Cult Stud of Sci Educ (2017) 12:33–43
DOI 10.1007/s11422-016-9756-2

FORUM

Re-inhabiting place in contemporary rural communities: Moving toward a critical pedagogy of place

Lacey D. Huffling[1] · **Heidi B. Carlone**[2] · **Aerin Benavides**[2]

Received: 1 October 2015 / Accepted: 31 October 2015 / Published online: 28 December 2016
© Springer Science+Business Media Dordrecht 2016

Abstract Heather Zimmerman and Jennifer Weible's (Cult Stud Sci Educ, 2016) use of place-based pedagogy in high school science education honors their participants' lived experiences and the rural communities from which they come. They raise an unresolved tension in their findings: Why did the youth in their study, who clearly learned a lot about the local watershed, not feel empowered or knowledgeable enough to propose collective, action-oriented strategies to address the poor quality of the water? We use this tension as a focus point of our response, drawing on one author's (Huffling's) biography and David Gruenewald's (Educ Res 32:3–12, 2003. doi:10.3102/0013189X032004003) critical pedagogy of place to re-imagine the curriculum that Zimmerman and Weible describe. We provide strategies that align with Gruenewald's (2003) constructs of decolonization and reinhabitation that could promote youths' collective empowerment.

Lead Editors: L. Avery and D. Long.

This paper is part of the special issue Cultural Studies of Rural Science Education.

This review essay addresses issues raised in Heather Zimmerman and Jennifer Weible's (2016) paper entitled: Learning in and about rural places: connections and tensions between students' everyday experiences and environmental quality issues in their community. doi:10.1007/s11422-016-9757-1.

✉ Lacey D. Huffling
lhuffling@georgiasouthern.edu

Heidi B. Carlone
hbcarlon@uncg.edu

Aerin Benavides
awbenavi@uncg.edu

[1] Department of Teaching and Learning, Georgia Southern University, P.O. Box 8134, College of Education, 275 Forest Drive, Statesboro, GA 30460, USA

[2] Department of Teacher Education and Higher Education, The University of North Carolina at Greensboro, 404 School of Education Building, 1300 Spring Garden Street, Greensboro, NC 27402, USA

Keywords Rural education · Science education · Environmental education · Place-based curriculum · Critical pedagogy of place

Resumen Heather Zimmerman y Jennifer Weible (2016) honraron las experiencias vividas de los participantes y las comunidades rurales de donde vinieron los jóvenes utilizando una pedagogía basada en el lugar en las clases de honores de educación científica en una escuela secundaria. Plantean una tensión no resuelta en sus resultados: ¿por qué los jóvenes en el estudio de investigación, que claramente aprendieron mucho sobre la cuenca local, no se sentían suficientemente facultados o con conocimiento suficiente para proponer estrategias colectivas orientadas a la acción para hacer frente a la mala calidad del agua? Utilizamos esta tensión como un punto de enfoque de nuestra respuesta, usando la biografía de un autor (de Huffling) y la pedagogía crítica de lugar de David Gruenewald (2003) para informar una re-imaginación del plan de estudios que Zimmerman y Weible describían. Proporcionamos estrategias que se alinean con construcciones de Gruenewald (2003) de descolonización y reinhabitation que podrían promover el empoderamiento colectivo de los jóvenes.

Rural science and environmental education reconceived

Rural science and environmental education, when considered from a cultural studies lens, is becoming increasingly complex. Our goals can no longer straightforwardly be about promoting learners to get to know and embrace their local ecology or encouraging individual conservation behaviors. Economic instability amidst dwindling natural resources brings into sharp relief the tensions between historical, economic, indigenous, cultural, agricultural, recreational, and social uses of land. North Dakota's fracking industry is one example of the ways an economically poor rural area has experienced unprecedented economic boom, but at the expense of the community's ecology, biodiversity, and, possibly, humans' health (Cwiak et al. 2015). West Virginia's controversial mountaintop removal coal mining has grown over the past two decades, a practice which results in many detrimental environmental impacts (e.g., deforestation, water quality, declines in stream and forest biodiversity) and accompanying increased rates of lung cancer and chronic heart, lung, and kidney disease (Hendryx and Ahern 2008). In our state (North Carolina), rural towns along the Dan River now face uncertainty after a Duke Energy coal ash pond released 80,000 tons of coal ash (CCR's) into the waterway (www.ie.unc.edu/issues/coal_ash.cfm). These are just a few examples that demonstrate the increasingly complex politics and interactions between land, economics, and culture. Rural communities often have to suffer for the well-being of society and the larger economy and/or for the promise of temporary economic benefits.

Amidst this landscape, science and environmental educators must re-envision effective pedagogy for rural communities, which is precisely why Heather Zimmerman and Jennifer Weible's (2016) article, *Learning in and about rural places: connections and tensions between students' everyday experiences and environmental quality issues in their community*, provides an excellent case for discussion. Their study examined the effectiveness of a place-based unit for high school students in a rural Pennsylvania Appalachian community that centered on their local watershed and water quality issues. Specifically, they examined how learners connected their experiences in rural places (e.g., hunting, fishing,

boating, swimming in the reservoir) and the ways their experiences interacted with their scientific meaning making. We view this as a timely and important article because it demonstrates the value of time and effort put into a place-based curriculum in a traditional high school science classroom. The youth in the study came away with increased understanding of the local watershed, including more sophisticated connections between and among the actors of an ecosystem (as evidenced by pre- and post- mind map analyses), and a better understanding of authentic scientific practices to evaluate stream health (e.g., a study of biological, chemical, and physical parameters).

In this response, we take up the unresolved tension the authors raise toward the end of the article. Though the study's high school students' knowledge increased throughout the unit, they "did not feel capable to act as a collective group to address the low water quality of the stream" (Zimmerman and Weible 2016). The authors attributed this finding, in part, to the lack of information youth had about possible collective actions to take and to the historical practices of schooling that silo school subjects, promoting the separation of "civic solutions" (social studies) and science. We agree that these possible explanations make sense. This tension, though, sparked great discussion among us—what would a curriculum that might promote collective action look like?

Our experiences and standpoint

Before we begin, we provide a little context for our perspectives. For the past 4 years, we have worked on a project called The HERP Project (Herpetology Education in Rural Places) (National Science Foundation, #ISE 1114558), which is designed to engage diverse high school youth in a field ecology summer enrichment program focused on herpetology (the study of reptiles and amphibians). One goal of the project is to ignite youths' passion for recognizing and protecting the rich biodiversity of herpetofauna in their own backyards. Zimmerman and Weible's (2016) article provided us an opportunity to discuss how we would improve our summer program's curriculum, if we were more deliberate about facilitating collective action. Thus, our ideas about Zimmerman and Weible's (2016) study here also apply to improving our own work with The HERP Project.

Another relevant standpoint is that one of us (Lacey) grew up in a rural, Appalachian community in Georgia close to the Tennessee border. She provides a brief biography here that illustrates the lens through which she views rural science and environmental education:

> As a White female who grew up in rural Appalachia, I experienced firsthand the complex interactions between the land, the people, economics, and a large mining company. Almost all of the men in the town worked at 'The Company,' which was how the locals referred to the copper mine. Yet, most of the area residents lived near or at the national poverty level and did not obtain an education beyond a high school degree, as the nearest college was several hours away.
>
> My grandmother stopped attending school in 7th grade because the only high school in the area was too far away and she was needed at home. My grandfather was also needed at home to work the land as his older brothers worked in the mine, so he only attended school until 8th grade. All of the men in my family (except my father) worked for 'The Company.' My dad struggled with the conditions of the mine and the effects it had on the land, so he chose instead to learn a trade and became skilled at car paint and body repair. This was always a point of tension at family gatherings

as his uncles and cousins would continually tell my father he could earn more money working in the mine. With limited employment opportunities in the area, most men did not have much of a choice as to whether they were going to work for 'The Company.'

In one of my earliest memories of 'The Company,' I was playing contently in my grandparents' backyard (a small row house built for workers of the copper mine) when the harsh whistle of 'The Company' shattered the peaceful afternoon. My grandmother rushed through the backdoor and scooped me up, tears streaming down her face. As a child, I did not fully grasp her concern, but later I would learn that this piercing ring alerted the entire town that a mineshaft caved in. My grandfather walked through the door that evening, covered in soot, and simply said, "It was bad, but we got 'em out," and my grandmother was crying again.

Mineshaft collapses were not the only concerns associated with 'The Company'; massive clouds of sulfuric acid poured out of the smoke stacks on a daily basis. The trees and vegetation, for miles, dried up and died. The area became a wasteland; the reddish-brown soil no longer supported life. Due to the desert-like conditions, the small town was one of the only two objects observable from the first orbit of space (Nicklaus 2011). Due to the acid rain and rapid oxidation, my grandfather's red truck had huge rust holes in the exterior, as did most cars. In fact, one of the first lawsuits involving air quality occurred when Georgia farmers downwind of the copper mine sued the state of Tennessee. "Cases went to the US Supreme Court twice in the 1890s and the high court agreed with the Georgia farmers both times." (Higgins 2001, p A8)

'The Company' also began to produce sulfuric acid, sulfonates, and liquid sulfur dioxide after investing in technology that turned the by-product of the copper smelting, massive smoke clouds, into usable organic chemicals that further degraded the environment. Though costs eventually made the deeply buried copper too expensive to mine, the newly acquired organic chemical plant was extremely profitable, so by-products from other mines were shipped to the area. However, by 1985, increasing environmental policies made the sulfuric acid production too much of a liability, and 'The Company' began downsizing and phasing out, reducing the workforce from around 3000 to 280, and the area became a ghost town (Higgins 2001). The ecosystem was destroyed, and the people, including my family, were left without work. One can still see the reddish brown soil today when driving down the two-lane road. Succession in this area had been slow; however, in the late 1980s, the Tennessee Valley Authority (TVA) provided much needed assistance to the land with aerial reseeding as they were facing large fines by the Environmental Protection Agency (EPA) (Nicklaus 2011).

Early on in my childhood, the toads (though at the time I knew them only as frogs) started disappearing from my grandparents' neighborhood. It was not until years later that I made the connection between the degradation of the environment and the loss of frog biodiversity. I always wondered as a child why the vegetation was destroyed and what this meant for the rest of the area and the people. This was my first experience with environmental injustice, and it has forever shaped how I view environmental issues.

Lacey's biography became a lens through which we viewed Zimmerman and Weible's (2016) study. Much like the students in their study, Lacey was intimately connected to

complex politics, place, and history of her family's land. In the next section, we delve into our discussion of curriculum reimagined using a critical pedagogy of place lens.

Toward a critical pedagogy of place

Similar to the high school students in Zimmerman and Weible's study, Lacey understood the environmental problems her community faced, but she did not know how to take collective action to help mitigate her town's environmental degradation. Thus, we take up the authors' calls for ways "to help young people develop action-oriented science knowledge, not just knowledge of environmental problems, during place-based education units". To frame our discussion, we begin with the following five place-based education principles, defined by Steven Semken (2005) and outlined by Zimmerman and Weible (Table 1). For each principle (mentioned below), we draw out possible strategies for realizing a critical, action-oriented approach. Our ideas are informed by David Gruenewald's (2003) critical pedagogy of place (which also informed Zimmerman and Weible's work, but perhaps not to the extent we use it here). According to Gruenewald (2003):

> A critical pedagogy of place aims to (a) identify, recover, and create material spaces and places that teach us how to live well in our total environments (reinhabitation); and (b) identify and change ways of thinking that injure and exploit other people and places (decolonization). (p. 9)

Reinhabitation emphasizes, "how humanity's diverse cultures attempt to live well" (Gruenewald 2003, p. 9) in areas of land that have been "disrupted and injured through past exploitation" (Berg and Dasmann 1990, p. 35; cited in Gruenewald 2003, p. 9). Decolonization "involves learning to recognize disruption and injury and to address their causes" (p. 9). We find these concepts, under the umbrella of a critical pedagogy of place, useful in framing a move toward a place-based curriculum that might promote collective action. We re-examine each of Semken's (2005) place-based principles and the place-based curriculum described in Zimmerman and Weible's (2016) study, in light of Gruenewald's (2003) pedagogy of place below.

Principle #1: Focus on the natural history of a local setting

A critical pedagogy of place would highlight not only the natural history of a local setting but also social and cultural history. By understanding the history of a place, youth can begin to consider the process of decolonization. Students can explore how the stream used to look and function. They might consider questions such as: What species were once abundantly present here, but are now either missing or scarce? How has the stream changed over time? Has it been re-routed or widened? How was it used in the past and how is it being used in the present? These questions provide opportunities for students to collect stories from their family and community members; narratives are a powerful tool for students' meaning making. Further, students could search Google maps and images for historic photographs and bring photographs from home, which would be another way to highlight the community reliance on the stream and the meanings that the stream holds for others. As students begin to understand how humans have decolonized the stream area, conversations regarding how humans can re-inhabit the space and live sustainably in the area can be addressed.

Table 1 Place-based principle #1 infused with critical pedagogy of place

Place-based education principle (Semken 2005)	Classroom activities	Community involvement
(1) Focus on the natural history of a local setting	Students delineated their local watershed and annotated local landmarks, industries, or activities familiar to each student.	Nature walk discussion focused on the history indicated by soils samples. Stream mapping discussion about the erosion of the bed over a period of time.
Ideas to infuse critical pedagogy of place	Broaden "natural" history to include social and cultural history of place. Students could conduct an investigation to understand how that place was used and/or changed over time, and for what reasons.	Highlight historical and current community reliance on the stream. Have students collect stories from family and community members that center on the watershed's role in the community.

The first two rows of this table come directly from Zimmerman and Weible (2016). We added the third row to reflect the ways we might integrate a critical pedagogy of place. This is true for each of the subsequent tables below

Zimmerman and Weible (2016) acknowledged that there was little to no involvement of parents and/or other community members outside of the scientists and environmental educators. They suggest that by incorporating more members of "the collective" that students might have been encouraged to consider, discuss, and move toward collective actions.

Principle 2: Attend to the diverse meanings that a place has for learners and teachers

Our ideas to infuse a critical pedagogy of place with this principle (see Table 2) overlap significantly with Principle #1 above. First, we might broaden "meanings" well beyond

Table 2 Place-based principle #2 infused with critical pedagogy of place

Place-based education principle (Semken 2005)	Classroom activities	Community involvement
(2) Attend to the diverse meanings that a place has for learners and teachers	Students added their personal landmarks and experiences to their group's watershed map and 3-D representation. Students brought water samples from areas they frequented for testing in class.	Discussions during the nature walk about experiences of students in the local watershed such as fishing or boating, recreational use, facilities at home or at the dam.
Ideas to infuse critical pedagogy of place	Broaden "meanings" to include more than students' *knowledge* and *experiences*. Include economic, historical, and cultural meanings of place by having students and/or teachers construct their own biographies of and with the place. Move beyond an anthropocentric point of view in examining "meanings" (e.g., ecojustice focused Photovoice). Extend research questions beyond knowledge-based questions.	Include voices of teachers and community stakeholders in the discussion of watershed—e.g., ecological entrepreneurs, farmers, hunters, and fishers. Get students to research families' funds of knowledge. Share public Wiki or newsletter with the families. Hold Paideia seminars and/or debates.

students' experiences with and knowledge of place to get them to explore their families' funds of knowledge (Moll, Amanti, Neff and Gonzalez 1992) about the watershed and local ecology, as well as economic, historical, and cultural meanings of place. For instance, students and/or teachers could construct family and personal biographies, much like Lacey did, and these could provide further points of discussion within the class. Giving students multiple presentation platform options (i.e. narrative, photo/video documentation, song, poetry) would enable students and teachers to express themselves in the media of their choosing while also highlighting their creative and artistic insights. This could be done in partnership with colleagues who teach other subjects. This would mean similarly broadening the meanings of "community involvement" beyond the Conservation District employee and park ranger mentioned in the article who did discuss "current issues, historical influences, government regulation, and personal choice" on a walking tour of the reservoir. However, those employees likely had a fairly narrow perspective that might be broadened by including voices of ecological entrepreneurs, hunters, fishers, and farmers who also likely have deep knowledge of the land, water, and natural history. Inviting those who engage in sustainable practices might enhance the idea that the watershed is, indeed, a collective responsibility.

The research questions in Zimmerman and Weible's (2016) article focused primarily on students' *knowledge*; we wonder if, perhaps, students' meanings (e.g., their values, traditions, emerging conflicts with and decision-making related to the watershed, etc.) may have been obfuscated with this approach. The pedagogy, as represented in the article, seemed to be heavily focused on uncovering sources of pollution, which may have created students' guilt and/or conflict not visible with the kinds of data collected. These kinds of knotty conceptual issues could provide opportunities for discussions in the forms of debate or Paideia seminars.

Finally, we wonder if the focus on "meanings" should go beyond an anthropocentric one. What does the watershed mean to the wildlife? The students collected data about macroinvertebrates, which is a great start. What about other wildlife? In our HERP Project, our interest is about the local herpetofauna (reptiles and amphibians), but questions about the plants, fish, and mammals also emerge. One pedagogical strategy we have used to elicit empathy about animals' perspectives is a photovoice project, which focused more on ecojustice than human health concerns per the original photovoice design (Wang and Burris 1994). In our photovoice project, students focused on how humans and environmental degradation affected herps in their local communities and what this in turn meant for the natural environment and community. We asked students to speak from the perspective of the organism and from their own perspective when they made their final poster projects, which we displayed at three environmentally focused community events.

Principle #3: Incorporate fieldwork and inquiry, with authentic artifacts and representations

We found the extensive and multi-faceted use of fieldwork described in the article to be an outstanding feature of the pedagogy. The underpinnings for this principle (see Table 3) helped students continue to develop their meaning of the place and understand where the place is "now," which is an important feature of Gruenewald's (2003) concept of decolonization. Using Gruenewald's (2003) concept of reinhabitation, we might also ask: How can scientific and environmental understanding be used to shape the place? How could this watershed be re-envisioned as a more ecologically sustainable place? Are we missing perspectives in our re-envisioning, and if so, how can we be more inclusive of the collective?

Table 3 Place-based principle #3 infused with critical pedagogy of place

Place-based education principle (Semken 2005)	Classroom activities	Community involvement
(3) Incorporate fieldwork and inquiry, with authentic artifacts and representations	All students participated in classroom preparations for the four stations utilizing tools that were used in the field by scientists on a regular basis.	The watershed investigation utilized scientific tools and concepts at all four stations.
Ideas to infuse critical pedagogy of place	Extend the concept of "inquiry" beyond scientific inquiry to include case studies of environmental policy; study industry standards for water quality.	Visit a water treatment plant to understand what counts as clean water for human use. Involve families in deciding where to collect water samples for further testing.

This is a good place to extend the concept of "inquiry" beyond scientific inquiry and to think about ideas for integrating social studies, which is also a point Zimmerman and Weible (2016) made in their discussion and implications section when they discussed "models of civically-engaged, scientifically-literate citizenry". The integration of past success stories, such as Environmental Protection Agency policies limiting the pollution of water in the United States and the establishment of water quality standards could strengthen the students' creative process about how to envision collective action strategies. Integrating new collective action stories could also inspire them. An interesting example of the general public taking part in testing water quality for freshwater organisms is the use of environmental DNA (eDNA) in a citizen science national monitoring program organized in the United Kingdom (UK) to help scientists identify sites supporting the great crested newt (*Triturus cristatus*) (Biggs et al. 2015).

We imagine many ways to expand local watershed investigations to help students re-envision their ecological place. Visiting water treatment plants, allowing students to further expand their research to other nearby places, encouraging students to go water sampling with and have discussions with their families, and shifting from guided inquiry to more open inquiry are all ideas for how to move toward a more critically oriented perspective of place.

Principle #4: Encourage ecologically sustainable and culturally appropriate norms and pedagogy (including case-based, project-based, or service learning)

As co-inhabitants of the land and because we are dependent upon nature for our survival, we have an ethical responsibility to attempt to live as compatibly as possible with the natural world. This principle (see Table 4) highlights how we currently live with the land (decolonization) and how we can learn to live in more sustainable ways by understanding historical ways of living in the land (e.g., traditional ecological knowledge of Native Americans; reinhabitation). We wondered if the webquest students in the study completed addressed ethical dilemmas humans face when trying to learn to live more ecologically and responsibly in a place. Some questions that could provide rich discussion include: "What needs to be remembered in and about this place? What needs to be changed or transformed in this place?" (Greenwood 2012, p. 99) How do I/we need to be changed or transformed? What do we envision this place to be in the future? As Angela Calabrese Barton and Edna Tan (2010) suggest, students can act as community experts by developing educational

Table 4 Place-based principle #4 infused with critical pedagogy of place

Place-based education principle (Semken 2005)	Classroom activities	Community involvement
(4) Encourage ecologically sustainable and culturally appropriate norms and pedagogy (including case-based, project-based, or service learning	Students completed a webquest about water pollution, read about characteristics of healthy watersheds, and interpreted macroinvertebrate study results.	Discussion at all stations of the field trip tied the work being done by students to the careers and hobbies of the adult community members.
Ideas to infuse critical pedagogy of place	Encourage students to imagine a better future for the land, the organisms, and themselves and how they will achieve it.	Encourage students to educate their local community.

materials such as flyers or public service announcements that put their scientific and environmental knowledge and understanding into action.

Principle #5: Increase the "sense of place" of learners and teachers

We see this "principle" as the end goal of all other principles; it highlights how one can *understand* a place, but not develop a *sense of place* for the area. Based on the data presented by Zimmerman and Weible (2016), it was difficult to determine whether or not students developed a sense of place. If we define sense of place as place attachment, the importance of a place to people (Low and Altman 1992), and place identity, how a place becomes part of a person's identity (Devine-Wright and Clayton 2010), then we could ask: Did students connect the meanings they developed of the place with their previous place attachments and meanings? Did students connect the meanings they developed about the watershed with their place identity (Devine-Wright and Clayton 2010)?

Making these connections demands a fair bit of student reflection, as students need time to think about and process the information they learn in class. We come back to questions based on Gruenewald's work (2003): What new memories need to be embedded in and with this place? How can a communal sense of place foster environmentally sustainable behavior? What are the next steps that need to be taken? What community strengths can be celebrated? What community struggles can be addressed?

Final reflections and a challenge to ourselves

Zimmerman and Weible's work raised many questions for us—questions that, incidentally, we struggle with in our own research and pedagogy. As former classroom teachers, we realize the inherent challenges of incorporating a critical pedagogy of place in school curriculum. It occurs to us that researching a history of place where no official history may be easily available and constructing such a history from primary sources may seem like a Herculean task. While difficult for a teacher to take on, working toward establishing awareness of a sense of place for youth could offer rewarding, engaging, authentic socio-scientific student learning; and promote collective action that could benefit not only students, but the whole community. In writing this forum piece, we return to our work with new ideas to research and develop curriculum that fosters a critical pedagogy of place.

As we work to help our students increase environmental awareness, contemplate the inherent value of the land, discover and celebrate the beauty and strength in their

community, and re-imagine local places, it behooves us to encourage our students to not simply consider their own perspectives and experiences but to also continually ask themselves: What perspectives, both human and non-human, are being silenced by my perspective and/or experience? Purposefully discussing the perspectives and experiences that are privileged in our re-imagining of places can lead to a fuller understanding of the collective and can stimulate further discussions surrounding the tensions between the land, the community, economics, and culture.

Movement toward a critical dialogue concerning power and privilege affords opportunities for all students to participate and highlights the need for social justice in science and environmental education. We encourage unveiling the inherent environmental value in all communities, to focus on community strengths as well as how we can live more compatibly in the spaces we inhabit.

References

Berg, P., & Dasmann, R. (1990). Reinhabiting California. In V. Andruss, et al. (Eds.), *Home! A bioregional reader* (pp. 35–38). Philadelphia: New Society Publishers.

Biggs, J., Ewald, N., Valentini, A., Gaboriaud, C., Degean, T., Griffiths, R. A., & Foster, J. et al. (2015). Using eDNA to develop a national citizen science-based monitoring programme for the great crested newt (*Triturus cristatus*). *Biological Conservation, 183*, 19–28. doi:10.1016/j.biocon.2014.11.029.

Calabrese Barton, A., & Tan, E. (2010). We be burnin'! Agency, identity, and science learning. *Journal of the Learning Sciences, 19*, 187–229.

Cwiak, C. L., Avon, N., Kellen, C., Mott, P. C., Niday, O. M., Schulz, K. M., et al. (2015). *The new normal: The direct and indirect impacts of oil drilling and production on the emergency management function in North Dakota*. Fargo: North Dakota State University.

Devine-Wright, P., & Clayton, S. (2010). Introduction to the special issue: Place, identity and environmental behavior. *Journal of Environmental Psychology, 30*, 267–270. doi:10.1016/S0272-4944(10)00078-2.

Greenwood, D. A. (2012). A critical theory of place-conscious education. In R. B. Stevenson, M. Brody, J. Dillon, & A. E. Wals (Eds.), *International handbook of research on environmental education* (pp. 93–100). New York: Routledge.

Gruenewald, D. A. (2003). The best of both worlds: A critical pedagogy of place. *Educational Researcher, 32*, 3–12. doi:10.3102/0013189X032004003.

Hendryx, M., & Ahern, M. M. (2008). Relations between health indicators and residential proximity to coal mining in West Virginia. *American Journal of Public Health, 98*, 669–671. doi:10.2105/AJPH.2007.113472.

Higgins, R. (2001 , January 7). *At crossroads: Facing life without copper*. Chattanooga: Chattanooga Times Free Press, pp. A1, A6–A7

Low, S. M., & Altman, I. (1992). Place attachment: A concept inquiry. *Place attachment* (pp. 1–12). New York, NY: Plenum Press.

Moll, L. C., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory Into Practice, 31*, 132–141. doi:10.1080/00405849209543534.

Nicklaus, T. (2011, March). History of the ocoee region. *Ocoee Info*. http://www.ocoeeinfo.com/history.html

Semken, S. (2005). Sense of place and place-based introductory geoscience teaching for American Indian and Alaska Native undergraduates. *Journal of Geoscience Education, 53*, 149–157.

Wang, C. C., & Burris, M. A. (1994). Empowerment through photo novella: Portraits of participation. *Health Education & Behavior, 21*, 171–186. doi:10.1177/109019819402100204.

Zimmerman, H., & Weible, J. (2016). Learning in and about rural places: Connections and tensions between students' everyday experiences and environmental quality issues in their community. *Cultural Studies of Science Education*. doi:10.1007/s11422-016-9757-1.

Lacey D. Huffling is an Assistant Professor of Curriculum and Instruction at Georgia Southern University. Her research focuses on identity and equity issues for marginalized populations in environmental and science education.

Heidi B. Carlone is a Professor of science education in the Department of Teacher Education and Higher Education at The University of North Carolina at Greensboro. Her research uses theoretical lenses from anthropology of education, sociocultural theories, and cultural studies to understand the culture of and diverse students' identity work within innovative science, environmental, and engineering education settings.

Aerin Benavides is a Ph.D. student in the Department of Teacher Education and Higher Education at The University of North Carolina at Greensboro. Her research interests are in equity of access to science, citizen science, science education outdoors, and environmental education.