

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

---

Publications of the University of Nebraska  
Public Policy Center

Public Policy Center, University of Nebraska

---

2023

## **“Popping it” as family in Mosquitoes & Me: affective accumulation and Anzaldúan aesthetic consciousness in *Ciencia Zurda***

Katherine R. Bruna

Jennifer Farley

Lyric Bartholomay

Follow this and additional works at: <https://digitalcommons.unl.edu/publicpolicypublications>



Part of the [Other Public Affairs, Public Policy and Public Administration Commons](#), [Other Social and Behavioral Sciences Commons](#), [Public Affairs Commons](#), [Public Policy Commons](#), and the [Social Policy Commons](#)

---

This Article is brought to you for free and open access by the Public Policy Center, University of Nebraska at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Publications of the University of Nebraska Public Policy Center by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.



# “Popping it” as family in Mosquitoes & Me: affective accumulation and Anzaldúan aesthetic consciousness in *Ciencia Zurda*

Katherine Richardson Bruna<sup>1</sup> · Jennifer Farley<sup>2</sup> · Lyric Bartholomay<sup>3</sup>

Received: 8 March 2023 / Accepted: 8 March 2023  
© The Author(s), under exclusive licence to Springer Nature B.V. 2023

## Abstract

This article uses key concepts of Anzaldúan philosophy to describe the Mosquitoes & Me summer camp as *ciencia zurda* or *left-handed science*. It details a day-in-the-life portrait of Elena, a first-generation Latina middle schooler, as she experiences the opportunities that Mosquitoes & Me provided for self-other bridge crossing and radically relational, *Nepantlan* potential. Our discussion of Elena’s experiences in terms of *Nepantlan* principles of diversity, Affect, and spirit, as well as Affective accumulation and aesthetic consciousness, infuse an emotional and spiritual dimension to inquiry science- and responsive science-complementarity and revisit a call for soul-centered, socially-transformative science.

**Keywords** Anzaldúa · Science education · Mosquito science · Nepantla · Affect

## Resumo

Este artículo utiliza conceptos clave de la filosofía de Anzaldúan para describir el campamento de verano Mosquitos & Me como ciencia zurda. Detalla un retrato del día a día en la

---

This manuscript is part of the special issue on Borderlands, guest edited by Angela Chapman and Alejandro J. Gallard Martínez.

---

✉ Katherine Richardson Bruna  
krbruna@iastate.edu

Jennifer Farley  
jfarley3@unl.edu

Lyric Bartholomay  
lyric.bartholomay@wisc.edu

<sup>1</sup> School of Education, Iowa State University, 901 Stange Avenue, 1218B Lagomarcino Hall, Ames, IA 50011, USA

<sup>2</sup> University of Nebraska Public Policy Center, 215 Centennial Mall South, Suite 401, Lincoln, NE 68588, USA

<sup>3</sup> Department of Pathobiological Sciences, University of Wisconsin-Madison, 1656 Linden Drive, Madison, WI 53706, USA

vida de Elena, una estudiante de secundaria latinoamericana de primera generación, mientras experimenta las oportunidades que Mosquitoes & Me le brindó para cruzar el puente entre sí misma y el potencial *Nepantla* que es radicalmente relacional. Nuestra discusión sobre las experiencias de Elena en términos de los principios de *Nepantla* sobre diversidad, afecto y espíritu, así como la acumulación afectiva y la conciencia estética, infunden una dimensión emocional y espiritual a la complementariedad de la ciencia investigadora y la ciencia receptiva, y hacen un llamado por una ciencia centrada en el alma y socialmente transformadora.

**Palabras claves** Anzaldúa · educación en ciencias · ciencia de los mosquitos · *Nepantla* · Afecto

We feel him approach—the father of one of our Mosquitoes & Me summer campers. At the end-of-camp celebration event, families have eaten, watched their kids receive recognition for camp contributions, and sampled mosquito science experiments. This man who’s approaching has a son named Yves (pseudonym) who received the “SBO Award.” “SBO” stands for Stinky Bucket Observation. Every day it was Yves, wearing a bandana over his nose and mouth, who used a pipette to draw a sample of water out of the big plastic bucket we kept outside at our camp-created mosquito habitat. With every Iowa summer day, the mix of water, grass, leaves, and dirt became smellier and smellier. On some of those days, the samples Yves retrieved, when looked at under the microscope, showed eggs, then larvae, then pupae, and then adults. We could always depend on Yves to return from his SBO expeditions, sample in hand, and entertain the rest of us with his descriptions of just how revoltingly smelly was the stinky bucket. How the SBO became Yves’ responsibility is unclear, but he embraced it and there were no other takers. His role in obtaining the daily samples was central to the camp’s inquiry-based mosquito science practices. We came to count on him and he came through.

Yves’ father nears and makes clear he has something to say. We brace ourselves, wondering if we’re going to hear an objection to Yves’ work with the SBO. Instead, we hear something different. From a stint in the military, Yves’ father recalls, he learned something he wants to share with us. “This camp isn’t only about mosquitoes,” he said. “It’s about learning to work together. Sometimes the best way to teach a person one thing is to teach them something else.”

Since that night, we’ve been reflecting on what Yves’ father told us. His words have taken on even more meaning in light of a 2018 National Institutes of Health (NIH) SciEd Conference special session theme, “It’s Less About the Science Than We Think.” In this paper, we take up Yves’ father’s invitation to think about science education, and our Mosquitoes & Me summer camp, as being about “something more than the science.” We want to think about what it means to frame science experiences as sites of “learning to work together.” If this idea is the point of departure, then it follows that science teaching and learning experiences can, and should, engineer and evolve intentional interactions. Further, these intentional interactions can, and should, sow the seeds of social change.

We ground our thinking in Gloria Anzaldúa’s (2015) idea of radical relationality, specifically as articulated in her alliance-oriented vision of *un mundo zurdo* or a *left-handed world* and the experience, in world-making, of *Nepantla*. In drawing on these ideas, we orient to Anzaldúa as a seminal philosopher of our time, one whose contributions are finally being understood for the way they provide ontological and epistemological insights that

challenge and enrich the modern philosophical canon. We acknowledge that her positionality, the standpoint from which her philosophy arose, is one we don't share. We write as White women with lived experiences far removed from the Borderlands/borderlands contexts and contours of Anzaldúa's reality. We don't intend to claim that we created Mosquitoes & Me as a science borderland. We won't attempt to demonstrate that our campers had borderland identities. What we will do is use key concepts of Anzaldúan philosophy to describe Mosquitoes & Me as *ciencia zurda* or *left-handed science* and detail a day-in-the-life portrait of Elena, a Mosquitoes & Me learner, as she experiences the structures that our programming provided for self-other bridge crossing with potential for Anzaldúan "radical relationality" and *Nepantla*. In doing so, we will import an Anzaldúan spiritual dimension to the discussion of inquiry science and responsive science complementarity (Brown 2017) and revisit the call for soul-centered science (Richardson Bruna 2016). We will conclude by making a connection between *Nepantlan* approaches to interaction, human development, social evolution, and social change and discuss what it would mean to center an Anzaldúan spiritual activism of self-transformation in science education efforts.

We begin by explaining who we are and the work we do with Mosquitoes & Me. Our interests are situated in Anzaldúan philosophy as informing an "epistemology of resistance" (Medina 2013) and describe how understandings of the individual-in-interaction can inform social change theory. Additionally, we indicate where connections exist between our interests and current issues in science education research. Here we will reference the complementarity of inquiry-based and culturally-responsive science education and, in a related way, the Affective dimensions of science teaching and learning. We will explain the foundation that already exists in science education research, but also in anthropological and psychological research, upon which an Anzaldúan philosophy of science education can build. Along the way, we will point out where science education policy seems to call for the attention we are giving to individual interaction, social evolution, and social change, and where it stops short.

For the core of the paper, we turn our attention to a day-in-the-life case of one of our campers, a Latina peer of Yves' named Elena (pseudonym). Drawing on Sarah Lawrence-Lightfoot and Davis's technique of portraiture (1997), we present a "picture" of Elena's participation in Mosquitoes & Me to demonstrate the affordances of Anzaldúa's philosophy in re-seeing science education. We use one day in Elena's camp life to document her interaction as part of a more expansive Mosquitoes & Me meshwork of diverse interactive pathways (Ingold 2008). It is the plurality, multiplicity, and liminality of these pathways that construed *un mundo zurdo*, or *a left-handed world*, where youth historically left-behind by science education and society learned to be young scientists by working together. The interactive pathways provided "something else"; they had the opportunity to live differently in a world that, by learning and working together, they just might change.

## What and why is Mosquitoes & Me?

Mosquitoes & Me is part of the broader Urban Ecosystem Project (UEP), an NIH grant-funded effort (#RG25M129210) aiming to advance the scientific knowledge, skills, and dispositions of historically excluded youth by engaging them in authentic activity through an ambitious and diversity-affirming instructional approach that catalyzes their capacity to act as public health agents of change in their communities. By authentic activities, we mean question-and-discourse driven experiences and experiments that develop insights

about mosquito biology, ecology, and disease transmission that translate into actionable understandings of their everyday relevance. For example, a camper's curiosity about how much water a mosquito egg needs to grow leads to a hands-on experiment comparing the development of eggs in varying amounts of water held in different ice cube tray segments. From the experiment, campers realize how little water it takes for an egg to develop. From this, they understand how many environments around their homes and neighborhoods serve as inadvertent mosquito habitats, ones they can disrupt through simple everyday behavior such as emptying rainwater collected in outdoor toys or turning off leaky faucets leading to puddles in local parks. The question- and discourse-driven nature of activities ensures that summer camp teaching and learning is people- and place-based. The water experiment, for example, is a response to participant-generated interest which affirms the legitimacy and power of youth ideas as a living curriculum and the mutuality of the teaching–learning dynamic. Using this living curriculum, the summer camp situates its conversation in the community context. Campers map their neighborhoods' mosquito hot spots which allow us to connect acquired understandings to concrete practices that youth could implement. Understanding how little water eggs need to develop results in tangible translation when campers survey a local hot spot park and identify how many potential habitats exist that are likely sources of the mosquito problem they experience. Now, positioned as young mosquito scientists, the campers can pass along this knowledge to their friends and families. For our campers, primarily Black- and Latinx-identified upper elementary and lower middle-grades youth, sensing science as a tool they can put to use in their own lives is a new experience, one that affirms their community spaces as sites of meaningful sciencing.

The authentic and diversity-affirming approach of *Mosquitoes & Me* is part of the UEP's long-term goal to interrupt health and education disparities in a low-income, urban context and to support underserved youth and their teachers in their trajectories toward science and improved science education. The rationale for the use of mosquitoes as the thematic vehicle draws on real-world needs having to do with climate change, urbanization, and mosquito control challenges. These require approaches to entomological talent expansion and science identity-making among urban youth, like our *Mosquitoes & Me* campers.

## New mosquito habitats

Climate change and urbanization are accelerating new mosquito habitats around the world and the need for new approaches to community-based control and prevention that are people- and place-responsive. With climate change, global temperatures are rising. With urbanization, more people are living in close proximity. Both climate change and urbanization impact mosquito-borne diseases. Mosquitoes and the pathogens they host are highly vulnerable to temperature changes. That cities in the warmer regions of the country are experiencing higher rates of mosquito-borne disease suggests mosquitoes and their pathogens are adapting to climatic temperature shifts (Rothman et al., 2021). Mosquitoes are utilizing the characteristics of urban environments created through human behavior in ways that vary by neighborhood. For example, mosquito samples collected from less wealthy areas, characterized by infrastructure issues such as abandoned structures and inadequate waste management, have more and larger mosquitoes than wealthy areas. This has health equity implications. If, as research suggests, larger mosquitoes live longer, then people who live in less wealthy areas may be at greater risk of mosquito-borne illness (Rothman et al., 2021). Climate change and urbanization are thus altering the risk of disease (Katz et al.,

2019) in ways that have disparate effects on urban populations, which are more likely to include people of color.

## **The need for community-based urban mosquito science**

Interrupting the disparate effects of mosquito-borne disease requires community-level action. According to the National Association of County and City Health Officials Report (2017), 68% of the country's entities dedicated to disease control are deemed "in need of improvement." This means they were insufficient in five key competency areas (routine mosquito surveillance, standardized trapping, species identification, larviciding and adult-ciding capabilities, and routine vector control). Exacerbating the infrastructure challenge is the reality that mosquito control efforts are increasingly challenging to implement because of stances on individual liberties vis-à-vis property rights and law enforcement (Bartlett et al., manuscript submitted for publication). Some mosquito breeding grounds, like garbage bins and leaky outdoor faucets, are in spaces only accessible by residents; others may be more publicly accessible, like puddles in community gardens or tire swings in parks, but still reliant on community-based surveillance (Alonso and McCormick 2018). This means that closing the gap between the infrastructure we have and the infrastructure we need depends on involving people in local control efforts. In this way, mosquito science is folded into broader calls for urban ecological stewardship. These include a range of efforts to monitor the local environment, advocate for sustainable ways of living in it, and educate the public (Fisher et al., 2015). Urban ecologically inclined programs to climate-proof cities are on the rise, and they will depend on grassroots involvement. Mosquito science, as a facet of urban ecology, can be an approach to empowering youth and educators to engage in urban ecology research and practice.

## **The need for engaging entomological and equitable science education**

The cause for the infrastructural control crisis is complex. Among its many causes is a dearth of entomological expertise. Entomology is essentially absent in school science for institutional- and individual-level reasons. College courses on invertebrate animals are disappearing because students, even those interested in science areas, don't think the content is relevant to career paths. With limited enrollment, colleges remove those courses from their catalogs, eliminating the visibility of entomology as a potential pursuit (Rivers 2006). Students studying to be teachers, particularly at the elementary level, have limited exposure to entomology in preparation programs, which likely means they will avoid the theme in their teaching, thus passing the limited exposure along to their students. For example, the coursework of an average preservice teacher may include only a week or two on insects as part of a general life science requirement (Wagler and Wagler 2012). The courses that do exist are usually taught in a traditional teacher-centered, didactic way. This format is less than ideal given that a hurdle most students face is a negative Affective orientation to insects (being "grossed out" or "scared to death") (Rivers 2006, p. 24). The lack of engaging hands-on entomological education means students don't have the opportunity for up close and personal experiences that can overturn these reactions. More intimate, curiosity-driven experiential learning is needed in entomology education (Rivers 2006).

Simultaneously there is a lack of scientifically robust, pedagogically engaging, and standards-aligned entomological instructional resources to support this style of teaching and learning. The lack of resources reflects a disconnect between the nature of contemporary science research culture with its limited attention to public science communication (Friesner et al., 2021) and the outreach needs of P-12 science schooling. The combination of lack of scientific training and limited scientific research experiences for P-12 teachers, particularly in under-funded urban schools (Darling-Hammond 2001), closes off students' learning opportunities and may explain the overall low entomological professionalization rates and racial/ethnic disproportionality. On the one hand, there is an expressed need for entomologists who can engage in culturally responsive public health activity in urban environments while, on the other, a documented lack of representation of individuals from minoritized backgrounds historically associated with urban demographics. This mismatch curtails national capacity for effective outreach, which is of particular concern given the predicted effects of climate change on insect habitats and populations in cities.

The need for enhanced entomological education intersects with the need for enhanced science education, particularly for youth from underserved backgrounds. Educational disparities persist between White students and students of color, as well as between students of low socioeconomic status, who are more likely to come from minoritized backgrounds, as well as those of high socioeconomic status, who are more likely to be White (Avery 2013). The lower science achievement of students of color begins in the late elementary grades, is exacerbated by a focus on reading and math-centered assessment-driven curriculum (National Academies of Science, Engineering, & Institute of Medicine 2011), and continues through high school, resulting in the underrepresentation of racial/ethnic minorities in college-level science studies and subsequent science careers (National Science Board 2018).

We know that active learning is essential to the acquisition of authentic science practices. Students who participate in science activities are more likely to see themselves as scientists (Archer et al., 2010). The move to reform science education through inquiry seeks to align what and how science is taught in school to the actual content and practices of scientists (National Research Council 2012). Next Generation Science Standards (NGSS Lead States 2013) urge approaches to science education that are more authentic by teaching through real problems involving current scientific issues and using real science practices and the habits of mind (Roth 1995) needed to solve them. One way of doing this is to involve learners in the design and conduct of scientific investigations (Crawford 2014). Science identity is formed by participating in science activities and learning how one fits in with the science community and culture (Vincent-Ruz and Schunn 2018). Students attending under-resourced urban schools are less likely to have received abundant experiences, material, or affirming psycho-social support about a potential future in science (Duschl et al., 2007). As part of their science experiences, students need to develop feelings of competence and aspiration (Carlone et al., 2014). They need to learn science, but they need to learn "something more."

Teachers, however, may face challenges in helping students participate in, feel competent about, and aspire to science. Teachers are likely unaccustomed to hands-on inquiry because of their own school socialization experiences, including teacher preparation. And teachers need to be familiar enough with the content to actively engage in modeling its science practices (National Research Council 2012). Through the co-learning model of Mosquitoes & Me summer camps, we aimed to equip youth and future teachers for robust science, while also addressing the need to develop and diversify entomological education,

expertise, and capacity for the urban ecological stewardship required for community-based and environmental equity-cognizant responses to climate change.

## Co-learning and community for college-going

To attain its goals, UEP provides Mosquitoes & Me summer camp programming to upper-elementary and middle-grades youth associated with two elementary schools in the urban core of Des Moines, Iowa. The two schools are those served by the ISU 4U Promise, Iowa State University's (ISU's) early outreach college access promise partnership (Richardson Bruna et al., 2017). These schools are among the most racially/ethnically diverse and socioeconomically stressed of those in Des Moines' urban core. What makes these two schools unique among others is that youth who graduate the fifth grade from either are eligible to receive tuition awards upon their undergraduate enrollment at ISU. While these tuition awards constitute the heart of the promise partnership, in- and out-of-school experiences support youth in becoming college-ready and thus able to cash in on the tuition award promise. The UEP's Mosquitoes & Me summer camp is one such experience. The ISU 4U Promise is noteworthy among national promise programs in its intensely place-based focus. Serving only two schools and their surrounding neighborhoods, the program has been able to cultivate and rely on a network of relationships at the district, school, and community level to responsively design experiences that support youth in a college-going trajectory. We intended, with Mosquitoes & Me, to provide an opportunity to acquire authentic science practices. We also intended to provide an opportunity to acquire authentic affiliation with ISU toward a possible ISU future. We went in to planning for Mosquitoes & Me knowing relationships, as part of the science, would matter. Our co-learning format in which preservice and inservice teachers experience science learning alongside youth was part of this relationally oriented approach.

From 2016 to 2019, we delivered Mosquitoes & Me as a two-week summer day camp from 8:00 am to 3:00 pm, Monday–Friday. We recruited youth and teacher participants who were associated with the ISU 4U Promise. Preservice teacher participants were Elementary Education students at ISU who had elected to do an urban practicum experience in the ISU 4U Promise schools as well as take the additional Teaching and Learning with Insects course associated with UEP. Inservice participants were teachers from the ISU 4U Promise schools. In some cases, participating teachers were also cooperating teachers hosting preservice teacher participants in their classrooms as part of the practicum experience. Reflecting Iowa demographics and teaching demographics nationally, our preservice and inservice teachers were mostly White women. Youth participants were primarily rising 5th-graders from either of the two schools or rising 6th-graders about to head off to middle school as recent graduates from either of the schools. The demographics of youth participants reflected those of the schools. In the year of Elena's case, we had thirty youth participants, ten male and twenty female. Nearly half of these participants checked the Latino/a box on our background survey and just over a third opted for Black or African American. The remainder were identified as White or Asian. Among the youth participants were also older individuals who had participated in an earlier summer camp and had returned as mentors. In 2018, nearly half of our youth participants were returners: ten in their second year and two in their third year. The year of Elena's case, we delivered, at youth request, a three-week summer camp. There were five preservice teacher participants but no inservice



teacher participants. We did, however, serve seventeen inservice teachers through a school-based Mosquitoes & Me professional learning community the following fall.

In our co-learning model, each of our teacher participants was assigned to work as a table leader with a small group of youth throughout the camp experience. To prepare them for this role, they took a year-long elective course in which they experienced examples of Mosquitoes & Me lessons and were facilitated in unpacking their interlocking pedagogical elements. Our aim was to prepare them to undertake their role responsibly and responsively as summer camp educators; importantly, it was not to make them mosquito science experts. When they participated as table leaders with youth co-learners, they understood the foundation of a curiosity-driven ambitious science pedagogy was to let learners' questions lead.

## The curriculum and pedagogy

The Mosquitoes & Me Curriculum (Richardson Bruna et al., 2019) is 170 pages of three NGSS-aligned units encompassing 21 lessons spanning mosquito biology, ecology, disease transmission, and prevention and control content. The curriculum is grounded in a pedagogical approach we describe as TriSC<sup>3</sup>i for its integration of cognition, culture, and communication elements. In developing TriSC<sup>3</sup>i, we aimed to promote holistic educational experiences that would help learners and their educators “try science.” The TriSC<sup>3</sup>i pedagogical framework not only guides enhanced science education delivery but provides a new integrative heuristic for understanding how these cognitive, cultural, and communicative components are reflexive and inherent in one another. TriSC<sup>3</sup>i recognizes that inquiry science and responsive science practices are mutually reinforcing.

Julie Brown (2017) describes this relationship as one of complementarity. She performed a metasynthesis of research articles to further discern the specifics of the inquiry science-responsive-science relationship. She found, for example, that “the use of models allowed students to explore scientific concepts through families’ funds of knowledge” (p. 1143) and that analyzing and interpreting data was a place for “interrogating science content in sociopolitical consciousness-raising experiences” (p. 1143). This idea of complementarity was integral to what we did in Mosquitoes & Me. We drew on campers’ funds of knowledge in modeling activity by having them test the repellent effectiveness of a vanilla oil popular among some of their families. After having them read a science article about the effects of a commonly used larvicide on the reproduction of certain bird species we helped them think about the ecological implications of mosquito control measures. In everything we did, we promoted a communication-rich environment because a guiding principle was that, through teachers’ and campers’ interactions, they would build their mosquito science understandings together. TriSC<sup>3</sup>i is our way of describing the inherent intersection of content acquisition, cultural connection, and coordinated communication in Mosquitoes & Me science programming.

The science activity of Mosquitoes & Me was interspersed with community-building activity. The day opened as we greeted each camper with a handshake at the door. Breakfast and agenda-setting followed. Then we formed a community circle where we sang and danced, shared talents, and offered recognitions. Adult and youth participants had opportunities to write letters to each other using a camp post office and play together during the lunch break. There were daily small group reflections on what each person learned, felt, or wondered, before sending campers off with another handshake or hug.

These community-building activities framed morning and afternoon science sessions that were people- and place-centered. Youth and adult learners told their mosquito stories, made maps of mosquito hot spots around their homes, went larval dipping in local waterways, and walked their neighborhoods looking for mosquito habitats. Using their learning about mosquito biology and behavior, they built traps and placed them in nearby parks, returning the next morning to see if they attracted any mosquitoes. Family members were interviewed about mosquito experiences, understandings, and remedies. Participants thought about in what ways mosquito habitats have changed over time and in what ways they have remained the same. Additionally, system maps of mosquitoes, humans, and societal infrastructure were constructed. Always, the emphasis was on acquiring a science voice; when participants shared ideas with the whole group, they were encouraged to stand so they could be heard by others as "loud and proud." At a final camp celebration, students got the chance to show off to family members all they'd learned. Each participant received a certificate acknowledging their unique contribution, like Yves' award for his important stinky bucket work, and were invited to return the following year to act as peer mentors, as Yves did for three years after his initial participation.

### **Mosquitoes & Me as *ciencia zurda* and "something else" science**

In the rest of this paper, we want to draw on Anzaldúan philosophy to explore how the complementary inquiry science-responsive science context of Mosquitoes & Me construed social interactions that, as Yves father told us, seeded learning that was more expansive and more important than the science content itself. To develop our discussion, we will use the case of Elena, a daughter of El Salvadoran immigrants coming of age in the new borderlands (Valdés 1989) of the American Heartland. We will draw on Anzaldúa's ideas of *un mundo zurdo* or a *left handed world* and *Nepantla* to describe Elena's Mosquitoes & Me experience as one of self-other navigation, one better captured by theories of learning, like Anzaldúa's, that speak to attainment in spiritually-infused, rather than standards-intensive, terms. This, we argue, is important in moving attention to Affect away from the periphery of science education toward its center. While Anzaldúan thinking has been taken up in education (Yazan et al., 2019), it has been given limited attention in science education (McWhirter and Cinamon 2020). This is something we hope our uptake of Anzaldúa in this paper will remedy.

As part of her social activism, Anzaldúa organized a series of meetings she thought of as *El Mundo Zurdo*, to emphasize it as a gathering of those identifying with marked or non-dominant identities. This *Mundo Zurdo* was also a world of alliance-building, where individuals from diverse backgrounds and with diverse needs coexisted, experienced commonality in community, and worked together. For Anzaldúa, the goal of *El Mundo Zurdo* was revolutionary change. In our science program, we incorporate the specificities of Anzaldúa's *El Mundo Zurdo Nepantla* practice into a more general philosophy of building *un mundo zurdo* or a "visionary location" (Anzaldúa 2015, p. 243) that connects the individual to a collective in a way oriented to evolving learning experiences away from how they have been to where they could be. We do this with an understanding of what may be lost by adopting an idea originating from and for a communities-of-color perspective and applying it to a context outside of Anzaldúa's intent. We acknowledge this may be perceived as a function of hegemonic power relations in which we, as White scholars, are positioned as oppressors co-opting ideas meant to confront and curtail the power we wield

by virtue of our Whiteness. This is a risk we run for the purpose of illuminating the potential of Anzaldúan philosophy to bring much-needed attention to the role of community-building and Affect in science education, attention that can help bring about its own form of revolutionary change.

In addition to bringing together individuals from diverse backgrounds, central to *El Mundo Zurdo/un mundo zurdo* is the idea of an overarching affinity identity binding together that diversity. For Anzaldúa, the affinity identity binding together her allies was a commitment to social justice. In *Mosquitoes & Me*, the affinity identity binding together faculty, teacher, and youth participants was the ISU 4U Promise university-school-community partnership program. Faculty and preservice teachers were from ISU, the inservice teachers worked at the partner schools served by the ISU 4U Promise, and the youth lived in the neighborhoods served by those schools and were either still in the elementary-level grades or early in their middle school years at ISU 4U Promise feeder schools. The shared ISU 4U Promise connection meant that a vision of a college-going future for *Mosquitoes & Me* participants, possibly one involving science study, bound the camp's diverse participants together. This vision was invoked in a variety of ways through the camp experience, some of them explicit and others more implicit. On the first day of each summer's camp sessions, for example, Katherine Richardson Bruna would ask youth if they knew about the ISU 4U Promise to make a direct connection between the camp and the college access program. The year of Elena's participation, when Katherine asked who had 100% tuition award eligibility, the hands of a majority of campers shot up, including Elena's. Aside from this kind of direct signaling, messaging about the connection between the camp and college was sent in other ways. Camper's nametags hung on ISU 4U Promise lanyards. Some youth wore the ISU 4U Promise t-shirts distributed each year through the schools. In this way, the ISU 4U Promise provided a spoken and unspoken discursive bridge between *Mosquitoes & Me* science experiences and projected college identities and possible future science selves. In what follows, we illustrate the kinds of interactions that *Mosquitoes & Me* activities construed out of which a lesson of community, one that Yves' father brought to our attention as the "something else learning" more important than the science, emerged.

## Affordances to science education of Anzaldúan learning theory

While not explicitly articulated as such, *El Mundo Zurdo* constitutes a theory of learning and social development. Similar to Lev Vygotsky's (1978) and later Yrjo Engestrom's (1987) Cultural Historical Activity Theory (CHAT), *El Mundo Zurdo* is premised on the idea that people, in working together toward a shared goal involving the use of tool-driven self and social transformation, become a community. Lisa Yamagata-Lynch (2007), for example, in describing CHAT, writes that the theory aims "to capture the *coevolutionary* process individuals encounter in their environment while learning to engage in shared activities" (p. 454, italics ours). Here we see an invitation to think of the shared activity of science education in terms of tool-driven practices construing interactions between individuals that serve this goal of self/social evolution. The processes of science teaching and learning, when viewed through this lens, can be deliberately developmental in promoting particular kinds of experiences, knowledge, and ways of thinking that shape human beings and by extension the world in which we live. Science education can entail the design of opportunities for people to engage jointly in practices that serve a purpose broader than science, that of community-building and social change.

In *El Mundo Zurdo*, Anzaldúa understood that diversity, Affect, and spirit have epistemic affordances. Asserting Anzaldúa into the philosophical canon shines light on how her borderlands theory is a part of, what Ana Louise Keating (2015) calls, a larger ethico-onto-epistemology involving the materiality of bodies, relationality, and interconnectedness. Science education has much to benefit by understanding these not just as corollary outcomes but as goals of teaching and learning.

## Diversity

In Anzaldúan philosophy, reality is inherently relational and knowledge is holistic and embodied. Relationships between people's holistic and embodied ways of knowing in this relational world are bridges that span and straddle and have potential to build alliances that reshape the self and the social. As Robyn Henderson-Espinoza (2013) writes, "The bridge functions both as a relational feature and as a reality that comes into being as one walks across it and relates with oneself" (p. 108). What builds the bridge are chained actions of individuals, which José Medina (2013) describes as holding the potential to form a kind of "kaleidoscopic consciousness" (p. 200). One person's actions echo in another's producing reality and subjectivity that is dynamically expanding because people are engaging with new ideas and evolving new identities. When chained actions achieve a degree of resonance and determination, they can constitute a form of social movement. Whereas before the chains were incidental to and emergent out of the group dynamics, they become definitional to and driving of future interaction and its intent. Thinking about interaction as chained in this way is not necessarily new to educational theory. For example, John Dewey (1927) wrote about casual social networks becoming more organized publics when their members develop their own distinctive ways of talking about their experiences and making their problems, interests, and goals heard. To the extent that individuals in the group strive to acknowledge and accommodate different perspectives to achieve epistemic balance in these chained actions, their interactions constitute a form of resistance to dominant Discourses (Gee 1989). This idea of an epistemology of resistance (Medina 2013) borne out of respect for the affordances of diversity is, however, a noteworthy Anzaldúan legacy.

## Affect

The emphasis on diversity's role in self/social formation that is part of Anzaldúan philosophy makes a crucial contribution to science education. It does this by making a link between diversity as an epistemic resource and Affect. The idea of ritual chains is not new to science education. Randall Collins (2004) for example, also talks about interactions among individuals cumulatively building to promote group identity through a form of emotional energy. He explains chained interactions as micro-level coordinated activity of body, gaze, and speech features. These features comprise the interaction event and constitute its conditions for generating entrainment that can lead to collective effervescence (Durkheim 1912). The positive feelings associated with synched activity drive further involvement as individuals more closely identify as a group and want to keep on interacting. There is attention in science education research to these dynamics. Scholars examine emotions and related constructs such as emotional arousal, climate, and energy (Bellochi et al. 2014). They explore their influences on interest, enjoyment, engagement, and achievement

(Sinatra et al., 2014). Psychology research provides substance to claims about the emotional dimensions of coordinated interaction. It details the relationship between synchrony and prosocial outcomes such as rapport, trust, and cooperation (Michael et al., 2020). What Anzaldúa philosophy does is make explicit an important aspect of group dynamics that is otherwise left tacit in the science education literature. This has to do with the benefit of interaction among individuals from different social groups.

The same psychology research documenting the prosocial effects of synchronous activity lends support to diversity's function in those interactions. Research (e.g., Tuncgenç and Cohen 2016) suggests that through synchronous interaction the interpretive processes, reflecting socially-constructed referents that people use to perceive and evaluate others are altered. Synchronous engagement produces physiological effects that forge bonds across social groups (Tuncgenç and Cohen 2016) and reduce prejudice and stereotyping. Because of these effects, some scholars recommend engineered social interaction among diverse individuals as a form of multicultural education (Atherton et al., 2019). This research seems to support Anzaldúa's ethico-onto-epistemology by attesting to the impact of one individual's field of energy on another's.

Science education does not ignore Affect, it just marginalizes it. David Fortus (2014) in his introduction to a special issue on Affect in the *Journal of Research on Science Teaching*, begins his review of Affect in science education by noting there is a genealogy of work dating back to the 1970s. He also notes however that, while emotions are implicitly understood to be part of teaching and learning, Affect is not articulated as a desired outcome of science education. He blames the outcome-driven focus on standardization of curriculum and pedagogy as the reason for the limited science education research on Affect. Fortus contends instead that a focus on Affect would better serve the content and practice goals of national education standards. "Until we learn how to create schools, classes, and informal environments that continuously kindle and feed the desire to learn," he writes, "we should not be surprised if we do not see much learning occurring" (p. 822). Affect is the kindling that feeds the fire of desire. The flame that burns and has potential to ignite others is what Anzaldúa called spirit.

## Spirit

Spirit is yet another aspect of Anzaldúa philosophy that flows from an emphasis on the epistemic and Affective advantage of connection among diverse individuals. It was the ultimate site of the *El Mundo Zurdo's* revolutionary aspiration. Anzaldúa (2015) quoted Aung San Suu Kyi's words that "It is not enough merely to call for freedom, democracy, and human rights. Without a revolution of the spirit, the forces which produced the iniquities of the old order world continue to be operative, posing a constant threat to the process of reform and regeneration" (p. 92). Diversity was central to her conceptualization of spiritual activism. "Spirituality, she said, recognizes the many differences among us, yet insists on our commonalities and uses these commonalities as catalysts for transformation" (p. 246).

Anzaldúa's interest in the life of the spirit can in some way be understood through the existing framework of holistic education and its attention to the broadest development of the whole person at the cognitive and emotional levels (Forbes 2003). But it is limited by dualistic, Cartesian points of view that regard these levels as distinct. A truly unified approach to holistic education is one in which we understand that a relationship exists between our inner selves and the outer social and natural worlds. Understanding spirituality

from this perspective, as a quest for wholeness, brings it in line with Anzaldúa's ideas about the work of individuals, connecting across differences in *El Mundo Zurdo*, to see themselves as part of a web of interconnections experiencing what she called "radical relationality," a vantage point from which to see the world, a visionary location, for (r)evolution. This is what promotes the possibility for epistemic, Affective, and social justice through "interaction that repairs neglect and insensitivity, expands people's capacities for feeling concerned, [...] through imaginative ways of relating to each other and forging solidarities across differences (Medina 2013, p. 23).

## **Nepantla**

Besides Anzaldúa's articulation of "the borderlands," the indigenous concept of *Nepantla* is her most noted philosophical contribution. *Nepantla* is key to the *El Mundo Zurdo/un mundo zurdo* experience. The concept names the phenomenological "in-between-space" dynamic of a borderlands identity. It is, Anzaldúa wrote, "the zone between changes where you struggle to find equilibrium between the outer experience of change and your inner relationship to it" (Anzaldúa 2002, pp. 548–549). According to James Maffie (2007), *Nepantla* was a model of human behavior in pre-conquest Nahua society. Anzaldúa's invocation of it in her writing invites us to ask three questions that further emphasize the role of diversity, Affect, and spirit in science teaching and learning. Drawing on Maffie's discussion, these are: (1) Diversity. Who is among the plurality of participants? (2) Affect. What are the processes of transaction and conjoinment? (3) Spirit. What is the experience of oscillation in these processes? As Maffie (2007) points out, the third question is qualitatively different from the first two in that the experience of oscillation is creative; that is, something happens, because of it. This something is akin to the ignition of a flame that burns at the center of a fire of desire. It is what Fortus (2014) encouraged us to understand as essential to learning.

With respect to the first question, *Nepantla* processes involve a relationship of dialogue, reciprocity, or mutual interaction between two or more individuals. The "in-between-space" is a social space that exists "in the middle of the relevant actors" (Maffie 2007). With this principal of plurality comes diversity as no two actors are identical. The diversity from one to another is magnified by socially-significant identity dimensions we associate with accepted demographic differences (like race/ethnicity, class, gender, etc.). In terms of the second question, *Nepantla* processes involve an "in-between-space" that is the "transacting, uniting, connecting or conjoining" of and among these plural parties (Maffie 2007). With this principal comes Affect as coordinated interaction that elicits emotional energy. The last question involves the phenomenological experience of the *Nepantla* processes themselves. With this principal comes spirit as the "in-between-space" of oscillation between and among others; it is one of co-creation, a tapping into life's essential imperatives of the birth of the new and the death of the old.

These *Nepantla* philosophical principles imply a fundamental reorientation to understanding teaching and learning. The selves of students are not stable but function as parts of a broader radically relational always "in-between" reality that is continuously evolving as those selves evolve from their interactions with each other. Henderson-Espinoza (2013) describes, "the turn toward another while one is standing on the relational bridge initiates new forms of relationality that are supported by the material knowledge cultivated and motivated by the turn inward" (p. 1011). This is, as Mariana Ortega (2001) elaborates, "a

Heideggerian self-in-the-making—an active self who is constantly projecting itself upon possibilities” (p. 5). To grasp the importance of self-other oscillation on this relational bridge is to orient away from the content of teaching and learning to its character. It is to put a premium on planning for intentional interaction that puts in the sights of learners their possible selves. In this view, science content is just kindling. Agentive interactive activity is the substance that fans the flames. This is what Yves’ father was so importantly signaling.

We suggest that there are aspects of *Nepantla* that resonate with major sociocultural theories of learning and human development, and these can provide a foothold for the further assertion of Anzaldúa’s overlooked theoretical importance. As an example, interaction is key to Vygotskyian constructivism. Vygotsky, in fact, talks about the role of Affect in interaction. It is definitional to the spontaneity and freedom we associate with play. “[T]he essential attribute of play is a rule that has become an affect. ‘An idea that has become an affect, a concept that has turned into a passion’” (Vygotsky 1966, pp. 15–16). In warning against the “terrible intellectualization of play,” he urged attention to learning and development beyond the cognitive, toward understanding the child’s Affective domain, their “motives to act” and their “inclinations” and “incentives” (p. 6) This idea of goal-driven activity is at the center of CHAT (Engestrom 1987) which builds upon Vygotskian constructivism by embedding it in a community of practice shaped by distinctive tools that are material, ideational, and discursive, as well as distinctive rules for their use, including who, how, when members of the community in what roles, can use them.

CHAT has been used by sociocultural researchers as both theory and method to orient to group activity as part of a community of practice and to organize systematic examination into how members use its distinctive tools, rules, and roles to achieve their goals. Anna Stetskenko and Igor Arieivitch (2004) have made a notable contribution by providing a genealogy of Vygotsky’s influence on CHAT, re-tethering the theory to the human developmental imperative for self-actualization, to feel oneself as agentive in the world. Invoking Vygotsky, these scholars remind us that it is not the activity outside of the individual that leads learning. Instead, self-making is the leading activity of and for learning (Richardson Bruna 2010).

*Nepantla* ideas align to anthropologist Tim Ingold’s (2015) description of the human experience. He urges us to think beyond the notion of “interaction” toward “correspondence.” The limitation of “interaction” is that it focuses on the nodes, or anchor points, with respect to which movement is understood to be taking place “between” them. The advantage of “correspondence” is reframing the focus not on these static, anchoring nodes as these may be individuals or ideas, but instead on the meshwork of experiences and understandings that exist in the “in-between” of individuals and ideas (p. 154). To examine individuals or ideas as monadic nodes that come into interaction, he asserts, is to presume that they were once separated. He instead urges us to start with the idea that everything—organism, individual, or idea—is entangled, a “tissue of knots whose constituent strands, as they become tied up with other strands, in other bundles, make up the meshwork” (Ingold 2008, p. 1806). He describes this using Anne Marie Mol and John Law’s (1994) idea of a “fluid space.” In this space, learning and human development—human coming into being—is not movement from one “place” (learning standard or developmental stage) to another, but rather an unfolding meshwork of paths in which one’s becoming being is entangled with another’s” (Ingold 2008, p. 1808). Learning and human development when viewed in this way is a process of anthropogenesis, a “making-in-growing of persons...who join in the middle, in the midst of things” (Ingold 2015, p. 154). This becoming-together is a kind of kinship (2015, p. 154) that reimagines relationships not as a connection of lines of nominal

node-like relationships but as an experiential meshwork of "amity," "mutual attention," "a commitment to life undergone with others" (p. 154). Folded back into *Nepantla*, Ingold's dynamic of "correspondence" construing the meshwork is what Maffie (2007) explains as "oscillation," "making-in-growing" names its transformative effect, and "fluid space" speaks to the ethico-onto-epistemology of "radical relationality" that is the foundation of Anzaldúan philosophy. Ingold asserts that these ideas have "the potential to transform our approach to the study of life" (p. 154). In the rest of this paper, we more modestly use *Nepantla* ideas to explore Mosquitoes & Me as case of *ciencia zurda* and better understand what Yves' father was telling us: The summer camp wasn't a place of learning mosquito science. It was a meshwork of entangled paths of correspondence among individuals and their ideas, a commitment to the "mutual attention" of youth underserved by science and their "making-in-growing" as learner-kin that the camp's approach to its content enabled. In what follows, we present a snapshot of Elena's path as it enmeshed with Mosquitoes & Me. Using *Nepantlan* interlocking ideas of diversity, Affect, and spirit, we enter into correspondence with others taking up Anzaldúan philosophy in education in hopes of promoting its potential to transform our approach to the study of science.

## Going with goodness: science education portraiture

We've chosen to present Elena's case using Sarah Lawrence-Lightfoot and Davis's (1997) portraiture technique. By illuminating social science issues through artistic means, the technique seems a match for Anzaldúa's emphasis on the holistic and aesthetic nature of experience. The purpose of portraiture is to capture context with a focus on appreciative appraisal. It replaces the clinical and pathological lens of conventional research's attention to what is wrong with one that seeks to see what is right. This gaze of goodness conveys to readers the strong, resilient, and worthy contours of a person and situation. Portraiture is similar in many ways to interpretive research, like ethnography. It begins with an interest in a context and is honed by a question. In following one's interest, one spends time exploring the context and the questions it raises through anthropological tools of observation, interview, and document collection. Where portraiture differs is in its aim to produce an account that is, in addition to being valid or trustworthy in the details and conclusions it presents based on the information collected, also sensory. The researcher concerns themselves as much with what is fact as well as felt in the context and aims to bring these details to life in the portrait. In this way, portraiture is a good fit for describing Mosquitoes & Me as *ciencia zurda*. If art sits at the left-hand of science, it may be particularly apt to use an art-based approach to detail a science learning space dedicated to students most often described in deficit left-behind language.

As we've discussed earlier in this paper, a conversation with Yves' father piqued our interest in the Mosquitoes & Me camp as being about "something else" besides science. We started to pay attention to the interplay, the correspondence, Ingold would say, between the community- and science-building aspects of the camp. Describing that correspondence meant looking for where we had sufficient information to robustly document the interplay in a camper's experience in the data we had collected. Our review led us to identify segments from our third year of implementation. At that point, we had become more sophisticated in our approach to data collection. Instead of just videotaped data from a stationary camera in the back of the room that captured full-group interaction, we were using microphones at each of the small-group tables that recorded the learners' conversations. We had



also become more democratic. Instead of just camp adult staff running the one main video camera, we were assigning campers roles to play in capturing camp footage by giving them handheld cameras they could use as they wished. This year, on day six, the second Tuesday of our two-week summer camp, one of these assigned campers used the camera to record nearly the entire stretch of the science activity happening at her table and most especially of the peer seated directly across from her—who was Elena. This meant we had clear video and audio of Elena's unfolding science correspondences with other Mosquitoes & Me individuals and ideas. As we explored using Elena for a case, we also discovered we had clear footage from her participation in one of our camp's central community-building rituals, the morning circle. These data sources, supplemented by interview information, provided a foundation for analysis. This is how, for the purpose of this article's analytical and aesthetic portrait, we came to use Elena as the focus for our Mosquitoes & Me goodness-grounded *ciencia zurda* case.

The portrait we share is a day-in-the-life snapshot of Elena's Mosquitoes & Me experience. At the point in time it represents, Elena has been working with her small group to use hands-on mosquito science activities to build understandings around aspects of mosquito biology, ecology, and disease transmission that will help them answer the camp's overarching essential question: In an end-of-the-world battle, who would win—mosquitoes or humans? Making people- and place-based connections is the way their inquiry was launched. This involved sharing mosquito stories and mapping mosquito hotspots in their neighborhoods. In their journals, they recorded their stories and maps about where mosquitoes live and breed and what they need to grow. They drew pictures of different specimens viewed under the microscope and worked together the puzzle of their life stage order. Additionally, the students reflected on human life stages and the kinds of foods that infants versus adults need to thrive. Participants brought in favorite food items from their homes to use to concoct their own group's larval nutrition recipe to test against a fish food control. Every morning, groups recorded what they saw in their flasks and added their observations to the camp-wide data table by asking questions such as: How many larvae are alive? What's the water quality? Any pupae? Any adults? What patterns are emerging across the recipes? Yes, larvae do, quite astonishingly, seem to like Cinnamon Toast Crunch!

And while keeping an eye on what's happening in their flasks, they also noted what was happening in the more naturalistic conditions of the Stinky Bucket. Yves has been going out every morning to draw a pipette sample from this contained biome for his SB Observation. As the days passed and the contents of the plastic bucket which contained camper-collected mosquito-habitat makers—grass, leaves, twigs, etc.—have soaked up the heat of the Iowa summer sun, Yves' reports—and his faux retching—have gotten more dramatic. One day, a microscopic examination of the SBO sample revealed larvae! On another day, there were pupae! It was time to put a lid on the SBO to keep the mosquitoes from developing into adults. But, the campers wondered, do mosquitoes need a bucket's worth of water to grow? How much water is enough for them to develop? How clean does it have to be? How could we find out? The tidy rows of ice cube trays provided the perfect means. Campers added eggs to carefully measured and recorded amounts of different kinds of water, put a glass plate on top for a closed environment, and have been observing, comparing, and discussing. This led them to think about environments that exist around their homes such as natural ones, like puddles after a rain, or human-made ones, toys abandoned after a day's play outside.

Moving mosquito science into the field, campers took a mosquito walk around their neighborhoods looking for potential habitats as well as dipping for larvae at a local park. In conducting this fieldwork they began to notice everyday things such as pools of water that

collect under a leaky drinking fountain, standing water below storm drains, hidden water cradled in the curves of tires on a play structure. This made them consider ways mosquito habitats and humans' interactions with mosquitoes have changed over time. Having read an article about larvicide and its effects on a bird population, students identified the dangers of some prevention and control measures. They read *Earth Mother*, a beautifully illustrated book about life's interconnected web, and began to consider the ethical dimensions of mosquito science, and were encouraged to embrace skepticism as a desirable scientific trait. As they watched mosquitoes grow from eggs to adults, fed on food pulled from their own shelves, mortared and pestled, and pipetted into flasks, their attitudes about these creatures changed from their first day's stories when they were portrayed as pests. As they drew the human body and labeled its major external parts and internal organs, they've started to think about corresponding structures and functions in mosquitoes. They witnessed their first dissection and learned the steps necessary for their own dissection under a microscope: Holding the abdomen with a probe, gently gripping the mosquito's head with tweezers, pulling slowly, and watching the intestines come free. As they observe a projected dissection on a whiteboard, a chorus of "ooohs" with some "don't do it's!" served as the soundtrack to the image of slimy intestines spreading across the slide. Structures that at first seemed amorphous took shape. Invited to the front of the room, campers circled into focus the mysteries of this new microworld. "Those are 'malpighian tubules.' They make mosquito poop. And a "It's not their fault" sentiment has begun to stir in their conversations. "They're just like us." "They don't mean to do harm." Maybe we humans might bear some responsibility. We've issued an invitation for mosquitoes to live around us, and they've come.

### **Elena entangled: a portrait of *ciencia zurda***

On the sixth day of Mosquitoes & Me camp, Elena is still sporting the gold, sparkly mini-backpack that has been her signature accessory since day one. She's twisting her long, dark, wavy hair and tying it in a knot on the top of her head, only to shake it out moments later and start again. She's standing among the other youth, preservice teachers, and two camp directors who are interspersed along the perimeter of the morning's opening circle formation. They're in the hallway outside the classroom they are using in the neighborhood high school. It's the one most of these youth will be attending in just a few years. The Morning Circle, responding to the constraint of the building's interior walls, is actually more of an oval. Campers line opposing sides of the hallway, tempted to lean against its walls. It's 9 am and another start of a hot Iowa summer day. Youth have arrived to camp on an air-conditioned chartered bus that picked them up at two central neighborhood locations. This, and the lure of breakfast, maybe even the promise of notes in their "mailboxes" from other youth, preservice teachers, and directors, helped get them out of bed for an early start. A few are already beginning to feel the effects of late summer nights. They slump, then sit. As Morning Circle activity begins, the directors ask everyone to stand. Small percussive instruments are distributed among youth in the circle who want them. As hand drums, tambourines, and triangles land in eager hands, their noise begins to fill the otherwise quiet and empty hallway.

The ritual starts with a song about strength in community. Two youth assigned to the role that day hold the poster-size laminated lyrics for all to see. Those with instruments beat them in rhythm, singing and dancing along as they have the previous five mornings. Other

youth stand still, maybe even stay silent. They're too shy or too cool for such things. The song ends with a chant led by the assigned youth helpers. Peace! Power! Love! Whooping and clapping. Katherine says, "What we're singing about today is the idea of pulling together, that there's strength in our numbers. That's what we're realizing in our learning." Pointing around the circle, she says "When someone has an idea, some else has an idea, and we build knowledge together." She concludes with a "firecracker." Sweeping both arms overhead, she claps them together in unison and then lowers them at her sides, fingers simulating fireworks cascading down from the sky. As she begins this movement, youth follow suit. This serves to transition from the noise and activity of the Morning Circle Song and Chant to the quietness of Recognitions. Having arranged her hair to her satisfaction, Elena has been fidgeting, chewing on her nails during the song and chant. Now she responds to the visual cue of the "firecracker" and claps her hands high overhead, making sparkles with her fingers as she lowers her arms to her sides.

Elena is not the most energetic Morning Circle participant but she's also not the most passive. Always a bit in motion, scanning the people around her, she seems to tune in to clues from key others that influence her participation. These include some of the preservice teachers she's developed relationships with, like Elizabeth, her table leader, and Irene, a particularly outgoing preservice teacher that Elena's taking a liking to. It also includes her tablemate, Yvonne. Standing next to Elena in the Morning Circle, Yvonne is a more inhibited participant. Standing across from Elena, Elizabeth and Irene, as preservice teachers and hired camp staff, are more exuberant. Elena's participation falls somewhere in between.

Like most other girls in camp, Elena's wearing blue shorts, a sleeveless summer top, and black Converse sneakers. Her sparkly backpack sets her apart, as well as the fact that she wears her shirt neatly tucked in, a feature of Irene's dress as well that we wonder if Elena has come to emulate. Elena seems to draw from both the youth and adult worlds. She laughs and smiles like many other eleven-year-old girls, but so far over the course of the camp she's demonstrating a brand of humor that is more quick-witted than merely silly. Her maturity may be due to her growing up amongst a household of adults. Describing herself "like an only child," Elena's two older sisters were already at college when she was young. This meant Elena spent a lot of time by herself when her parents, immigrants from El Salvador, were working. Although living away from her, Elena's sisters taught her the importance of building relationships, especially with teachers, something they understood as the key to their own success. Comfortable with adult interaction and advised to see adults as resources for her future, Elena keeps one eye on her age mates, like Yvonne, but the other on the adults, like Elizabeth and Irene, whom she is coming to admire. She is adept at navigating multiple worlds. The fact that she grew up in a Spanish-speaking home is rarely evident in camp, presenting itself only occasionally in non-standard forms of speech and writing. Outside of her family, Elena told us in an interview, she mostly speaks English, even in the presence of other Spanish-speaking peers. The only time she spoke in Spanish at *Mosquitoes & Me* was translating, privately, for a peer who, having just arrived from Honduras, didn't speak any English at all.

She stands with both hands on her hips as she listens to the recognitions part of the Morning Circle ritual. Anyone is invited to share anything they appreciate about someone else at camp. On this day, there is a recognition from Ricardo to "Miss Lyric" who amazed them with a mosquito dissection the day before. Sweep, Clap, Sparkle. Preservice teacher Elizabeth offers a recognition to Nissa, who had told Elizabeth she taught the Morning Circle dance to her mom. Sweep, Clap, Sparkle. Anna, another preservice teacher, recognizes Ashanti. Anna says, "Andrea told me she was so grateful to be here. And so I told everyone how awesome that was, my mom, everybody." Sweep. Clap. Sparkle. Preservice teacher

Emily shares that Rogelio gave her a thumbs-up after her lesson. Sweep. Clap, Sparkle. Katherine recognizes preservice teacher Jana, saying "We go where the energy takes us in the camp and this depends on what you all need, which means sometimes plans have to change. So, I told Jana that I needed her to change something and she said, OK! And isn't that great to be so flexible—It makes everything easy!" Sweep. Clap. Sparkle.

When recognitions quiet, Katherine transitions to Gifts. In yesterday's Circle, Nissa sang her favorite song, *La Seine Cabaret*, from the movie *Monsters in Paris*, and today her peers ask her to sing it one more time. Katherine says, "Nissa is going to share her gift again. Let's give Nissa our eyes and ears." Everyone sits down for Gifts and when the shuffling has settled, Nissa begins softly, singing, making some arm and foot movements as if living a scene from the movie in her head. It is very quiet. When she finishes, there is clapping, beating on the percussive instruments, and woo-hooing. There's a pause to see if anyone has another Gift to share. When no one comes forward, Jana says she has a chant she wants to teach us. In call and response form, it goes like this:

Calamine, calamine, calamine lotion [rubbing hands against arms as if spreading lotion]  
Oh no no, not the lotion [arm outstretched, wagging index finger]  
Itchy itchy, scratchy scratchy, now I've got one on my backy [hands behind back, as if scratching]  
Quick get the bug spray! [repeat] [holding imaginary spray can]  
Pssshhhhh, Got that bug! [waving arm with imaginary spray can back and forth]

The chant concludes and everyone claps. Even Elena. She's been watching Jana and laughing, clearly enjoying herself, but she didn't do the chant, or its motions, along with her. She hasn't let herself get swept up in the group's emotional energy. Maybe she's finding the singing, dancing, and chanting of Morning Circle activities too childish. Elena says she's easily bored. She likes being active—playing outside, riding on bikes, and going swimming. In school this means she's happiest with hands-on learning that allows her to explore. Otherwise, she grows impatient and "spaces off." It's not just activity that Elena needs to be stimulated, but purposeful activity. Elena doesn't feel challenged by her school subjects and also doesn't receive any accelerated or differentiated programming. She thinks teachers talk too much. She just wants to do the work. But Elena doesn't let her frustrations become barriers to success. She gets good grades across all subjects, whether or not she finds them to be interesting. Her favorite subject, math, is important to her because of the role it plays in her future. She has set her sights on being an architect or an engineer, a career she knows that her 100% tuition award will help her pursue. Elena is serious about her learning and this shows sometimes at Mosquitoes & Me. Her composed demeanor, however, is about to change.

Elena is ready to head into the classroom and see how her group's larval nutrition and water experiments are going. She's putting back on the gold, sparkly signature backpack she removed while seated when Irene calls out across the circle, "I think Elena wants to dance!" Elena stops what she's doing, and with a mixture of surprise and amusement, calls back "What? What did you say?" While Irene repeats herself, Elena holds her right arm outstretched in front of her with her palm forward, as if to say "no." She is smiling and laughing as she turns toward the wall, to avoid any more attention. Elena's reaction causes Irene to shift to others around the circle. Ivan takes up Irene's invitation to keep the Morning Circle going. He is far from timid. He has used the Gifts portion of Morning Circle to share his dancing skills on previous days. He calls out to the everyone, "I want to do Popsico!".

Popsico is an activity that Irene learned from being a camp counselor. She taught it in the Morning Circle during the first few days of camp. From the beginning, it was a big hit. Popsico involves an opening routine of shared chanting and movement, followed by someone being called on to take the lead and model some new moves. Everyone mimics the moves before that person passes the Popsico on to someone else.

Starting the Popsico, Irene calls out to Ivan, "Are you ready?" She then begins: "His hands are high, his feet are low and this is how he Popsicos." Everyone in the circle looks to Ivan to see what movement he is going to make. Ivan bends his knees, repeatedly moving them apart and together, and we all mimic his movements while chanting:

Pop.si.co.  
 Pop.pop.si.co.  
 Pop.si.co.  
 Pop.pop.si.co

Ivan passes the Popsico to another youth who passes it along to another who passes it to a preservice teacher. Thinking things are winding down, Katherine calls out, "Does anyone else want to get the pop?" Elena now is eagerly raising her hand. Right at the same time, the preservice teacher is passing the pop to Katherine. Katherine puts her arms above her head, swinging them in a circle as she rotates her body by quarter turns. The hallway is a sea of upraised arms and bodies turning in unison, including Elena's. At the end, there's a final "Popsico!" and noisy, enthusiastic clapping. Katherine says, "I think we're awesome. I think this group of people is awesome. I'm feeling the energy. I hope you're feeling the energy. We're going to keep the energy going as we go into the science classroom" Lyric Bartholomay adds, "My scientist friends, we're going to start our morning like we do every morning with a little data collection." Elena and her fellow campers head into the classroom, many still chanting "pop.si.co, pop.pop.si.co...".

Elena takes her place at her team's table. They've named themselves The Backyard Mosquitoes. She lifts the lid off their ice cube tray and tells her table mates to "smell this." Everyone around the table covers their noses and mouths and makes the retching faces and sounds that Yves in his SBO work has modeled. Elizabeth asks the team members what the larvae in their flask look like. Elena comments that they look bigger and begins filling out the data table in her notebook.

Lyric opens group discussion about what they're finding with their larval nutrition experiment. "I'm curious about your data," she says. "I'm a scientist so I'm curious." Youth volunteer to stand and share their observations "loud and proud." Lyric praises Nissa for the way she refers to her notebook for the data she reports. Nissa's team is feeding their larvae a recipe with spicy buffalo sauce, and the data suggest they seem to be thriving. Katherine calls out, "Maybe they're adapting! Maybe mosquitoes will win the end-of-world battle because of spicy buffalo sauce!" As they near the end of data sharing, Katherine looks at the class chart and observes that there seems to be one thing that the larvae are eating that is killing them all. She asks youth to look at the chart and see what it is. One of them calls out "ranch!" "Maybe humans will win because of ranch dressing!" Katherine responds. Irene adds, "Eat ranch to keep mosquitoes away!" Lyric picks up this idea. "What if you've found something that really kills mosquitoes, imagine how could that help your community?" A connection to community is something Elena feels her school experience is missing. She knows that math and science are tools she can use not just to understand the world but to change it. She is especially concerned about climate change and thinks people should be thinking about it more. This is another reason that she prefers

hands-on activities—they help you see what is happening. At school, teachers seem to just talk. They don't help students understand how what they are talking about relates to real world issues.

It's finally time for *The Backyard Mosquitoes* to share. Elena is already standing. Notebook in hand, she shares her observations from the ice cube tray water experiments. Lyric prompts her to share other observations, besides just visual. Elena says the water in the tray smells like puke and she punctuates this with a "gross" face. Lyric winds down the data collection and sharing session by orienting them to tomorrow's focus. "So tomorrow let's start looking at all our data and start analyzing. What am I learning about? What did I predict? What am I now seeing, and why? We'll write summary statements because communicating our ideas is one of our good science practices."

Lyric uses this point to transition into the day's new lesson. "Let's think about why we're here and what we're doing. You're all mosquito scientists and we have a challenge." Katherine chimes in, "One of the cool things about growing big smart brains when you're young so that in adult life you've got the smartest brain possible is that you begin to see and understand things that other people may not be aware of. You'll be able to use your brain to realize that some people may be telling you half-truths but you can navigate through the world more confident in your own reasoning and own decision-making. So we want you to look at this video clip. Now that you've been a bit further in your mosquito science journey, we want you to think about how they're portraying a particular aspect of mosquito science here. Feed it through your learning and your "is it really possible" skepticism.

Youth view a video clip from the movie *Jurassic Park*. The segment is an advertisement for the Park intended for its future tourists. It explains the foundational premise of the movie. Scientists were able to extract dinosaur DNA from a mosquito fossilized in amber and use it to create living dinosaurs that now roam freely on this island and that, for the price of admission, visitors can come and see for themselves.

Jana, who is helping Lyric, freezes the clip showing the mosquito fossilized in amber. Lyric asks campers to look at its anatomy, given what they learned the day before. Campers volunteer answers and Jana circles the corresponding parts on the image paused on the whiteboard. Lyric probes further. "What do we notice about male and female antennae?" They re-watch the clip. Elena's got an idea. Lyric encourages her to stand up and say it "loud and proud." Elena observes that the antennae of the mosquito on the screen indicate it's a male. Hearing this, Ivan calls out "false facts"! Bartholomay asks him if he thinks Elena's conclusion is wrong. "No," Ivan clarifies. "The facts in here are right. The facts in the movie are wrong!"

Lyric adds additional detail. The mosquito in the movie is of the species *Toxorhynchites*. She passes around a specimen for the campers to look at. With her team, Elizabeth asks *The Backyard Mosquitoes* what they notice. Elena leans in to look at it closely and comments that it's different than the other mosquitoes they've seen and bigger. As their mosquito observations were taking place, Yvonne starts up a conversation with Elizabeth about when she went to sleep the night before, eventually teasing Elizabeth about her boyfriend. Elena chimes in that she went to bed at midnight and got up early to go the gym as she is on a girl's wrestling team and feels tired. She declares she wants to take a nap and suggests that the air-conditioned climate of the chartered buses that transport them to and from camp would feel good. She lays her head on the desk. Aisha joins in the conversation, explaining that she was up late because her baby sister was crying. She imitates the sound. Redirecting their focus, Elizabeth asks what more they see. Elena raises her head and continues observing the new mosquito specimen. She sees a smaller mosquito with the larger one. There are

three little ones, Aisha adds. Elizabeth asks why they think the little ones are in there. Elena thinks that the big mosquito may feed off the little ones.

Lyric, who has been making the rounds among the groups, says she's interested to hear what people are noticing. Elena's hand shoots up before Lyric can finish. Lyric, trying to distribute talk turns, calls on two other campers. Elena's hand stays up and she quietly mouths the words "me, me, me" as she shifts to her other arm, to keep from tiring. Eventually Lyric calls on her. Elena stands, and says, "I'll tell you what I think. I think the bigger one eats off the smaller ones that are in there." Lyric confirms that this species does, in fact, eat other mosquito larvae. They aren't blood feeders at all. It turns out the makers of Jurassic Park got their "false facts" doubly wrong.

The last activity of the morning, before the youth head to an adjoining room for lunch, is another dissection observation. They are going to learn more about internal anatomy to think about how mosquitoes transmit disease. Lyric asks the students to remind her of the steps she needs to take and they call these out in order. She's also asking them to identify the internal organs they remember. Elena is using the notes in her science journal to call out answers, while also getting her cellphone ready to record. Lyric adds a twist to this dissection. The mosquito she's dissecting is one she has blood-fed on her arm. Its crop, a food storage organ, is full of her blood, storing it to provide nutrients for her ovaries, to feed her future babies. Henri says the crop resembles a pimple. Ricardo can't resist. He starts to chant. "Pop it, pop it!" Elena calls out, "wait, wait, wait!" She's not quite ready to film. Energy builds as the rest of the campers, including Elena, join in the chant. Lyric inserts her probe into the tiny, swollen balloon-shaped organ that, under magnification and projected on the whiteboard, is now the focal point for everyone's attention. As red fluid spreads across the screen, satisfied "oohs" and "aahs" fill the room. Elizabeth comments that the dissection looks like her throw-up when she vomits Kool-Aid. From Elena, who is rolling her eyes, a sarcastic "wow," and then beaming with pride, "I filmed the whole thing."

In the remainder of camp, Elena and her peers will use their knowledge of mosquito anatomy in a simulation using a paper soup cup, parafilm, and straw to explore the mechanics of a mosquito's piercing "bite" which, it turns out, is really a mosquito "suck" and learn about disease transmission. They'll make clay figures of mosquito anatomy. They'll build their own traps based on what they've learned, and place them in a local park to see if they attract any mosquitoes. They'll design their own mosquito hero or villain for a comic strip. They'll make public service announcements about control and prevention. They'll work in groups to research an animal that is part of the mosquito ecosystem and present their reports to staff at the local zoo. On the last day, they'll return to the question of who would win—a mosquito or human—in the end of world battle and realize that's the wrong question. It's about learning to live on this planet together. It's about "mosquitoes and me." They'll celebrate their learning journey at a family celebration. Meant to be a celebration for families, it ends up being a celebration of family. This is how Elena describes her Mosquitoes & Me experience, "like a family." Everyone, adults and students, worked together. This "family," she says was about "being together and listening to everyone." "Everyone could say and ask what they need. And anyone could help."

## ***Nepantlan* learning: toward an aesthetic consciousness in science education**

First, imagine that the portrait we've provided of Elena's Mosquitoes & Me day in a life experience is a series of photographs. Each one is bounded by its corners, creating a sequenced separation of one learning event from the next. Imagined this way, Elena's portrait depicts her in both individual and group activity. In the first set of photographs from the Morning Circle, she is one of many Mosquitoes & Me participants. These include other young people like Yvonne, Ricardo, Rogelio, Nissa, Ivan, Aisha, Ashanti, and Henri, but also preservice teachers such as Elizabeth, Irene, Emily, Anna, Jana and program leaders Katherine and Lyric. In this photographic portrait, the first images show her acting alone as she was playing with her hair. Successive images show her beginning to act in unison with others like giving a "firecracker" after Recognitions, laughing, and clapping after the calamine chant, refusing and then fully joining with others in Popsico.

The second set of photos from the Morning Science Activity show the same individual-group dynamics. Elena makes individual water experiments and toxorhynchites observations, shares those with her team, and then with the whole group. As with the Morning Circle, this involves increasing levels of participation. With Popsico, Elena came to fully coordinate her actions with others by the turn of her body in rhythm, the swing of her arms overhead, and the articulations of her mouth. In Morning Science Activity, there is a similar dynamic pattern to coordinate her actions with others. The sequence shows her working alone, discussing with her team, and enthusiastically sharing with the full group such as the holding of her upraised arm, the mouthing of "me, me, me," the coming to her feet to say "I'll tell you what I think...". In this sequenced separation, you see the diversity of Mosquitoes & Me participants. Yvonne, Nissa, Aisha, and Ashanti are African-American. Ricardo and Rogelio are Latino. Henri is East Indian. They are Elena's age-mates. Elizabeth, Irene, Emily, and Jana are Elena's preservice teacher co-participants. They are White and in their early 20s. Katherine and Lyric, the program leaders, are also White, but decades older. You also see the interactions among these diverse participants: Elena standing next to Yvonne in the Morning Circle, Irene trying to call Elena into Popsico, Elena telling Elizabeth her water experiment observations, Elena putting her head down on the table while talking with Elizabeth, Ivan responding to Elena's Jurassic Park observations, Lyric calling on Elena for her toxorhynchites ideas, Elena filming Lyric's dissection. From what you can observe in this photographic representation of Elena's portrait, you understand that in Mosquitoes & Me different people, youth and adults of different races/ethnicities and genders from different places, the university and the local community all come together. You can also see the different practices of their coming together via their interactions in Morning Circle and Morning Science Activity.

What you do not see from the sequenced photographic representation is Elena's experience of the diversity-in-interaction. For this, you would need a representation that blurs the edges from one snapshot to another, something that splices them into a unified whole, allowing one moment to blend into another and yet another. While this sounds simply like videotaping, even that wouldn't be sufficient. To understand Elena's experience, you'd need a representation that isn't just a seamless chronological representation, but an Affective accumulation. You'd need to understand Elena's own sense-making of, to invoke her entangled anthropogenesis, as part of a "making-in-growing of persons...



who join in the middle, in the midst of things” (Ingold 2015, p. 154). To capture science education as an Affective accumulation would be to acknowledge and affirm its aesthetic form. This is where Anzaldúan *Nepantlan* philosophy stands to make a significant contribution.

The first principle of a *Nepantla* experience is diversity. This is the plurality principle. *Nepantla* requires mutual interaction among two or more individuals but, moreover, it refers to the in-between-space generated from the interactions of people from different social locations. These spaces are especially generative in creating a relational and ontological bridge (Henderson-Espinoza 2013). Elena’s portrait demonstrates that the *Mosquitoes & Me* environment held structural plurality potential for Elena to make self-other “bridge” crossings. It also demonstrates the energy construed out of the coordinated interaction of diverse others. This is the second principle of *Nepantla*: Affect. Returning to Tim Ingold (2008), we see Elena join the strand of herself to those of diverse others. The Morning Circle’s rituals of Songs and Chants provide specific structure for these crossings. Elena takes exploratory steps by clapping and laughing before venturing further on with full-body participation. In *Popsico*, she joins her physical actions with those of the full group, feeding and being fueled by its collective emotion. Similarly, in the Morning Science Activity, team-based learning provides a specific structure for Elena to move from individual to small group to whole group participation. There too her crossings intersect with those of others in a crescendo of collective emotion. Her insights about the wrong mosquito in the Jurassic Park clip spur Ivan to call out “false facts!” and promote whole group reflection on the power of their mosquito science learning. And there are more private crossings too. Because of the table audio, we know the dialogue accompanying her head-on-table observable tiredness: conversation with teammates about late nights and early mornings. Elena shares she’s up early to go the gym. Aisha shares she’s up late with a baby sister. Yvonne teases Elizabeth about her boyfriend. Back at whole-group scale, when Ricardo, during the dissection, picks up on Henri’s invitation to see the crop as a bloody pimple and calls out to Lyric to pop it, Elena joins her voice to the class chant and to the subsequent group’s “oooooh,” a shared expression of satisfaction. These structures existed in *Mosquitoes & Me* as bridges for Elena’s diverse self-other explorations. We see Elena take strides to cross, bundling the strand of herself with the strands of others, as part of the “unfolding meshwork of paths in which one’s becoming being is entangled with another’s” (Ingold 2008, p. 1808).

The sequenced photographic portrait of Elena’s *Mosquitoes & Me* experience attests to the presence of diversity and affect but not their potency. In this way, it stops short of demonstrating the third principle of *Nepantla*: spirit. Spirit is the phenomena of interaction as lived correspondence (Ingold 2015) or self-other oscillation (Mouffie 2014). Spirit was essential to Anzaldúan activism, the primary site, to her view, of the revolution. It is life’s essential creative force. In Elena’s portrait, we see Elena as one of diverse others and we see her bridge to diverse others in ways that have observable Affect. We can impose an interpretation of this Affective accumulation on Elena’s learning. What would it mean to try to capture her spirit?

To do this, we will use the idea of *perezhivanie*. Beth Ferhold and Monica Nilsson (2016) describe the *perezhivanie* as a type of viewing device that allows you to dimensionalize moments in time, like the isolated sequenced snapshots of Elena’s learning events or even the contiguous videotape of those events, so that their life’s meaning in becomes clear. They take on a “lived momentum” (Sobchack 2004) above and beyond each instantiation that is akin to consciousness of one’s life as a work-in-progress. It is an aesthetic form of consciousness. Applied to its field of origin, the arts, *perezhivanie* describes the

difference between each "scene" in a narrative and the meaning that, together, they come to comprise. Lev Vygotsky (1971) theorized human development as a process of "reorientation in relation" (p. 150). The first is a matter of anatomy, of parts. The latter is a matter of physiology, of how the parts work together. The parts of a life's scenes unfold one after the other but the meaning we make of them isn't linear. It's recursive. This dynamism is a constant "reorientation in relation" since each moment of life adds a new part to its scenes that changes the whole to which our self-understanding must adjust. This is how the "lifeless construction"—a scene in isolation—"is transformed into a living organism" (Vygotsky 1971, pp. 149–50.)

One of *perzhivanie*'s characteristics is the pivot. This is a moment of being "suspended momentarily in a state of bring simultaneously ourselves and not ourselves" (Schechner 1985). It is the link between past and future, the moment of oscillation, the moment when kindling sparks, and new flame of spirit ignites. To be aware of how moments add up to lives (Lemke 2000) is to have aesthetic consciousness.

Mosquitoes & Me activity was wrapped in a self-reflective frame that provided pivot points for learners to see themselves outside of themselves. This took many forms. The first form was conversation about their ISU 4U Promise eligibility and the purpose of the programming to build connections between them and the university. This projected upon them a sense of futurity, that programming was part of a pathway to a potential college-going eventuality. This set the stage for the second form, the building of community between program leaders and preservice teachers, as representatives of the university, and campers as residents of neighborhoods served by the ISU 4U Promise program. The Morning Circle's Reflections and Gifts, which positioned everyone as equal participants in giving and receiving created this sense of community. Community was also important to the ambitious science foundation of the Mosquitoes & Me curriculum and its co-learning pedagogy. This was the third form of self-reflectivity. In Elena's portrait, Katherine references this in the Morning Circle by saying "What we're singing about today is the idea of pulling together, that there's strength in our numbers. That's what we're realizing in our learning." Pointing around the circle, she says "When someone has an idea, some else has an idea, and we build knowledge together." And she makes the relationship between community and science learning explicit. "I think we're awesome. I think this group of people is awesome. I'm feeling the energy. I hope you're feeling the energy. We're going to keep the energy going as we go into the science classroom."

This kind of self-reflectivity on being-in-community, inclusive affirmational identity, and growing-into-futurity was part of explicit Mosquitoes & Me discourse. In Elena's portrait, we see it when Lyric says, "Let's think about why we're here and what we're doing. You're all mosquito scientists and we have a challenge." Katherine echoes, "One of the cool things about growing big smart brains when you're young so that in adult life you've got the smartest brain possible is that you begin to see and understand things that other people may not be aware of. You'll be able to use your brain to realize that some people may be telling you half-truths but you can navigate through the world more confident in your own reasoning and own decision-making." Youth began to embrace and echo this discourse. When Ivan picks up on Elena's insight about the Jurassic Park video by calling out "false facts!" he quickly adds an affirmational tag for his community of peers: "The facts in here are right. The facts in the movie are wrong!" When Elena stands to share her insights about the toxorhynchites specimen, she begins by saying "I'll tell you what I think."

There was also a more tacit kind of Mosquitoes & Me discourse, one achieved by rituals that served to join the one to the whole through coordination of physical movement or attention. Reflections was a space that invited campers to articulate self-other

crossings through expressions of appreciation. Gifts was a space that invited learners to manifest the self-other crossing through the giving of a performance that others received with a kind of quiet reverence. In both cases, the self-other crossing is celebrated with a ritualized “firework” that, once signaled through the beginning sweep of arms overhead, reverberates in the entrained actions of others and culminates in a collective clap and “sparkle.” So too with Popsico, which acted as a type of physical call and response. Youth are called to watch the one with the “pop,” and respond by mirroring their actions, making each member of the collective an important part of its overall choreography. In Elena’s portrait, we see Popsico be a pivot for her entrainment.

And we think we see the Popsico pivot, morph, and travel. In Morning Science Activity, in response to the “bloody pimple” crop, when Ricardo calls out for Lyric to “pop it!” and the whole group begins the chant, there’s an echo of the Morning Circle Activities of Gifts and Popsico. Ricardo in a sense has passed “the pop” to Lyric. Lyric, though no longer in the Morning Circle, is sharing a talent. She begins her dissection and, as with Gifts, the campers quiet. Everyone is focused on the image on the whiteboard, watching her actions closely. Though there’s not the possibility or expectation for campers to mimic the dissection itself, since only Lyric is at the microscope, they simulate co-dissection by calling out the steps as she does them. When she punctures the crop and the blood spreads across the slide, there’s a similar Affective crescendo. This is not expressed through entrained physical activity of bodies in motion, but through entrained verbal expression of shared Affect. In her portrait, we see Elena pivot from self-to-other as she Popsicos and she “pops.” We believe Elena’s description of Mosquitoes & Me as family, a place of “being together and listening to everyone” is a way of naming this kind of intimate visceral interaction. It was her way of defining her experience of aesthetic consciousness. It is the same thing, we believe, that Yves’ father wanted us to see as the “something more” than science.

Mosquitoes & Me was a learning and living borderlands where science education meant self-education, where structures existed for youth to be with diverse others in an Affectively accumulative interaction and able to reflect on those interactions. In this way, as much as possible for elementary-aged campers, Mosquitoes & Me provided for a science *perezhivanie*, a way of viewing their science learning as more than a series of moments, but as a pathway forward that they were unfolding through those interactions. In this way, Mosquitoes & Me was a left-handed world of *ciencia zurda* where youth from backgrounds historically underserved by science came to view themselves, like Elena, as having something to say.

From our experience with Mosquitoes & Me, we believe the future of science education and science education research lies in understanding processes of Affective accumulation, how inquiry science-responsive science complementarity construes interactions whose importance lies not in science measures but in self-making. To guide our future examination, we will certainly need to take up the theoretical and methodological approaches of interactive analysis to observe learners more closely, like Elena, in their self-other-self crossings. As we continue our work to explore Mosquitoes & Me, will also certainly look to philosophical approaches, like those of Anzaldúan *Nepantla* that urge us to observe more closely still for the moments when science meets art, when learning meets living, when those on the margins step into the center, and spirits ignited, like Elena with her signature gold backpack, sparkle. These are the moments that add up to meaning, that can make relationships, in Anzaldúan thinking, revolutionary.

## Anzaldúan science education for social change

To leverage Anzaldúan affordances of diversity, Affect, and spirit in science education is to situate science teaching and learning as part of broader social change processes. Social change theorists (Greenfield 2009) already include attention to learning environments as part of understanding pathways of human development that reflect broader societal transformation. They understand, for example, that the transnational migration characteristic of contemporary globalization entails not just movement of people, but of ways of knowing. The societal transformation resulting from globalization has implications for selves. Individuals now have access to different kinds of relationships, experiences, and activities. In this context of macro- and micro-level diversification, the opportunity for and value of experiences promoting cooperation and responsibility takes on new meaning. Institutions, such as schools, can mediate between societal transformations and individual development by designing activities that provide practice for particular kinds of productive social interaction. Anzaldúan philosophy helps us understand the value of diversity, Affect, and spirit in such design.

In 1910, Sir Rupert M. Boyce published a seminal book titled *Mosquito or Man*. In it, he describes the discovery of the mosquito's role in disease transmission and documents the broader British tropical medicine movement inspired by that discovery. The second part of the book's title, *The Conquest of the Tropical World*, illustrates the intersection of colonial interests—the conquest of the tropics—and the development of science. Boyce proclaims in his preface that British "pioneers of commerce" no longer "dread the unseen hand of death" (p. viii). In this way, he frames *Mosquito or Man* within the Western narrative of civilization as progress. This is encapsulated by his opening quote: "Stagnation, the great enemy of life." (p. viii). The quote invites a parallel between the ecological idea of stagnation such as standing water associated with mosquito reproduction and the economic idea of stagnation associated with capital generation (flowing money). The medical issue of public health is the go-between. Tropical medicine, he writes, "added new territories to civilization," its research provide benefits "to the coloured man as to the white" (p. 3). In this way, to stagnation as an enemy of life, Boyce counterposes flow as a friend. Tropical medicine afforded movement, for Europeans and their money; in so doing, it shaped the world stage on which we continue to see socio-political scenes play out today.

Boyce could not have foreseen that a little over one hundred years since the publication of *Mosquito or Man* his book would inspire the naming of a summer camp in the American Midwest. At the time of his writing, Des Moines was a newly established frontier city with its own business and scientific elites just beginning to emerge. Ideologies of classism and racism, in Europe and the United States, were widespread. Boyce could not have imagined the tools of science being put into the hands of Mosquitoes & Me young scientists, like Elena. But the space where one person's imagination ends is where another's imagination begins. The space "in-between" what is and what could be is the space of creative potential, the bridge that paves the path from past to future. It's time we take up what Anzaldúa's ideas offer us and call for another scientific revolution, one of teaching and learning that speaks soulfully to matters of the self and spirit. Young people, like Elena, deserve "something more" science, and are ready to pivot.

## References

- Alonso, W. J., & McCormick, B. J. J. (2018). Urban ecology and the effectiveness of *Aedes* control. In M. Betancourt-Cravioto, J. A. Falcón-Lezama, & R. Tapia-Conyer (Eds.), *Dengue fever: A resilient threat in the face of innovation*. IntechOpen. <https://doi.org/10.5772/intechopen.78688>
- Anzaldúa, G. (2015). *Light in the dark/Luz en lo oscuro: Rewriting identity, spirituality, reality*. Keating, A. (Ed.). Duke University Press.
- Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2010). ‘Doing’ science versus ‘being’ a scientist: Examining 10/11 year-old schoolchildren’s construction of science through the lens of identity. *Science Education*, 94(4), 617–639. <https://doi.org/10.1002/sce.20399>
- Atherton, G., Sebanz, N., & Cross, L. (2019). Imagine all the synchrony: The effects of actual and imagined synchronous walking on attitudes towards marginalized groups. *PLoS ONE*, 14(5), e0216585. <https://doi.org/10.1371/journal.pone.0216585>
- Avery, L. M. (2013). Rural science education: Valuing local knowledge. *Theory Into Practice*, 52(1), 28–35. <https://doi.org/10.1080/07351690.2013.743769>
- Bellochi, A., Ritchie, S. M., Tobin, K., King, D., Sandhu, M., & Henderson, S. (2014). Emotional climate and high quality learning experiences in science teacher education. *Journal of Research in Science Teaching*, 51(10), 1301–1325. <https://doi.org/10.1002/tea.21170>
- Brown, J. (2017). A metasynthesis of the complementarity of culturally responsive and inquiry-based science education in K-12 settings. *Journal of Research in Science Teaching*, 54(9), 1143–1173. <https://doi.org/10.1002/tea.21401>
- Carlone, H. B., Scott, C. M., & Lowder, C. (2014). Becoming (less) scientific: A longitudinal study of students’ identity work from elementary to middle school science. *Journal of Research in Science Teaching*, 51(7), 836–869. <https://doi.org/10.1002/tea.21150>
- Collins, R. (2004). *Interaction ritual chains*. Princeton University Press. <https://doi.org/10.1515/9781400851744>
- Crawford, B. (2014). From inquiry to scientific practices in the science classroom. In H. Lederman & S. Abell (Eds.), *Handbook of research on science education* (Vol. 2, pp. 515–541). Routledge.
- Darling-Hammond, L. (2001). Inequality in teaching and schooling: How opportunity is rationed to students of color in America. In B. D. Smedley, A. Y. Stith, L. Colburn, & C. H. Evans (Eds.), *The right thing to do, the smart thing to do: Enhancing diversity in the health professions: Summary of the Symposium on Diversity in Health Professions in Honor of Herbert W. Nickens, M.D.* (pp. 208–233). National Academies Press.
- Dewey, J. (1927). *The public and its problems: An essay in political inquiry*. Holt.
- Durkheim, E. (1912). *The elementary forms of the religious life* (J. Swan, Trans.). George Allen & Unwin Ltd.
- Duschl, R., Schweingruber, H., & Shouse, A. (Eds.). (2007). *Taking science to school: Learning and teaching science in grades K-8*. National Academies Press.
- Engestrom, Y. (1987). *Learning by expanding: An activity theoretical approach to developmental research*. Orienta Konsultit.
- Ferholt, B., & Nilsson, M. (2016). *Perezhivaniya* as a means of creating the aesthetic form of consciousness. *Mind, Culture, and Activity*, 23(4), 294–304. <https://doi.org/10.1080/10749039.2016.1186195>
- Fisher, D., Svendsen, E. S., & Connolly, J. J. T. (2015). *Urban environmental stewardship and civic engagement: How planting trees strengthens the roots of democracy*. Routledge. <https://doi.org/10.4324/9781315857589>
- Forbes, S. (2003). *Holistic education: An analysis of its ideas in nature*. Foundation for Educational Renewal.
- Fortus, D. (2014). Attending to affect. *Journal of Research in Science Teaching*, 51(7), 821–835.
- Friesner, J., Colón-Carmona, A., Schnoes, A. M., Stepanova, A., Mason, G. A., Macintosh, G. C., Ullah, H., Baxter, I., Callis, J., Sierra-Cajas, K., & Elliott, K. (2021). Broadening the impact of plant science through innovative, integrative, and inclusive outreach. *Plant Direct*, 5, 1–28. <https://doi.org/10.1002/pld3/316>
- Gee, J. P. (1989). Literacy, discourse, and linguistics: Introduction and what is literacy? *Journal of Education*, 171(1), 5–25. <https://doi.org/10.1177/002205748917100101>
- Greenfield, P. M. (2009). Linking social change and developmental change: Shifting pathways of human development. *Developmental Psychology*, 45(2), 401–418. <https://doi.org/10.1037/a0014726>
- Henderson-Espinoza, R. (2013). Gloria Anzaldúa’s *El Mundo Zurdo*: Exploring a relational feminist theology of interconnectedness. *Journal for the Study of Religion*, 26(2), 107–118.
- Ingold, T. (2008). Bindings against boundaries: Entanglements of life in an open world. *Environment and Planning A*, 40(8), 1796–1810. <https://doi.org/10.1068/a40156>

- Ingold, T. (2015). *The life of lines*. Routledge.
- Katz, G., Leisnham, P. T., & LaDeau, S. (2019). *Aedes albopictus* body size differs across neighborhoods with varying infrastructure abandonment. *Journal of Medical Entomology*, 57(2), 615–619. <https://doi.org/10.1093/jme/tjz170>
- Keating, A. (2015) (Ed.). Re-envisioning Coyolxauhqui, decolonizing reality: Anzaldúa's twenty-first century imperative. In Anzaldúa, G.A., Light in the dark/Luz en lo oscuro (pp. ix–xviii).
- Lawrence-Lightfoot, S., & Davis, J. H. (1997). *The art and science of portraiture*. Jossey-Bass.
- Lemke, J. (2000). Across the scales of time: Artifacts, activities, and meanings in ecosocial systems. *Mind, Culture, and Activity*, 7(4), 273–290. [https://doi.org/10.1207/S15327884MCA0704\\_03](https://doi.org/10.1207/S15327884MCA0704_03)
- Maffie, J. (2007). The centrality of Nēpan̄tla in conquest-era Nahuā philosophy. *The Nahuā Newsletter* 44. <http://www.nahuānewsletter.org>
- McWhirter, E. H., & Cinamon, R. G. (2020). Old problem, new perspectives: Applying Anzaldúan concepts to underrepresentation in STEM. *Journal of Career Development*, 48(6), 877–892. <https://doi.org/10.1177/0894845320901797>
- Medina, J. (2013). *The epistemology of resistance: Gender and racial oppression, epistemic injustice, and resistant imaginations*. Oxford University Press.
- Michael, J., McEllin, L., & Felber, A. (2020). Prosocial effects of coordination: What, how and why? *Acta Psychologica*. <https://doi.org/10.1016/j.actpsy.2020.103083>
- Mol, A., & Law, J. (1994). Regions, networks and fluids: Anaemia and social topology. *Social Studies of Science*, 24, 641–671. <https://doi.org/10.1177/030631279402400402>
- National Academies of Science, Engineering, & Institute of Medicine. (2011). *Undergraduate research experiences for STEM students: Successes, challenges, and opportunities*. National Academies Press. <https://doi.org/10.17226/12984>
- National Association of County and City Health Officials. (2017). *NACCHO report: Vector control assessment in Zika virus priority jurisdictions*. National Association of County and City Health Officials. <http://nacchopreparedness.org/naccho-report-vector-control-assessment-in-zika-virus-priority-jurisdictions/externalicon>
- National Research Council. (2012). A Framework for K-12 science education: Practices, cross-cutting concepts, and core ideas. National Academies Press. [www.nap.edu/download/13165](http://www.nap.edu/download/13165)
- National Science Board. (2018). *Science and engineering indicators 2018*. NSB-2018-1. National Science Foundation. <https://www.nsf.gov/statistics/indicators/>
- NGSS Lead States. (2013). *Next generation science standards: For states, by states*. National Academies Press.
- Ortega, M. (2001). "New mestizas", "world travelers", and "dasein": Phenomenology and the multi-voiced, multi-cultural self. *Hypatia*, 16(3), 1–29. <https://doi.org/10.1353/hyp.2001.0043>
- Richardson Bruna, K. (2010). Like a rock: Globalizing artifact and agency in the science education of Mexican newcomers. In W.-M. Roth & K. Tobin (Eds.), *Re/structuring science education: ReUniting sociological and psychological perspectives* (pp. 249–274). Springer.
- Richardson Bruna, K. (2016). A struggle for the soul. Reversing the odd alchemy of science education and research. *Mind, Culture, & Activity*, 2(3), 259–269. <https://doi.org/10.1080/10749039.2016.1201118>
- Richardson Bruna, K., Farley, J., McNelly, C., Sellers, D., & Johnson, R. (2017). If we build it, will they come? Fielding dreams of college access and affordability through an innovative promise program. *Journal of Higher Education Outreach and Engagement*, 21(4), 51–80.
- Richardson Bruna, K., Schneider, S., Erickson, S., & Bartholomay, L. (2019). *Mosquitoes & Me summer camp curriculum*. <https://research.hs.iastate.edu/urban-ecosystem-project/educator-resources/>
- Rivers, D. (2006). Teaching general entomology to disinterested undergraduates. *American Entomologist*, 52(1), 24–28.
- Roth, W.-M. (1995). *Authentic school science: Knowing and learning in open-inquiry science laboratories*. Kluwer Academic.
- Rothman, S. E., Jones, J. A., LaDeau, S. L., & Leisnham, P. T. (2021). Higher West Nile virus infection in *Aedes albopictus* (Diptera: Culicidae) and *Culex* (Diptera: Culicidae) mosquitoes from lower income neighborhoods in urban Baltimore, MD. *Journal of Medical Entomology*, 58(3), 1424–1428. <https://doi.org/10.1093/jme/tjaa262>
- Schechner, R. (1985). *Between theater and anthropology*. University of Pennsylvania Press.
- Sinatra, G. M., Broughton, S. H., & Lombardi, D. (2014). Emotions in science education. In R. Pekrun & L. Linnenbrink-Garcia (Eds.), *International handbook of emotions in education* (pp. 415–436). Routledge.
- Sobchack, V. C. (2004). *Carnal thoughts*. University of California Press.

- Stetsenko, A., & Arievitch, I. M. (2004). The self in cultural-historical activity theory: Reclaiming the unity of social and individual dimensions of human development. *Theory & Psychology, 14*(4), 475–503. <https://doi.org/10.1177/0959354304044921>
- Tuncgenç, B., & Cohen, E. (2016). Movement synchrony forges social bonds across group divides. *Frontiers in Psychology, 7*. <https://doi.org/10.3389/fpsy.2016.00782>
- Valdés, D. N. (1989). The new northern Borderlands: An overview of Midwestern Chicano history. *Perspectives in Mexican American Studies, 2*, 1–28.
- Vincent-Ruz, P., & Schunn, C. D. (2018). The nature of science identity and its role as the driver of student choices. *IJ STEM Ed, 5*, 48. <https://doi.org/10.1186/s40594-018-0140-5>
- Vygotsky, L. S. (1966). Play and its role in the mental development of the child. (Nikolai Veresov & Myra Barrs, Trans.). *International Research in Early Childhood Education 7*(2), 3–25.
- Vygotsky, L. S. (1971). *The psychology of art*. MIT Press.
- Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. In M. Cole, V. John-Steiner, S. Scribner, & E. Soberman (Eds.). Harvard University Press.
- Wagler, R., & Wagler, A. (2012). External insect morphology: A negative factor in attitudes toward insects and likelihood of incorporation in future science education settings. *International Journal of Environmental & Science Education, 7*(2), 313–325.
- Yamagata-Lynch, L. C. (2007). Confronting analytical dilemmas for understanding complex human interactions in design-based research from a Cultural-Historical Activity Theory (CHAT) framework. *The Journal of the Learning Sciences, 16*(4), 451–484. <https://doi.org/10.1080/10508400701524777>
- Yazan, B., Rudolph, N., & Selvi, A. F. (2019). Borderland negotiations of identity in language education: Introducing the special issue. *International Multilingual Research Journal, 13*(3), 133–136. <https://doi.org/10.1080/19313152.2019.1633095>

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.

**Katherine Richardson Bruna** is the Founding Director of the ISU 4U Promise and Professor of Social and Cultural Studies of Education at Iowa State University. She is a cultural studies of science education scholar and teaches courses on social justice and bilingual education as well as interpretive research methods.

**Jennifer Farley** is a Senior Research Manager at the University of Nebraska Public Policy Center. Her research and evaluation projects in education focus on school-based mental health services, family engagement, and the experiences of diverse learners.

**Lyric Bartholomay** is a Professor of Parasitology and at the University of Wisconsin-Madison. She is a vector biology and public health entomology scholar, whose research and teaching efforts are aimed at innovation toward, and rigorous evaluation of, interventions to prevent exposure to mosquito and tick-borne diseases.