5	64	28%	
<i>Eurycea bislineata</i>	2	0	0	0	0	0	3	2	7	3%	
<i>Gyrinophilus porphyriticus</i>	1	1	0	0	1	0	0	0	3	1%	
<i>Notophthalmus viridescens</i>	0	0	0	0	1	1	0	2	4	2%	
<i>Plethodon cinereus</i>	3	1	1	3	6	12	20	29	75	33%	
<i>P. glutinosus</i>	1	2	4	2	6	9	6	9	39	17%	
<i>P. wehrlei</i>	0	0	0	0	0	1	2	0	3	1%	
TOTAL	29	25	12	22	38	25	31	47	229		
SPECIES RICHNESS	6	5	4	4	7	5	4	5	9		

Table 2. Salamander species and abundance by habitat along Locust Spring Run Trail.

SPECIES	TERRESTRIAL			AQUATIC		TOTAL
	ROCK	LOG	LEAF LITTER	STREAM	SEEP	
<i>Desmognathus fuscus</i>	0	0	0	1	0	1
<i>D. monticola</i>	9	1	0	18	5	33
<i>D. ochrophaeus</i>	29	30	2	1	2	64
<i>Eurycea bislineata</i>	1	5	0	1	0	7
<i>Gyrinophilus porphyriticus</i>	1	0	0	1	1	3
<i>Notophthalmus viridescens</i>	0	4	0	0	0	4
<i>Plethodon cinereus</i>	25	47	3	0	0	75
<i>P. glutinosus</i>	13	22	4	0	0	39
<i>P. wehrlei</i>	3	0	0	0	0	3
Total	81	109	9	22	8	229
	35%	48%	4%	10%	3%	
SPECIES RICHNESS	7	6	3	5	3	9

Salamanders of [REDACTED]
[REDACTED] Run Trail
June 18, 2014

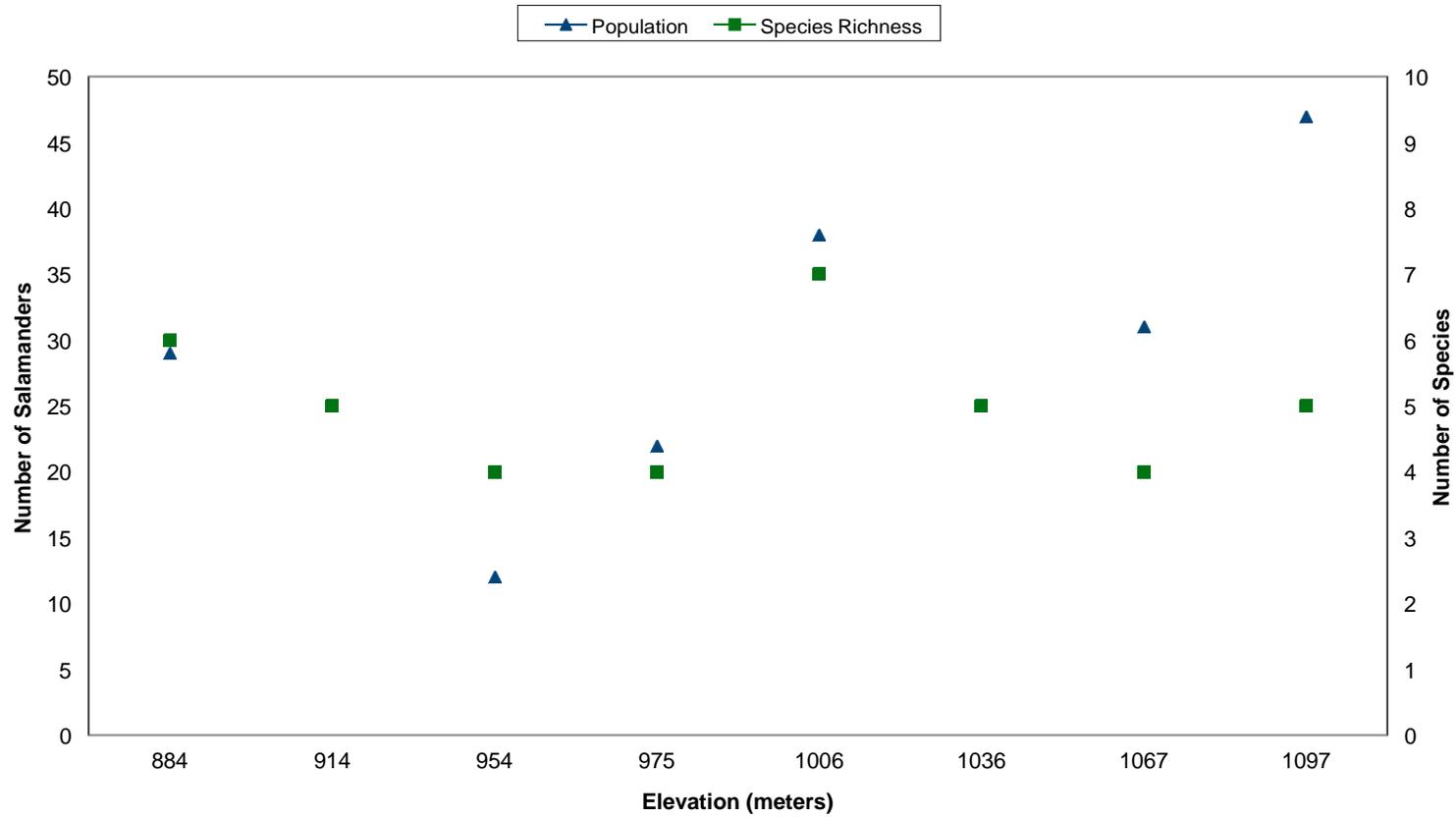


Figure 1. Number of salamanders and species richness by elevation.