

# Taking Science Education Outdoors with Herpetology (the Study of Reptiles (turtles, snakes, lizards and alligators), and Amphibians (frogs and salamanders): Equity in Action

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A high school aged student intently measures a Six-lined Race-runner's (*Cnemidophorus sexlineatus*) snout-vent length (SVL) with calipers (Figure 1). He is American Indian, and his partner is Asian, the daughter of first generation Chinese immigrants. He is from a predominately rural area, and she lives in a large urban area. These partners are participating in a weeklong residential summer Herpetology Research Experience (HRE), which is part of a National Science Foundation (NSF)-funded informal science education program titled Herpetology Education in Rural Places & Spaces (*The HERP Project*)\*. HREs are based on the idea that all students can learn science by enacting authentic field science.

Prior to their encounter with the Six-lined Racerunner, this group also lassoed a Carolina anole (*Anolis carolinensis*). The young woman in the photograph (Figure 1) had never seen anoles in the wild before, but she had used many science tools (calipers, pesola scales, and digital scales) in previous science classes. The young man, a Lumbee Indian, had caught many anoles before, as anoles are abundant where he lives. Young children in his community often catch these lizards and keep them for a while and even coax them to bite their earlobes, so that they are wearing a pair of live anole earrings as an accessory (Figure 2). Together, these two HRE participants worked as scientists to catch the anole with a lizard lasso for the first time

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**Figure 1.** High school students use a caliper to measure snout-vent length (SVL) on a Racerunner caught in the field.

(Figure 3). Both students brought unique prior knowledge to this process, as well as to the overall HRE experience of which this activity is a part. Both students also relied on their prior knowledge, each other, and new knowledge and skills learned in this program to meet the challenge of the lizard mark-recapture study, which included measuring the anole's SVL and tail length, identifying the anole's sex (males have a larger, more colorful dewlap (Figure 4), which is displayed in courtship and territorial defense), and marking the anole with a permanent nontoxic marker (Figure 5).

As the lizard story above details, HREs provide rich contexts for students to embrace science. Lee and Luykx (2010) argue that students of all backgrounds should be allowed challenging science-learning opportunities that permit them to explore and construct meanings based upon their own linguistic and cultural experiences. HREs enable these types of learning opportunities by purposely selecting participants from various backgrounds with different kinds of experiences. Some students arrive at HREs with outdoor experiences and animal husbandry/pet care-taking knowledge that they can link to the science investigations they encounter. Other students arrive with disassociated knowledge acquired from animal shows on television, or from books, looking for links to what they are doing. All students have something to offer, and all students have something to learn in these herpetological field experiences. The following vignette from a previous summer's field notes describes how students from the Lumbee Indian community (Donald and Jason) bring expertise to the HREs:

Donald and Jason were in my student group during JR's demonstration. I noticed quickly that...(they)...were immediately comfortable with the concept of dogs and their use in outdoor/hunting situations. They were the most active students in terms of helping JR and me to keep track of the dogs during the demonstration. They were also more comfortable with being separated from the group in a forested area in order to find dogs that had strayed. Thus, their rural background allowed them to function as the most reliable and helpful group mem-

bers in this setting. At one point, JR allowed the dogs to jump in a small pond to cool off. The Lumbee students understood immediately the necessity of keeping the dogs cool and helped interpret this fact to other students.

JR quickly recognized the Lumbee boys' familiarity with dogs and their ability to manage them. He rapidly promoted the boys to positions of responsibility in order to relieve his own anxiety about losing one of his dogs. Project leaders as well as other participants recognized Donald and Jason's performance during this day's activities. This recognition of others as significant contributors to project work is an important part of equity in a field science community.

Another challenging aspect of the HREs, portrayed by the preceding vignette, is the out-of-doors setting. Unlike textbooks, which provide a limited scope, the natural world affords students opportunities to participate in authentic field science practices and offers both academic and personal challenges for students to meet wherever they are. Additionally, participants can determine the challenges that they are ready to tackle and proceed. These challenges provide many opportunities for differentiation. There is a challenge to fit each student's needs, skill level and prior knowledge. Thus HREs provide each participant with an equitable experience. In this paper, we focus on these equitable experiences.

The purpose of this paper is to describe our efforts to provide equitable science learning during two weeklong summer informal science education programs focused on herpetology for high school students. We define equity as we envisioned it in *The HERP Project*. We explain why we did what we did to encourage equity in our HRE programs, how we did so, and how we saw evidence of equity in action. We offer a number of suggestions and lessons learned to other informal science educators who are designing similar field science programs.

### Equity in Science Education

Equity is the quality of being fair and impartial and can also be considered as an action towards creating equality. More specifically, equity can be viewed as the process that brings about equality (Unterhalter, 2009). However, equal access alone does not assure participation by a diverse population, so additional, yet reasonable, measures are necessary to ensure that diverse students can participate in science experiences. In 2010, the *Review of Research in Education* featured a special issue on "Equity in Education". In the introduction, Luke, Green, and Kelly (2010) stated, "The most durable and robust problem facing education research since mid-20th century is the persistence of educational inequality" (p. xi) This statement highlights the need for continued advancement towards equity in all educational settings. All students, whether from the dominant or non-dominant culture, have a right to an equitable education.

Historically, non-dominant groups including females, non-white students, and low-income students have lacked access to science as a career option and have been constrained in science classrooms (Brickhouse, Lowrey, & Schultz, 2000; Brickhouse



& Potter, 2001). Often these groups were seen as deficient and lacking the qualities needed to excel in the sciences (Martusewicz, 2012). Therefore, science has often been viewed as classed and raced. To counter this deficit viewpoint, scholars have argued that instead of viewing these groups from a deficit standing, educators should acknowledge that these groups offer perspectives, experiences, and knowledge that the dominant group does not possess (Ladson-Billings, 2004; Martusewicz, 2012). The National Research Council's committee on learning in informal environments (Bell, Lewenstein, Shouse, & Feder, 2009) also provided several reasons for promoting equity and serving non-dominant groups:

To ensure equitable treatment of all individuals; to continue to develop a well-trained workforce; to develop a well-informed, scientifically literate citizenry; and to increase diversity in the pool of scientists and science educators who can bring new perspectives to science and the understanding of science (p. 210).

Thus, we believe equity is an issue that should be purposefully addressed when creating informal learning environments.

Increasing diversity in student populations in many nations, along with differential science performance in schools among demographic groups make the goal of 'science for all' an increasing challenge (Lee & Luykx, 2010). Students from the non-dominant cultural groups may tend to see informal science experiences as 'owned' by the dominant cultural group, and it is through offering them ownership and validating their perspectives and cultural heritage that they become excited about outdoor informal science activities. Science is, after all, a socio-cultural activity, and increased diversity in the pool of scientists will benefit science and society as a whole (Bell, et al., 2009).

### Description of The HERP Project (Herpetology Education in Rural Places & Spaces)

The primary focus of *The HERP Project* is to support education, conservation, and field science experiences related to herpetology. About ten years ago personnel at the University of North Carolina at Greensboro (UNCG) began organizing hands-on outdoor herpetology field experiences for K-12 students and teachers, bringing authentic science and 'real' scientists into outdoor science education (Matthews & Tomasek, 2012).

These programs, the first one known as *Slip Slidin' Away\*\**, grew to encompass an extensive team of professors, scientists, local teachers, and a grant from the National Science Foundation (NSF). Now known as *The HERP Project*, the project offers three HREs, two of which are weeklong summer residential programs, and the other a one month-long HRE activity associated with a comprehensive three year summer college preparation program for high school students, who are potential first generation college students. HRE's extended learning experiences are also offered throughout the year on select weekends. This article focuses on the equitable practices of the two weeklong HREs.

Throughout the two weeklong programs, students rotated through different research studies. This rotation allowed each of the participants equitable access to the HRE curriculum. In each



*Figure 2. A participant coaxes an anole to serve as a temporary earring.*



*Figure 3. Catching an anole with a lizard lasso.*



*Figure 4. Identifying the sex of an anole (males have a larger, more colorful dewlap, which is used in courtship and territorial defense).*

research project (Aquatic Turtles, Box Turtles, Snakes, Stream Amphibians, Ephemeral Pools, Frog Calls, and Lizards), students had a chance to use science tools, collect data for scientific research studies, and interact with scientists. The schedule provided students with field experiences such as catching, processing, and marking aquatic turtles in turtle traps placed around a lake; catching and processing salamanders in minnow traps in streams or ephemeral pools (bodies of water without fish that periodically dry up); listening for frog calls for a population study; searching for, processing, and marking box turtles in the woods; capturing, and processing lizards using a tool we call a lizard lasso (known in the scientific literature as a 'noose');





**Figure 5. Marking an anole (with a permanent non-toxic marker) for the Lizard Project's mark-recapture study.**

walking cover board transects to survey reptiles and amphibians (collectively called 'herps') found under the boards; and searching for nocturnal herps while hiking through the woods.

### The Importance of Equity in HREs

The *HERP Project's* educational researchers believe that participant diversity enriched the HREs for everyone involved. Previous research has shown, that promoting equality benefits everyone (Bell, 1979 –1980; Brickhouse, Lowrey, & Schultz, 2000; Brickhouse & Potter, 2001; Carlone, 2004). However, as noted previously, it takes a conscious act of equity to achieve equality, so one of the guiding principles of our HREs was to include students from a variety of backgrounds and perspectives. In our two weeklong HRE's our goal was to reproduce the demographics of each of the areas of the state where we offered the HREs. Knowing that people from certain racial groups (Blacks, Hispanic and American Indians) are historically underrepresented in the sciences and, in North Carolina (NC), represent a larger proportion of low-income families; our HREs aimed to pay close attention to these factors. We were especially interested in the rural low-income population.

### Creating Equitable Opportunities

Our first step in creating equitable learning experiences was recruiting and then accepting participants from a diverse population. The intent of the two weeklong HREs was to admit 30 students into each program, mirroring the demographics of the counties where each program was held, one in the NC central Piedmont (CCR) and the other in the NC inner coastal plain (Rockfish). We had a stated emphasis on diversity, so HRE personnel privileged racial, cultural, economic, and gender diversity when selecting participants, and we developed our HREs to engage diverse learners in a broad range of science practices and increase their interest in and identification with science (Fenichel & Schweingruber, 2010).

### Populations of Interest, Populations of Participants

Our targeted participants for HREs were NC rural students. Science achievement and participation gaps between NC's urban (primarily affluent populations) and rural (predominantly low-

income) areas demonstrate limited science outreach to rural citizens, many of whom are from non-dominant groups ([www.ncpublicschools.org](http://www.ncpublicschools.org)). Rural areas, home to nearly 40 % of NC residents ([factfinder.census.gov](http://factfinder.census.gov)), usually possess inferior educational resources to those of urban areas

Our targeted NC regions included four counties (Robeson, Alamance, Durham, and Orange) with large populations of Blacks, Hispanics, and American Indians (especially, members of the Lumbee Indian tribe). The Rockfish HRE was held at the junction of Robeson, Hoke and Cumberland Counties. Robeson County (a targeted county), has a poverty level of 30 % and is populated by nearly equal numbers of Lumbee Indians, Blacks, and Whites. Alamance, Durham and Orange counties (CCR is in Orange County but draws participants from these adjacent counties) have non-white populations ranging from 30 % –40 %, with Blacks (12 % –38 %) and Hispanics (8 % –14%) representing the largest non-white populations. The poverty level for all three of these counties is 16 % (<http://quickfacts.census.gov/qfd/states/37000.html>).

Thirty students were admitted to each program; 29 students attended the HRE at Camp Chestnut Ridge (CCR) and 27 students attended the HRE at Camp Rockfish (Rockfish). The demographics (Table 1) of CCR and Rockfish participants varied somewhat, but the largest racial group at both HREs was White participants (30 % at CCR and 41 % at Rockfish). We recruited heavily from the American Indian community, and CCR had 13% and Rockfish 33% American Indians. We did not recruit as many Black students as we desired, and we plan to work harder to attract that targeted population in the summer of 2013, especially at Rockfish, where nearly one third of the local population is Black. We recruited a larger population (proportional to county demographics) of Hispanic students, perhaps because of our efforts to provide personal contacts and written materials in Spanish. We also attempted to create an equitable environment by endeavoring to admit equal numbers of males and females to each HRE. As has been documented by several scholars (Brickhouse, Lowrey, & Schultz, 2000; Brickhouse & Potter, 2001; Carlone, 2004), female engagement in science requires a broader definition of science. Thus, expanding participants' view of science and engaging females in field science are additional goals of *The HERP Project*. Of the 29 students at CCR (Table 2), 14 were female, 15 male. Of the 27 students at Rockfish (Table 3), 11 were female, 16 male. For both CCR and Rockfish there

**Table 1. Racial Demographics for HRE's at CCR and Camp Rockfish.**

| Race of Participants (By self-report) | Chestnut Ridge HRE, (CCR) | Rockfish HRE (Rockfish) |
|---------------------------------------|---------------------------|-------------------------|
| Asian                                 | 0%                        | 4%                      |
| Black                                 | 17%                       | 11%                     |
| Hispanic                              | 20%                       | 7%                      |
| Mixed Race                            | 20%                       | 4%                      |
| American Indian                       | 13%                       | 33%                     |
| White                                 | 30%                       | 41%                     |

were female campers from lower socioeconomic groups who, after being accepted, did not attend the HREs. All of the students were 14 to 18 years old and in grades 9 to 12.

### Additional Factors for Participant Selection

Recent findings show that both high and low achieving students placed in mixed ability groups benefit from working cooperatively in science (Boaler, 2008; So, Seah, & Toh-Heng, 2010). In fact, So, Seah, and Toh-Heng (2010) “found positive impacts on academic achievements showing improvement of student understanding in the course of reflective thinking and progressive inquiry. Overall, quantitative data suggested that the collaborative knowledge building environment was beneficial for both high-achieving and low-achieving students” (p. 479). Thus, HRE personnel chose participants who were representative of varying degrees of prior knowledge and experience. Senior personnel evaluated application essays and other supporting application materials to determine a participant’s level of prior herpetological experience and knowledge as either novice or expert. HRE personnel created small, similar-aged student research groups composed of novices and experts, boys and girls, and multiple races attempting not to isolate any one student of a particular race, gender, or age. HRE personnel invested a large amount of time arranging these small groups, and these efforts contributed to the dynamics of the small groups and the overall experience. These truly diverse small groups of participants were observed enacting equitable practices, with very few exceptions. Experts and novices valued each other’s prior knowledge, shared equipment and took turns; and expert participants were observed offering first time experiences to novices. Below, we include two excerpts from perceived novices and two excerpts from perceived experts as an illustration of the application essays that we used to evaluate participants for acceptance to the program and to determine levels of prior herpetological experience and knowledge:

### Perceived novices

A Lumbee Indian female, from a family with a low income who lives in a rural area, wrote the following application essay. This rising 9<sup>th</sup> grader’s essay is presented below in its entirety.

Dear whomever this may concern.

I would really like to participate in this camp because I have never had a camping experience. I believe that camp Rockfish would be an excellent first for me. I love learning new things an [sic] meeting new people. I love animals an [sic] I enjoy doing hands on activities especially dealing with nature. A career as a veterinarian has always been my life dream an [sic] I think going to this camp would give me more insite [sic] into this career. I am very out going an [sic]not afraid to try new things. I feel that after this experience I will be more educated on different places, people an [sic] the life around me For all these reason [sic] I will be thrilled to e [sic] accepted to camp rockfish.

Sincerely,

Student Applicant

**Table 2. Participants Accepted to the HRE at Camp Chestnut Ridge (CCR).**

| Student | Rising Grade | Gender | Race | Income | Address           |
|---------|--------------|--------|------|--------|-------------------|
| 1       | 10           | M      | MR   | M      | Rougemont, NC     |
| 2       | 9            | F      | W    | H      | Hurdle Mills, NC  |
| 3       | 10           | F      | H    | L      | Burlington, NC    |
| 4       | 10           | F      | B    | L      | Browns Summit, NC |
| 5       | 10           | M      | W    | L      | Mebane, NC        |
| 6       | 10           | M      | B    | L      | Greensboro, NC    |
| 7       | 9            | M      | W    | H      | Chapel Hill, NC   |
| 8       | 10           | F      | W    | L      | Laurinburg NC     |
| 9       | 11           | M      | H    | L      | McLeansville, NC  |
| 10      | 11           | M      | H    | M      | Burlington, NC    |
| 11      | 11           | F      | W    | H      | Burlington, NC    |
| 12      | 9            | M      | AI   | L      | Pembroke, NC      |
| 13      | 9            | M      | W    | H      | Greensboro, NC    |
| 14      | 9            | M      | AI   | L      | Rowland, NC       |
| 15      | 11           | M      | B    | L      | Burlington, NC    |
| 16      | 9            | M      | AI   | M      | Pembroke, NC      |
| 17      | 9            | F      | H    | M      | Laurinburg NC     |
| 18      | 9            | F      | W    | M      | Jamestown NC      |
| 19      | 11           | F      | W    | L      | Boone, NC         |
| 20      | 9            | F      | AI   | L      | Lumberton, NC     |
| 21      | 10           | F      | B    | L      | Mebane, NC        |
| 22      | 11           | M      | MR   | M      | Holly Springs, NC |
| 23      | 11           | M      | B    | L      | Moreno Valley, CA |
| 24      | 9            | F      | MR   | M      | Jamestown, NC     |
| 25      | 9            | F      | W    | H      | Raleigh, NC       |
| 26      | 10           | M      | MR   | L      | Chapel Hill NC    |
| 27      | 12           | F      | H    | L      | Burlington, NC    |
| 28      | 11           | F      | MR   | L      | Burlington, NC    |
| 29      | 9            | M      | MR   | M      | Chapel Hill NC    |
| 30*     | 11           | F      | H    | L      | Burlington, NC    |

Notes: \*Denotes student was accepted to participate but did not attend the weeklong HRE. For Gender M=Male, F=Female. For Income H=High income household, M=Medium income household, and L=Low income household. For Race AI=American Indian, A=Asian, B=Black, H=Hispanic, MR=Mixed Race, W=White. Data were obtained by self-report from participants and their parents. Racial categories used were US Census demographic groups. Economic classifications were based on 2010 US Census data that reported the median household income to be \$51,914 (<http://quickfacts.census.gov/qfd/states/00000.html>); thus, the income classifications used were low (0-\$24,999), medium (\$25,000-\$74,999), and high (above 75,000).

**Table 3. Participants Accepted to the HRE at Camp Rockfish.**

| Student | Rising Grade | Gender | Race | Income | Address            |
|---------|--------------|--------|------|--------|--------------------|
| 1       | 11           | F      | B    | L      | Burlington, NC     |
| 2       | 9            | F      | B    | L      | Lumberton, NC      |
| 3       | 11           | F      | AI   | L      | Maxton, NC         |
| 4       | 9            | F      | B    | L      | Lumberton, NC      |
| 5       | 9            | F      | W    | H      | Haw River, NC      |
| 6       | 9            | F      | W    | H      | Reidsville, NC     |
| 7       | 9            | F      | A    | L      | Raleigh, NC        |
| 8       | 11           | F      | H    | M      | Knightsdale, NC    |
| 9       | 10           | F      | W    | L      | Siler City, NC     |
| 10      | 11           | M**    | H    | L      | Hope Mills, NC     |
| 11      | 9            | M      | AI   | L      | Lumberton, NC      |
| 12      | 9            | M      | AI   | L      | Lumberton, NC      |
| 13      | 9            | F      | AI   | M      | Fairmont, NC       |
| 14      | 9            | M      | AI   | L      | Pembroke, NC       |
| 15      | 9            | M      | AI   | L      | Pembroke, NC       |
| 16      | 10           | M      | AI   | M      | Pembroke, NC       |
| 17      | 9            | M      | AI   | M      | Red Springs, NC    |
| 18      | 12           | M      | W    | H      | Reidsville, NC     |
| 19      | 11           | M      | W    | H      | Richmond, Virginia |
| 20      | 9            | M      | M    | H      | Cary, NC           |
| 21      | 10           | M      | W    | H      | Angier, NC         |
| 22      | 11           | M      | W    | L      | Mountain City, TN, |
| 23      | 11           | M**    | W    | L      | Fayetteville, NC   |
| 24      | 9            | M      | W    | L      | Burlington, NC     |
| 25      | 11           | M      | W    | M      | Fayetteville, NC   |
| 26      | 8            | M      | W    | M      | Dunn, NC           |
| 27      | 9            | F      | AI   | L      | Lumberton, NC      |
| 28*     | 9            | F      | AI   | L      | Lumberton, NC      |
| 29*     | 11           | F      | B    | L      | Fayetteville, NC   |
| 30*     | 9            | F      | AI   | L      | Rowland, NC        |
| 31*     | 10           | F      | AI   | L      | Pembroke, NC       |
| 32*     | 11           | F      | H    | L      | Burlington, NC     |

Notes: \*Denotes student was accepted to participate but did not attend the weeklong HRE. \*\* Denotes Student who is Hearing Impaired. For Gender M=Male, F=Female. For Income H=High income household, M=Medium income household, and L=Low income household. For Race AI=American Indian, A=Asian, B=Black, H=Hispanic, MR=Mixed Race, W=White. Data was obtained by self-report from participants and their parents. Racial categories used were US Census demographic groups. Economic classifications were based on 2010 US Census data that reported the median household income to be \$51,914 (<http://quickfacts.census.gov/qfd/states/00000.html>); thus, the income classifications used were low (0-\$24,999), medium (\$25,000-\$74,999), and high (above 75,000).



A rising 10<sup>th</sup> grade Hispanic participant, from a family with a low income, who lives in the NC Piedmont, wrote the following in her essay:

I am not familiarized with all the reptiles and amphibians out there because I do not know where they are located. I imagine that amphibians and reptiles live near the beaches though. I believe this because I see the reptiles and amphibian close to the water when I go to the zoo. Like for examples, turtles live in the water but yet again on land and lizards live in warm tropical climate.

HRE will be a great opportunity for me learning to be independent without my parents being there by my side looking out for me. It will be very interesting to be involved with reptiles and amphibians. Science is one of my top favorite subjects in school because I am interested in the career science have to offer [sic].

### Perceived experts

A rising 11<sup>th</sup> grader, a White male, whose family has a medium income and lives in an urban area in an adjacent state, wrote the following two paragraphs as a part of his four-paragraph application essay:

I have always been interested in animals, especially reptiles and amphibians. For me there are few things as thrilling and fascinating, as glimpsing a snake slither out from underneath a rock. I often find myself out in the woods cradling a new herp, I had never seen before, completely in awe. I have amassed a small library's worth of books on reptiles and amphibians and almost all of my knowledge pertaining [sic] herpetology is self-taught either from reading or experience. I have been on herpetological surveys with the Virginia Herpetological Society, but they don't hold them often. I have been looking for herpetological programs for some time now and H.R.E. seems really interesting.

I try to make as much time as possible to go out and study the herps in my area. For me, the most interesting aspect of herpetology is actually going out into natural places and searching for reptiles and amphibians. Since I live in the city, I can't just go into my backyard and find herps. About once a week from February-October I drive out to swamps and forests in my area to study the local fauna. One of my favorite places to visit is Crewe's Channel a swamp about 20 minutes outside Richmond. Here I observe the emergence of frogs of frogs [sic] and salamanders in early spring, the abundance of snakes in May, and lizards and turtles basking under the warm autumn sun. Walking a short trail I flip logs and rocks searching for snakes. I usually go at dusk so I can cruise the quiet stretch of road that runs along the swamp, pausing for herps I spot on the warm pavement. Over the last few years I've seen Black Rat Snakes, Rough Green Snakes, Garter Snakes, Ribbon Snakes, Racers, Northern Water Snakes, Copperheads, American Toads, Green Tree Frogs, Painted Turtles, Marbled Salamanders, Spotted Salamanders, Five-Lined Sinks [sic] and many other species.

A White male, rising 9<sup>th</sup> grader, who attends a private Catholic High School and is from an affluent suburban family, included the following information in his essay:

Vacation for some is the beach, for others it might be the city, but for me, I like a place that has the pines, oaks, and cypress. I like the Croatan. The Croatan National Forest is in Craven County and some of it is owned by a private thirty six member camp where I like to hunt, fish, and observe the wonderful wildlife and landscape in the twelve thousand acres that the camp has to offer. Every now and then there are researchers that come to camp to help and give advice on how to help the large variety of animals that are present. When they come, I make an extra effort to tag along with them when they go on the lake or in the woods to observe the habitat of the animals so I can learn some bits of information that I can use and act on. They observe alligators, turtles, bass, brim [sic] frogs, snakes, deer, fox, coyotes, multiple species of duck and many more that are variables in the process of making camp a better place.

### Actions by HRE Personnel to Ensure Diverse Participation Recruitment

When promoting programs to participants from low-income families, it is essential to inform teachers in schools with low-income populations about the programs. Teachers can make the difference by helping their students complete and submit applications, as well as serving as contacts when student applications are not submitted on time or to assist if applications are to be submitted online. Some HRE applicants did not have access to the Internet or to a printer at home. HRE personnel took these circumstances into consideration and communicated with participants' parents and guardians by phone and mail. HRE personnel mailed all necessary forms (health and permission to participate forms) to those households that did not have access to the Internet or to a printer and included self-addressed stamped envelopes so materials could be returned. HRE personnel readily accepted such forms by mail rather than requiring their completion online. In addition, some HRE personnel drove to some households to help with the necessary paperwork if the parents or guardians needed assistance. HRE personnel also translated every form, letter, and email correspondence into Spanish, which served to enhance communication with the Spanish-speaking families.

The *HERP Project* personnel learned from the summer's first weeklong HRE at CCR that participants without Internet needed to be called if forms were going to be required prior to the participant's arrival at the HRE. For the Rockfish HRE, *HERP Project* personnel called a number of participants' parents. One filled out registration forms online for the English-speaking parents, and another, who speaks fluent Spanish, filled out registration forms online while speaking to the participant's Spanish-speaking parents. These actions ensured that these parents and guardians were informed directly about the HREs and all necessary paperwork for their children was completed.

### Recognizing issues that interfere with participation.

Even though the HRE's were free to participants, some students struggled with transportation to and from the programs as well as access to some of the recommended commodities. In order to provide equal access, HRE personnel tried to anticipate these situations so that the lower income students were not deterred from participating. For instance, several parents were not comfortable driving long distances, could not afford to take time off work to drive to HRE sites, and/or could not afford the cost of round trip travel to an HRE. Thus, HRE personnel provided transportation for some low-income families making attendance possible for some participants who otherwise might have been unable to attend.

HRE participants also needed field equipment such as water bottles, backpacks, field guides, raincoats, insect repellent, sunscreen, and flashlights or headlamps. *The HERP Project* supplied refillable, reusable water bottles to students who did not have one, and they also supplied headlamps for use during night hikes. Each participant received a small *HERP Project* backpack that included a field guide, which ensured equal access to one of the necessary tools of a field scientist. *The HERP Project* also provided rain ponchos, sunscreen and insect repellent.

*The HERP Project's* expenses for low-income participants were slightly higher than for higher-income participants, who could afford their own transportation and supplies. Through minimal expense to the program, low-income students were assured equal access to drinking water, protection from the elements, and necessary field equipment. These small expenses made a big difference in equalizing the outdoor learning experiences for all participants.

### Ensuring equal access to participation.

Equity can also be interpreted to mean fairness in valuing each person or participant in an activity or discussion (Unterhalter, 2009). Exemplary African American science teachers argue that there are three important components to promoting interest in science for diverse students: 1) students need to have a genuine interest; 2) students need to be encouraged and provided with scaffolding in order to develop this deep interest; and 3) multiple view points need to be presented (Jianzhong, Coats, & Davidson, 2012). Not only were multiple viewpoints allowed in the HRE's, they were encouraged and valued. Students were encouraged to feel safe to speak, ask questions of the project leaders and other students, as well as to feel comfortable in making mistakes. A common 'mistake' that can erode equity is the misinterpretation of what a student from a different culture or race is saying.

One of the co-authors noted in her field notes during the HRE at CCR an example of misinterpretation of a student's response. These field notes were taken after the Calling Amphibian Survey Protocol (CASP) night activity when the entire group had gathered to debrief their experience.

One student, a Black female, commented upon the fact that it felt strange to be walking to the left around the lake as we listened for frog calls in two-minute in-

tervals. A visiting Herpetologist, a White male, commented that we walked around the lake to the right. We had walked around the lake in a clockwise direction.

I thought at length about this comment wondering why the student had thought that she had walked around the lake to the left. I realized, after pondering this, the scientist was thinking of the direction we walked from an aerial view. He was imagining the direction being to the right, as the hands on a clock would seem to rotate to the right as we look upon a clock on the wall. She had a different perspective. She was imagining standing at the shore of the lake and looking out upon the lake. If one were standing looking at the water, the direction we were moving from station to station was to the left. If she were to define a direction of movement it would be on her left from her view at the shoreline.

From the student's point of view she was correct; from the scientist's point of view he was correct. The scientist was unable to see the student's point of view and understand that she was also right, from her perspective. These are the types of perspectives that we try to consider as we encourage student participation in the HREs.

By appreciating what all students bring to the experience and by searching to understand all students' perspectives, HRE personnel promoted enhanced learning and group involvement. This enhanced learning occurred while HRE participants were in the field doing exciting and engaging research projects that encompassed all areas of science. The vignette below from a previous summer's field notes illustrates this process.

Despite the rain on Sunday, Monday morning's weather is sunny. We will visit the vernal pool with Dr. K this morning. The entire group includes Donald, Jason, other participants, and also my husband Andy. Although Andy has studied salamanders for thirty years, he is a novice this morning. Although it is Andy's second year working with this group, this is Andy's first trip to the vernal pool. Dr. K is showing Andy how to guide data collection for spotted salamander larvae and insects at the vernal pool. After the morning's organizational meeting, my group makes the kilometer trek to the vernal pool. The road that leads to the vernal pool is rutted and muddy, as it also serves as a horse trail for our residential setting. We occasionally must avoid horse droppings. Billy, who is somewhat socially inept, is also in our group. During the walk, Billy complains about the mud and sloppiness. Once at the pool, he is uncomfortable with the concept of wading into muddy water. To the contrary, the Lumbee Indian boys, Donald and Jason, talk about how wading in the pool is similar to swimming in the Lumber River, something they do often during the summer. Andy tells the students to pair up in groups of two to inspect the 20 or so minnow traps for larvae; he does not designate the groups. The other students, aware of Billy's sometimes inappropriate behavior, are reluctant to work with him. Finally, Donald volunteers to team with Billy, and not only works with him from a data collection point of



view but does an admirable job of keeping him on task.

Donald's behavior indicates his comfort in this messy aquatic outdoor environment. He has spent his summers swimming in the Lumber River near his home. The Lumber River is a black water river that has a dark tea color due to a high concentration of dissolved tannins. I heard him and his fellow Lumbee students discuss these swims off and on during the week. Also, it was obvious that Donald had invested in the learning community here to the point that he was willing to assist a colleague who was challenged by the specific learning environment so that group success in data gathering could be achieved. Although this is the first day of the program, Donald is more of an expert than Billy and is willing to mentor him.

As the above vignette illustrates, students also recognized and extended the equitable practices to others in their research groups. This perpetuation of practices created a safe environment for all students to interact and engage with each other and the leaders.

Additionally, we noted on several occasions that perceived expert participants recognized that perceived novices needed to experience success since they had had less prior access to these types of opportunities. Two perceived experts explained to one of the co-authors in separate conversations that they held back themselves from rushing in and being the first to lasso a lizard because they knew that they would make lassos at home, while other students might not have the opportunity to lasso a lizard at home. This same co-author also noted in the field that one White female participant, who was extremely adept at spotting and capturing lizards, had her lasso poised to snag a lizard, but instead motioned to one of the Black females and asked her if she would like to lasso the lizard. After the lizard was lassoed, the White female asked the co-author if she could teach her to make the lassoes, so she could use them at home. Thus, this participant relinquished the opportunity to lasso her first lizard because she recognized the need for someone else to have that experience.

Not all of the perceived experts responded in this matter. One White male participant, who was a perceived expert, wanted to be the first to experience new opportunities, and he often bragged about these encounters to the other perceived experts. Interestingly, the other experts noted this in their exit interviews. Even though they classified this student as one of the smartest at the HRE, they quickly pointed out that he did not take others into consideration as much as they thought he should have since he had the opportunity to do these types of activities at home.

### The Equitable Approach of the Program: Equity in Action

As discussed previously, using the outdoors as a context provides an equitable approach to science exploration. When experiences are incorporated in learning, as well as examples, analogies and values from different cultural and linguistic groups,

a higher science achievement is fostered (Aikenhead, 1997; Matthews & Smith, 1994). Participating teachers found that the HRE's helped them learn how to meet the challenges of science education, because they too learned by 'doing'. Student participants develop a genuine interest in science when they realize they are exploring and discovering, using scientific tools and skills, and seeking information that scientists may not know yet; such as the species of turtles living in a particular lake. This joint quest puts students, teachers, scientists, and project leaders on the same level. None of them know for sure what species of turtle they will find in the turtle traps set in the lake.

All explore together, and what each member does and notices is important to the group. What makes HRE science investigations rewarding is the fact that each student has prior knowledge and experience to offer. An interpreter for two deaf students (one White male, one Hispanic male) at Rockfish this summer reported on the third day of the HRE that the two students she worked with had had an excellent day. She noticed that there were no longer two languages (sign and spoken) as the boys were fully integrated into the group and the group worked as one.

HRE programs have an equitable academic approach. All of the groups have access to the same resources. Each group visits all project areas. Each group is mixed according to ability, gender and race (Boaler, 2008; So, Seah, & Toh-Heng, 2010). All participants have access to the same curriculum regardless of previous academic standing.

### Curriculum

*The HERP Project's* use of local reptiles and amphibians creates a curriculum that is relevant for the students. Local wildlife is accessible to teachers and students in parks and wooded areas of NC. These animals may be in students' back yards or in their schoolyards. Many students begin to see their local environments as homes to the reptiles and amphibians they learned about at HREs. Often students report involving their whole family in listening to frog calls when they return home after the HREs conclude.

### Technology

An equitable approach to technology is also part of an HRE. All students are given opportunities to use a variety of computer hand-held devices. The chance to do real and relevant hands-on science, meet and work with scientists, use some of the latest technology in the field, and learn how scientists think are what get these young people excited about science. One bemused participant said slowly under his breath, noticing that each student in his group had an Ipad to use to record data, "Thousands of dollars of technology". I pads and Samsung Galaxies were used in the field, allowing participants to submit data forms, take photos or videos, and keep track of the route the group took through the woods by marking GPS coordinates for locating waypoints along the hike.

This use of technology supports Kellner's (2003) proposed view of a new critical theory in education in terms of technology. He suggests the restructuring of "education so that all students



have access to evolving technologies and multiple literacies” (p. 62.). Each project leader and teacher made a conscious effort to provide each participant access to the Ipads and Galaxies. Every student left the HRE having had a chance to use both forms of technology. Initially, some students were more comfortable using the devices than others, but each student developed a familiarity with the devices by the end of the HREs. The HRE personnel also used the participants as resources as they had the students field-test applications and also provide detailed feedback about possible improvements. One Black student noted that he felt that he had contributed to science by being able to contribute to improving technological field applications.

### Participant Voice and Choice

The HRE personnel valued participant voice and choice by allowing participants to have a choice of nightly activities and a say in how evening programs were run. Each evening, participants chose an elective to attend, and at first, each elective was designed to accommodate only eight students. As the week progressed at both HREs, more students wanted to participate in certain electives numerous times. The participant limit was removed, and personnel were reassigned to facilitate larger numbers of participants in more popular electives.

At the Rockfish HRE, participants expressed a desire to have a talent show as the final evening activity. The HRE personnel rearranged the schedule for both day and evening activities to help make this request a reality. HRE personnel worked closely with one another to reschedule the posttests, surveys, and interviews that were planned for that day in order to provide time for this new activity. The participants were able to choose how they would display their talents, and several students chose to perform with other participants even though they had met only four days earlier. The Lumbee boys danced with the other boys in a group performance. One Black girl displayed extraordinary abilities in step dancing. One Lumbee girl clogged, which is her talent for the Miss Lumbee Pageant. As a ‘grand finale’ most of the HRE personnel participated in a group dance wearing waders, headlamps, and field clothes.

After the talent show, participants and some personnel did the Cuban shuffle. At first, some participants were off to the side watching, but as the song progressed and with encouragement from fellow participants, every student was dancing by the end of the song. As discussed previously, everyone was on equal standing in scientific inquiry, but the talent show helped put us on more equal standing socially.

### Implications from our Work on Equity in Outdoor Science Education & Recommendations for Other Programs

1. Be purposeful about your intent. If your intent is to offer all students in your community an equal opportunity to attend your program then commit to doing whatever you have to do to make that happen. Our goal was to reproduce the demographics in our participants so that it reflected the demographics in our counties and the school systems in those

counties.

2. Take word of your program out to schools and community groups so that members of your target audience are informed about possibilities. We recruited in person at schools with targeted populations, in school systems with targeted populations and in community groups as requested, including garden clubs. We recruited online through teacher networks and then targeted teachers we knew to ask them as well as members of our local advisory board to let students know about these opportunities.
3. We worked with specific agencies to target students including the Offices of Indian Education for the Public Schools of Robeson County and Cumberland County Schools.
4. Teachers who both encourage their students to apply and sit down with their students to assist them in completing the applications are more likely to have students who are accepted into and attend and complete the program.
5. We have delegated spaces for teachers in our programs. Our teachers receive free room and board as well as a stipend for attending our programs. They serve as group leaders/facilitators while in our programs. We anticipate that our teacher participants will mentor student applicants particularly well in the next two summers (our grant period).
6. Make sure your personnel are sensitized to the goals of the project. The focus of our project is rural education. Many less affluent minority individuals live in more rural areas of our state.
7. Once you get applicants from your targeted audiences speak with them to make sure that they understand the parameters of your program.
8. Simple things go a very long way toward making the experience a good one for all students. Providing things like water bottles, daypacks, waders, gloves, insect repellent and sunscreen helps students be more comfortable in the out-of-doors. Modeling dress (for the field) and talking about how each of us makes sure we are comfortable in the field puts students at ease.
9. Personnel need to be sensitive to the needs of the students and offer flexibility with curriculum.
10. Some students will be unable to attend the program unless transportation is provided.
11. Provide Spanish speakers or Language Interpreters to engage with parents whose primary language is not English. We had Spanish speaking personnel who were able to call homes, talk parents through completion of certain forms, and answer questions.
12. Respond promptly to parents via email or telephone. Several of our teenagers had never been away from home. Worried parents were relieved to know that their children were fine, engaged and enjoying the program.
13. Talk parents and students through required research forms.
14. Plan to have more attrition when you recruit from diverse audiences. Some students are unable to attend due to family finances (can't actually transport child to the program, need child to work to help family meet expenses) or family mem-

bers' illness (in some cultures an ill family member means that all immediate family members and friends make caring for the ill member a priority. This is very true for Lumbee students and new teachers often wonder why teenagers are required to stay home if a grandparent or an aunt or uncle is ill. Similar practices seem to be the case with Hispanic families too.

- Remember that equity does not always mean doing the same things for all of your participants. Two of our students who are hearing impaired spent an evening in the field doing a listening activity (listening for specific frog calls and making decisions about the frequency of those frog calls). While we aren't sure exactly how we'll handle this in the coming summers we'll definitely use sonograms and see how they work too.

The extra effort to provide a more equitable science program is well worth the work as it expands upon and improves the experience for all participants. It is our hope that the teachers involved with *The HERP Project* will enact what they learned about equity in science throughout the school year. The benefits of our efforts to reach underserved populations in science will hopefully serve as a good example for others organizing informal science programs. As teachers around the world find a more diverse student population in their classrooms, we hope this article will help them find new perspectives on science.

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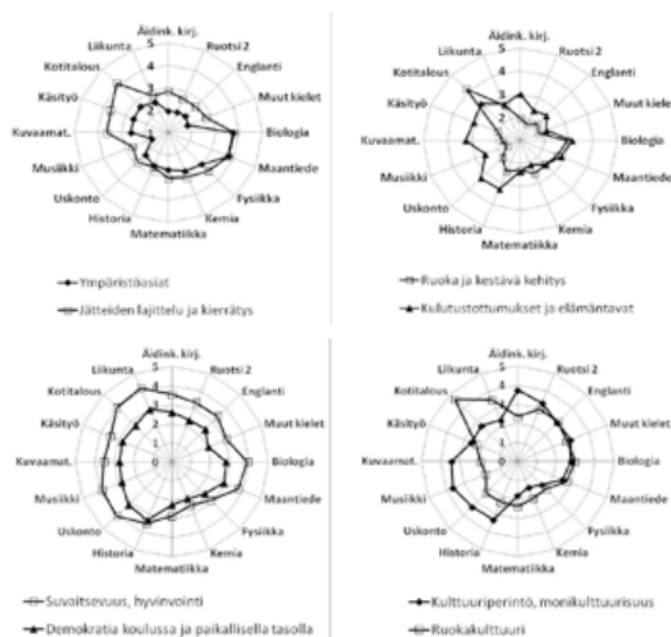
\*\* *Slip Slidin' Away* was partially funded by a Burroughs-Wellcome Grant from 2007–2010.

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## Korjaus Natura 4/12 sivulla 32 on virheellinen kuva 2.

Anna Uitto, yliopistonlehtori, opettajankoulutuslaitos, Helsingin yliopisto  
Seppo Saloranta, rehtori ja tohtorikoulutettava, opettajankoulutuslaitos, Helsingin yliopisto



Kuvio 1. Ekologisesti ja taloudellisesti kestävän kehityksen aiheiden käsittely aineenopettajien omassa opetuksessa.

Kuvio 2. Sosiaalisesti ja kulttuurisesti kestävän kehityksen aiheiden käsittely aineenopettajien omassa opetuksessa.



