A Linguistic <ecosystem>:

Curricular Methods for Science, Literacy, and Identity in Outdoor Education

Samuel Rubin

A thesis

submitted in partial fulfillment of the

requirements for the degree of

Master of Education

University of Washington

2024

Committee:

Sylvia Bagley

Lakeya Afolalu

Program Authorized to Offer Degree:

Education

University of Washington

Abstract

A Linguistic <ecosystem>:

Curricular Methods for Science, Literacy, and Identity in Outdoor Education

Samuel Rubin

Chair of the Supervisory Committee:

Sylvia Bagley

College of Education

For many students, a significant barrier in science understanding is complicated scientific language. My research explores ways that word study in scientific contexts can facilitate rich learning experiences and develop scientific identity. While research in learning sciences has examined interdisciplinary science/literacy curricula, the targeted study of science, literacy, and identity in outdoor education is unique to this project. By synthesizing literature on science sensemaking, educator language stances, and socio-cultural learning theories, I designed a set of lessons where students engage in structured, contextual word study and field-tested these lessons with four groups of fifth-grade students at an environmental education center. I found that the study of scientific words in outdoor contexts allows students to share and sustain their identities while building confidence in science, literacy, and the outdoors. Based on my findings, I propose an "Environmental Word Investigation" (EWI) framework to be used by educators in designing identity-sustaining science/literacy lessons. By centering literacy in the science-focused world of outdoor education, this research fosters new possibilities for land-based English literacy work.

Table of Contents

Acknowledgements

This work would not be possible without the support and inspiration of the graduate students, staff, and faculty of IslandWood and the University of Washington. Thank you to Dr. Déana Scipio for guiding my creation of this project, and to Dr. Priya Pugh for developing my teaching practice and encouraging me to engage in linguistic work in the outdoors. I also would like to acknowledge my professors, teachers, and peers, including Rebecca Loveless, Izzy Mayer, Sarah Merkt, Michela Dimond, Oscar Newman, Grace Cornell Gonzales, and Dr. Emma Elliott, who shared with me the pedagogy, literature, and theories that support this work. Thank you to Dr. Lakeya Afolalu for agreeing to review this work and challenging me to take more critical stances. And to my advisor, Dr. Sylvia Bagley, thank you for your guidance in my time at the University of Washington. Finally, I thank the Duwamish, Suquamish, and Port Gamble S'Klallam Peoples whose past, present, and future stewardship of the land allows for and guides this work.

Introduction

In my experience teaching in elementary school settings, a significant barrier in science sensemaking and understanding is both the perception and reality of complicated scientific jargon. I have observed situations where students repeatedly receive definitions for lengthy words such as "freshwater macroinvertebrate," but the perceived complexity of the word blocks their ability to recall previous instruction and connect it to other words. Consequently, a student might disengage from a scientific identity because they feel they lack the understanding and science-specific language to form that identity. Given that scientific language is often lengthy and morphologically intricate, this structure makes them ripe for linguistic study.

Scientific words are designed to describe–though they may look complex at first glance, they usually employ Greek or Latin roots that are recognizable to an elementary school student with close examination. For example, when a student spends some time with the aforementioned <macroinvertebrate>, they may recognize the prefix <macro-> as the opposite of <micro->, like in <microscope>. If pushed to go further, they might also see <invert>, having seen the word <inverted>. Another student may notice the prefix <in->, and thus be left with the base <vert>. While not a word itself, <vert> appears in many words an elementary student might come across. Perhaps in math they learned about <vertical> axes, in social studies they read about religious <converts>, or in a social-emotional learning class they thought about whether they were more <extroverted> or <introverted>. In studying these words, students may find a common thread of "turning" in the meanings of these words, which would align with the Latin root *vertere* meaning "to turn." Now, a student looking at <macroinvertebrate> would notice denotations of "large," "not," and "turn" within the word, and the larger, unfamiliar word becomes a conglomerate of small, familiar morphemes. While these morphemes don't reveal the full meaning of the word, they provide students with a schema for deeper understanding and connection.

This method of word study blurs the boundaries between science and literacy in novel ways. The scientific approaches of noticing, wondering, analyzing, and hypothesizing with lexical data in a literacy context challenge dominant notions of science and literacy as discrete, exclusive endeavors that ascribe to white, colonial norms (Bang et al., 2010, Guttiérez et al., 2009). By challenging (at the elementary level) the rejection and/or containment of non-dominant practices, such as Indigenous knowledges or Black translingual competencies, science and literacy expertise and scholarship in higher education is available to a more diverse population (Kiramba and Oloo, 2019; Park, 2013; Richardson, 2011). Moreover, imbuing literacy practices in science supports a key component of science and reveals deeper meaning (Shanahan and Shanahan, 2010). The deep study of words also creates space for multilingual learners to share their expertise. For example, in Spanish, the word *murciélago*, or "bat," comes from the Latin *mus, murus* meaning "mouse" and *caecus* meaning "blind." A Spanish-speaking student might find *ciego* ("blind" in Spanish) within the word, and thus provide more context and knowledge in a scientific discussion. Or, in Lushootseed, the word for "brown," *pədix^{w}alus* contains the word *pə́d,* meaning "earth," revealing a natural connection between language and land that might resonate with Indigenous students and/or students accustomed to land-based education (McCoy et al., 2016; Tulalip Tribes of Washington, 2023).

In science contexts, we need to move beyond definitions towards more interdisciplinary study of words, to develop profound comprehension and meaningful learner identity. In doing so, science and literacy education can more closely align with culturally-sustaining practices. To examine the effectiveness of this method of scientific and linguistic inquiry, I propose a set of context-driven lessons that gives students the opportunity to engage in this work. My curricular research explores ways that word study in scientific contexts can facilitate rich learning experiences and develop scientific identity. In this project, I ask: How can outdoor educators aid

development of student identities as scientists and learners by providing tools to dissect and understand scientific vernacular?

Positionality

I am a linguist by nature and by nurture. I decided to follow a course of study in linguistics in my undergraduate education because I have always been interested in words–how words form, describe, challenge, and harm. When I was struggling to understand my queer identity, common language helped me describe, identify, and find community. In my Jewish upbringing, I understood my study of language, specifically my study of Hebrew in ancient texts, as a way to connect to my Jewish heritage and identity. Linguistics, as a pursuit of asking deep, intricate questions about seemingly unstructured human processes, naturally aligns with my queer and Jewish cultural norms of questioning that which is accepted as fact. As linguistics is so tied to my own identity, I wonder how structured language study can support other students in meaningful learning and identity formation.

As a white, cis, non-disabled man, I recognize that language has also been a powerful medium for those with identities like mine to maintain power and perpetuate systemic inequities. The way I speak and am expected to speak aligns with the hegemonic, racist, sexist, classist, and ableist notion of "proper" English in the United States, and I am afforded many privileges due to my linguistic repertoire and practices. Historically and presently, Americans who speak non-mainstream Englishes and other (often non-European) languages experience marginalization, discrimination, and violence. For instance, speakers of African American Language (AAL)–a diverse, grammatical, and linguistically rich language–often experience discrimination in classrooms, the workplace, and society as a whole due to negative perceptions of the language (Baker-Bell, 2020; Baugh, 2015; Holliday, 2022). In boarding schools and other educational systems across the Americas, Indigenous languages have historically been banned to

force assimilation and erasure of identity (de los Rios et al., 2019; Dunbar-Ortiz, 2014). Today, this erasure continues with Indigenous languages and other languages that aren't associated with whiteness, including Latin-American Spanish dialects (de los Rios et al., 2019). There is massive and legitimate mistrust between speakers of these languages and white, Dominant American English (DAE) speakers like me. I work to rebuild this trust by supporting and sustaining the entire linguistic repertoires of my students through intentional pedagogical choices in my teaching and research.

Literature Review

Science Identity and Learning

Often, a student's perception of what a scientist looks like is overrun by stereotypes, namely the "white man in a lab coat" trope (Framework: Culture, Learning, and Identity, 2020). Scientific identity is presented as discrete and unchanging, and students can be pushed away from meaningful scientific practice if this conception of identity remains unchallenged. Nasir and Cooks (2009) reveal how providing students with ideational resources, or ideas about the self and relationships to place and practice, in learning contexts is vital to developing a strong learner identity. Students who possess the ideational resources to position themselves in their schema of a scientific identity will be able to deeply engage with scientific practices.

To dismantle fixed perceptions of who and what constitutes a scientist, work to "desettle" conceptions of science prove beneficial. As Bang et al. (2012) highlight:

> In our view, desettling entails imagining multivoiced meanings of core phenomena as open territory for sense-making in the science classroom, similar to the kinds of meaning-making opportunities that are available to scientists in the field. Furthermore, we believe that engaging with diverse meanings amplifies rather than attenuates learners' relationships and experiences with the larger world and the places in which they live. (Ingold, 2011, as cited in Bang et al., 2012, p. 308)

Additionally, in working to desettle science and bring in student culture, I employ cultural-historical approaches to learning presented by Kris D. Gutiérrez and Barbara Rogoff

(2003), where culture is understood to be a set or "repertoire" of practices. Combining the processes of desettling science with the framework of culture as participation not only supports students with diverse repertoires of practices in feeling represented and understood in the classroom, but also supports all students in profound and personalized connections to the natural world and scientific inquiry (Bang et al., 2012; Guttierez & Rogoff, 2003). Research has shown that when students experience STEM lessons that relate to their community, practices, and interests, or learn about scientists that look, think, or act like them, they are more engaged and successful in STEM classes (Anwar et al., 2021; Calabrese Barton & Tan, 2019; Calabrese Barton & Tan, 2017; Mulvey et al., 2022; Rahm & Downey, 2002). If science is being taught in a way that combats hegemonic, settled expectations, they are provided with ideational resources around science that include themselves and their cultural practices.

Along with providing students with ideational resources, students need both relational and material resources to develop a strong learner identity (Nasir & Cooks, 2009). Science, as described by the National Research Council's *Framework for K-12 Science Education,* is "fundamentally a social enterprise," requiring constant collaboration and conversation (NRC 2012). To develop an identity as a scientist, a science curriculum must provide students with the relational resources that are inherent in scientific practices. Material resources, the physical artifacts students use to construct knowledge and learner identity, can be imagined with a desettled lens (Bang et al. 2012; Nasir & Cooks, 2009). An expensive electronic microscope and a large piece of butcher paper are–in different ways–equally valuable resources for students, and using more accessible, less expensive tools (like word study) in science sensemaking can help students build scientific identity in their everyday lives.

Language, Literacy, and Identity

In engaging in language and literacy work, whether related to science or not, it is vital to ensure students' linguistic repertoires are sustained. Django Paris (2012) offers "culturally sustaining pedagogy" as a "term, stance, and practice" in supporting the whole learner, specifically discussing how language, literacy, and culture are at the core of this pedagogy. Culturally sustaining pedagogy calls educators to go beyond mere representation and relevance to students' repertoires of practice to provide students with an education that maintains and *sustains* their culture. Not only does the culturally sustaining stance support learning and identity development, but is necessary for a pluralistic and democratic society (Paris, 2012).

Translanguaging, or the fluid use of one's full linguistic repertoire as a pedagogical stance, allows for cultural sustainment among multilingual students (Wei, 2022). Often, multilingual students in the United States for whom DAE is not a first language are seen as lacking literacy skills and knowledge (Kiramba & Oloo, 2009; Paris, 2012). Race is a major contributing factor to these deficit narratives–no matter how well a student employs standard forms of English, their race will be foregrounded in assessments of their linguistic competence (Flores and Rosa, 2015). Dr. April Baker-Bell (2020) identifies how "anti-Black linguistic racism gets normalized in and through much research, disciplinary discourses, curricular choices, pedagogical practices, and teacher attitudes" (pp. 7-8). She also uplifts the use of "White Mainstream English" instead of DAE to highlight how race is critical to the systematic hegemony of linguistic norms (Baker-Bell, 2020). Thus, culturally sustaining language and literacy work is inherently an anti-racist practice, and must always be examined through a critical racial lens.

Despite these deficit narratives, multilingual students have a wealth of "translingual and transcultural competencies" that, when supported, contribute to greater student and community

learning (Kiramba & Oloo, 2009). Even if a translanguaging stance is not adopted in a learning environment, students–if allowed–will naturally "go beyond narrowly defined linguistic resources in meaning- and sense-making" (Wei, 2022, p. 173). Thus, providing the space for students' translanguaging can assist in the pursuit of knowledge. The enactment of a translanguaging stance gives students space to exhibit their whole selves, employs a student's entire meaning-making repertoire, and supports their educational and social repositioning as successful readers and writers (Garcia, 2020; Gonzales & Machado, 2022). Omogun and Skerrett (2021) describe the brilliance with which youth, specifically Black multilingual immigrant youth, can "construct identities and fulfill other goals" through employment of their entire linguistic repertoires (p. 424). When language and literacy study sustains students' full linguistic practices, it necessarily takes an anti-racist stance, and benefits to learning and identity development are clear.

Word Study and Literacy in Science

> We southerners usually take for granted a view of language as a dislocated phenomenon that develops in an isolated way inside the brains of human beings without any necessary influence from the environment. (Rasmussen & Akulukjuk, 2009, p. 285)

The above quote is referencing Inuktitut, an Inuit language, and the ways that Inuktitut is inherently tied to land. Nevertheless, words in all languages, English included, contain historical, environmental, and cultural stories that reveal themselves with attunement and study. Pete Bowers and John Kirby have laid out the foundations for Structured Word Inquiry (SWI), a method of revealing these stories and developing strong literacy skills through interactive, student-centered morphological literacy instruction. Morphemes can be defined as the smallest meaning-bearing parts of words, and are already vital areas of study in the curricula of many effective literacy programs (Carlisle, 2000; Wolter & Dilworth, 2014; Zoski & Erickson, 2017). In the SWI study, students who were taught using SWI's morphological instructional methods

scored higher on vocabulary tests, including tests with novel words that contained familiar bases (Bowers & Kirby, 2010). SWI aligns with Charles Goodwin's theories on co-operative action in learning contexts, which he defines as the "process of building something new through decomposition and reuse with transformation of resources" (Goodwin, 2018, p. 3). In working together to "decompose" words into their meaning-bearing parts, uncovering significance and connections, and then recombining for enhanced definition, students are engaging in co-operative action. When students share intellectual resources and actions through decomposition and reuse, they can "inhabit each other's actions" (Goodwin, 2018, p. 11). Additionally, when coupled with theories of translanguaging as not merely the linguistic practices, but rather the holistic actions of multilingual students (García, 2020), SWI as an enactment of co-operative action can blur linguistic boundaries and provide culturally sustaining education. As an effective form of literacy instruction and a method for student connection and deep learning, morphological instruction creates opportunities for learning and identity development in science contexts.

Some research has examined the importance of developing context-dependent literacy strategies, especially in science. Oliviera and Barnes (2019) posit that students must be able to "approach science texts and orient themselves in relation to the scientific written word" (p. 25). Their article examines "aloud reading" in science class, specifically how teachers mediate scientific literacy experiences for students. While not going in depth on students' approaches to reading by themselves, their discussion shares important points around the social nature of literacy, connecting to the NRC's centering of science as a social enterprise.

Shanahan and Shanahan (2012) present a theory of "disciplinary literacy," where literacy instruction within specific disciplines should not only be related to the subject, but specifically tied to the unique practices of the discipline. They share that because science is so specific in its

use of classical roots, “analyzing the Greek and Latin derivatives can provide particularly effective support in understanding science concepts” (Shanahan & Shanahan, 2012, p. 9). In SWI, etymology is a vital tool for understanding morphemes and connecting word meanings across contexts, and such knowledge and learning is similarly integral to effective science education.

Word study in science contexts is imbued with student experiences and knowledge and is naturally relational and translingual. Importantly, word study as an interactive linguistic pursuit provides students with cultural artifacts that allow them to mediate their environment (Esmonde, 2017; Vygotsky, 1978). In other words, word study expands language’s mediational and relational power through contextual and interpersonal pedagogical moves. The learner, then, develops language and literacy practices necessarily connected to their own experiences, actions of their peers, and their environment. As a scientific practice, it has the potential to foster and sustain positive scientific identity development.

Methods

Data for this project were collected at IslandWood, a nature-based environmental education non-profit on Bainbridge Island, the homelands and homewaters of the Suquamish, Duwamish, and Port Gamble S'klallam Peoples. Each week, around 100 fourth to sixth graders from the greater Salish Sea region attend a four-day field trip through IslandWood’s School Overnight Program (SOP). Graduate students and staff instructors lead these students in small field groups, designing the week’s lessons and activities around student and instructor interests, school requests, and phenological changes. I lived, worked, and studied at IslandWood in the 2022-2023 school year, and because of this relationship to the organization and the place, was able to conduct my research through IslandWood’s “Researcher in Residence” program.

My research began with two info sessions held in October 2023 for the graduate instructors, whose field groups I was hoping to join to conduct this research. I led a sample word study lesson so that graduates could envision the activities of the curriculum, and after discussing the logistics of the research I coordinated with four graduate instructors to include my lessons into their curriculum in relevant and supportive ways.

The field groups each had between eight to twelve fifth graders from a single school. Of the schools represented in the field groups, all were public schools, three from Seattle and one from Tacoma. Table 1 shows selected demographic data for each of the schools as a whole, as I did not ask students in my groups for this information. Nonetheless, this table gives an idea of the diversity of identities and cultural repertoires students brought to these lessons.

I was able to teach a total of eight lessons across four field groups. Each field group received two one-hour lessons over two days. The first lesson involved a pre-brief to get to know

Table 1

Demographic Data for Schools Represented in Field Groups

Race/Ethnicity	**School 1**	**School 2**	**School 3**	**School 4**
American Indian/Alaskan Native	0.3%	1.9%	0.0%	0.3%
Asian	5.7%	8.0%	13.6%	4.2%
Black/African American	65.8%	21.6%	0.2%	26.2%
Hispanic/Latino of any race(s)	8.2%	15.0%	5.4%	25.1%
Native Hawaiian/Other Pacific Islander	1.5%	3.8%	0.0%	4.7%
Two or More Races	6.2%	12.2%	16.3%	20.9%
White	12.3%	37.6%	64.5%	18.7%
Other Demographic Data				
English Language Learners	26.5%	17.4%	4.1%	13.4%
Low-Income	77.4%	53.5%	4.8%	49.3%
Students with Disabilities	19.3%	21.6%	6.8%	22.6%

Note. Data sourced from washingtonstatereportcard.ospi.k12.wa.us. All language used to describe identities matches language used on the website.

the students and understand their science, literacy, and identity repertoires, followed by a word study lesson investigating a key word chosen in collaboration with the graduate instructor. In the second and final lesson, I led another community word study, then had students work in pairs on a self-directed word study to assess transfer and build independence (see Appendix A for an example worksheet). Words investigated included <ecosystem>, <photosynthesis>, <macroinvertebrate>, <interdependence>, <medio ambiente> (“environment” in Spanish), and <k̓aʔk̓aʔ> (“crow” in Southern Lushootseed). Words in other languages were intentionally included to support students’ translanguaging and encourage students to employ their entire linguistic repertoires in these lessons (Wei, 2022). The second lesson ended with a debrief to discuss takeaways and perspectives on the synthesis of science and literacy.

In conducting this research, I made an effort to prioritize students’ comfort and agency. Supported by information on informed assent and children’s rights in research from Harcourt and Conroy (2005), I designed a conversation around my research that I conducted with every group, before each lesson. I explained to students my positionality as a master’s student at the University of Washington, a previous IslandWood instructor, and a researcher, and shared that I was interested in how students engage with and respond to the activities I had designed. I expressed that I would write about these lessons, and may use their words and/or work in my writing, but never their names or identifying features. I prompted questions about me or my research, and made clear that questions or concerns could be expressed at any time. I then conducted an eyes-closed vote to assess whether students were comfortable with me audio recording the lesson. Students unanimously voted “yes” to audio recording in three out of the eight sessions. In the other five sessions, when unanimous votes were not reached, I took field notes of student responses and work. In all sessions, I collected or took photographs of my own student-facing writing and student work with their permission.

Analysis

I first transcribed data from the audio recordings using an AI transcription site, *Riverside.fm* then listened to the audio and modified as necessary. During my first listen, I pulled any salient interactions and listened once more to ensure fidelity. When transcribing, I identified myself as "RESEARCHER," and any students as "STUDENT #," with each unique number corresponding to a unique student in the interaction. In my analysis, and in this paper, the student numbering system resets after every interaction. For example, STUDENT 1 in one interaction may or may not be the same student in another interaction. I define an "interaction" as one uninterrupted block of transcribed text. Student names are only used in this paper when necessary to differentiate between students, and are pseudonyms to protect their identity.

Once the audio was transcribed, the transcriptions, field notes, student worksheets, and student-facing work were compiled and analytically coded using an open code method (Gibbs, 2008). Final codes included: *Scientific Identity, Language/Literacy Identity, Science Sensemaking, Language/Literacy Sensemaking, Science + Literacy/Language Connection, Science + Culture, Translanguaging, Connection to Place,* and *Community Building.* The codes allowed me to validate the various patterns I noticed during data gathering. With the help of the final codes, I was able to see which themes occurred more often across lessons and groups, allowing me to present findings that best represent the implications for science, literacy, identity, and learning in these lessons.

Findings

The set of lessons researched had four main sections: a prebrief, a community word study, a partner word study, and a debrief. The prebrief consisted of icebreakers and conversations around science and language to get the students primed for the lesson and gather baseline information. Community word study was the "meat" of the lesson, taught each day with

the entire field group. This section focused on decomposing a large scientific word into its morphemes, looking for base and root connections, and co-constructing a definition of the word. The partner word study, on day two, allowed students to apply their word study knowledge and build skill and confidence in analyzing new words. The debrief worked to synthesize their learning and gain insight on takeaways. My findings will be presented in the same order as the curriculum, in order to honor and emulate the natural progression of student thought during the lessons. The findings show various ways students interacted with the activities and each other to develop scientific and literacy identity and knowledge, and ways in which the context of the lessons provided support for this sensemaking.

Prebrief: "We Have no Experience"

When I first met each group of students, I had two goals. First, I worked to get to know them and help them feel comfortable with me as a guest teacher and researcher. Second, I wanted to gauge their epistemological stances towards science, literacy, and identity. To achieve my first goal of community building, I asked each student to share their favorite word. Unsurprisingly, this simple icebreaker revealed as much about their use and understanding of language as my targeted prebrief questions. Some students shared food they enjoyed, such as "lasagna" or "boba." Others, through their favorite words, expressed affection for the natural world ("'Mountain' because I love the snow on the mountains") or relationships ("'Family' because I love my mom and I love my cousins"). One student demonstrated their language identity by sharing the word "*oishii"* explaining that "it means tasty in Japanese, and I've been learning Japanese, and I've just been saying it so much randomly. You might hear me say, like, *oishii desu ka* like, a few times." Another student shared their favorite words were "God and Black" using this opportunity to offer insight on not only their identity and culture, but what parts of their identity and culture they value highly. An interaction at the end of the icebreaker nicely

synthesized language, identity, and culture, when a student wanted to share an additional favorite word:

> STUDENT: I like Hashem.
> TEACHER: What is your word?
> S: Hashem.
> T: What does that mean?
> S: Um, uh, God in Hebrew.
> RESEARCHER: Yeah, I think it means God in Hebrew. I speak Hebrew, too.
> S: Oh, you do? Are you Jewish?
> R: Yeah!
> S: I am too! I'm Jewish too!

This word, *Hashem*, highlighted the students' religious, cultural, and language practices and allowed them to find connection with others, in this case me (the researcher). A sense of comfort and belonging was catalyzed by one word, a testament to the power of language and the proclivity of students to identify shared cultural repertoires (Guttiérez & Rogoff, 2003).

While challenging to fully understand students' beliefs about language, science, and identity, my initial discussion questions revealed some interesting perspectives. One group of students expressed a connection between material and relational resources and their ability to engage in literacy:

> RESEARCHER: What do you do when you don't know a word?
> STUDENT 1: The teacher shows the meaning on a slide, or asks the class, and usually someone answers.
> STUDENT 2: I get out my dictionary.

A similar resource-based understanding was revealed in this interaction about science:

> RESEARCHER: How are you scientists?
> STUDENT 3: Scientists observe and show their group mates things.
> STUDENT 4: We are not scientists because we don't have materials, we didn't get a master's degree, we have no experience.

In both interactions, Students 1 and 3 expressed how relational resources are involved in their learning, including teachers and peers as vital to their learning in neutral and positive ways. Students 2 and 4, on the other hand, focused on the importance of material resources. Student 4

went further, explaining how a lack of specific materials or accolades can fully disqualify someone from an identity category.

Another group conveyed positive attitudes toward various literacy resources after I asked for their strategies in tackling unfamiliar words:

> STUDENT 1: I'll search the word, then I'll try to guess and then I'll ask about what it says.
> RESEARCHER: Yeah, guessing, asking. Any other ideas of what you do when you see a big, maybe confusing, interesting word? Yeah.
> STUDENT 2: Look at what it has to do with other words that you know.
> R: Nice. Is that what you were going to say?
> STUDENT 3: Um, not really. Like, I guess like if there's something about water that has like, <aqua> in it or like something like that. But I know <aqua> means like…something about water.

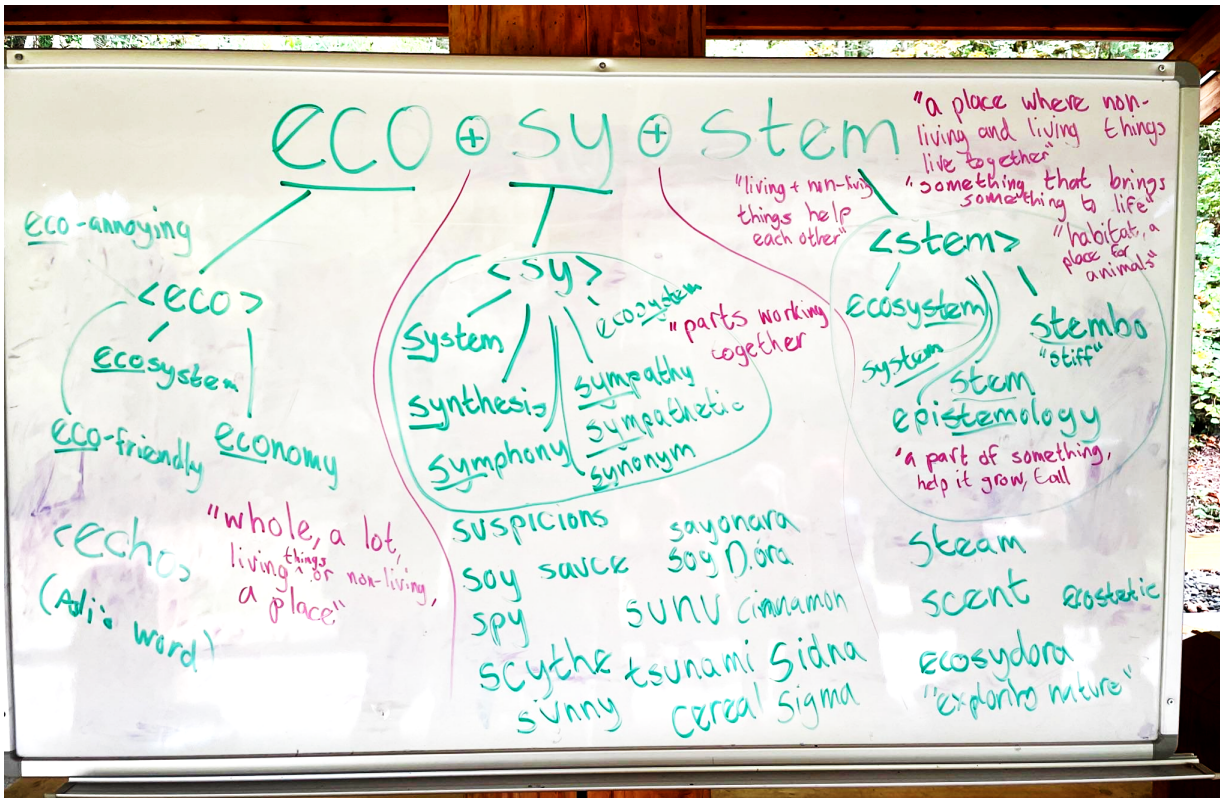
The example of <aqua> presented by Student 3 suggests the students were primed by their environment, as this discussion occurred on a rainy day in an outdoor classroom. Before the above interaction, another student had offered <geology> when describing literacy strategies, another scientific and contextual word to explain their process for learning about novel words. Findings from the prebrief discussion begin to demonstrate a need to provide students the tools to understand language and scientific concepts, and how a contextual, morphological literacy curriculum in the outdoors that is rooted in student interest and existing funds of knowledge (González, 2005) can lead to deeper, more critical learning.

Community Word Study: "Parts Working Together"

I worked with each graduate field instructor to find a word for word study that stemmed from the emergent interests of the students and the curricular wishes of the instructor. To this end, words studied as a large group included <ecosystem>, <macroinvertebrate>, <photosynthesis>, and <interdependence>. I found that studying highly contextual and interesting scientific words supported students in engaging with the literacy activities and situating themselves within the work.

Figure 1

An artifact of community word study on the word <ecosystem>.



Note. In this image, words connected to the target morpheme are written in green and suggested definitions are in pink. All words written by the researcher were proposed by students.

Some students came into these lessons with previous knowledge about the word studied, usually from a classroom science or vocabulary lesson. In Figure 1, the definition for <ecosystem> written at the top which reads “a place where non-living and living things live together” was provided by a student at the beginning of lesson as a definition memorized from previous instruction. As the lesson went on and the morphemes were investigated, new definitions arose. For the students whose thinking appears in Figure 1, the first morpheme, <eco>, was the most recognizable. When asked for words containing <eco>, many students shared <eco-friendly>. One student, who seemed bothered by some of their friends in the group, wondered aloud if <eco-annoying> was a word. This neologism, though perhaps targeted at a

classmate, demonstrated deep engagement with the lesson. By combining <eco>, a target morpheme, with <annoying>, a current emotion, this student was positioning themself within the literacy work. Furthermore, by tying their emotion to the morpheme <eco>, the student indicated a connection to place and nature, as this lesson was occurring outdoors in a heavily forested area. In searching for words with <sy>, a similar connection to place was revealed when a student offered <symphony>. The group had just had a music lesson where they investigated the sounds of their environment and created their own "nature symphony." This communal knowledge and experience allowed them to coalesce around a definition of "parts working together" for the <sy> morpheme, with the help of other words.

Group discussion was vital for developing ability and confidence in scientific word study. When investigating <macroinvertebrate>, one student had mentioned the prefix <micro>, and the group was brainstorming words with that prefix:

> RESEARCHER: <Microscope>, <microphone>, <microscopic>. What about something you use that you might use to cook your food?
> STUDENT 1: <Microwave>.
> R: Yeah. Why does a <microwave> have <micro>?
> STUDENT 2: Ooh, a <microwave>.
> STUDENT 3: Because they're microscopic waves that heat the food up.
> STUDENT 4: What's a <microphone>?
> R: Yeah, why is <microphone> like that?
> S4: Because it makes…I don't know.
> S3: It makes small sounds louder!

By giving students the prompting to ask and answer questions on their own, even without full knowledge of the entire morphology of a word, they began to develop these skills on their own. After I had prompted a question about how <microwave> was connected to <micro>, Student 4 expressed curiosity about <microphone>, and Student 3 posited an idea. This short interaction highlights how during these lessons, students shift from using teachers and instructors as resources to using their own intuition and peers for literacy knowledge. Additionally, by asking

an open-ended question that built off of previous knowledge, Student 4 demonstrated a scientific mindset (NGSS Lead States, 2013).

An important instructional move during word study work is writing down all ideas students share during the lesson, both to support safe risk-taking and to encourage students to use each others' ideas to mediate their own thinking. For example, one student suggested "Soy Dora" when I prompted for words with the <sy> morpheme, so I wrote it outside the <sy> word family circle (as seen in Figure 1). Later, after generating our definitions for each morpheme, I asked students to synthesize the findings to hypothesize a definition for <ecosystem>. One student misunderstood the prompt, and shared the word <ecosydora>, a word they had created, which they said meant "exploring nature." This student had invented a new morpheme, <dora>, sparked by a different student's semi-joking suggestion of "Soy Dora," and had given it meaning in connection to the popular children's show "Dora the Explorer." In combining <dora> with <eco> and <sy>, this student was demonstrating an understanding of how morphemes combine and carry meaning. Additionally, as the students had been exploring nature throughout the day, the word study allowed them to define their sensemaking in new and interpersonal ways.

Once students understood the invitation to propose a new, more informed, definition for <ecosystem>, many ideas arose. The first, "living + non-living things help[ing] each other," indicates a more active and collaborative ideation of an ecosystem, as compared to their original definition of just "living together." Another definition, "something that brings something to life," similarly suggests action, support, and connection as integral to an ecosystem, as opposed to mere coexistence. Through this literacy work, students would now be able to pay more critical attention to the interconnectedness of their surroundings, and situate themselves as "a part of" rather than "apart from" their environment (Bang et al., 2007).

Partner Word Study: "That Sounds Like…My Language"

During partner word study, students made more nuanced connections between the literacy work and their identities and practices. When I gave the students the opportunity to select their word from a series of words I had compiled, one student remarked "I am going to choose my culture" before choosing <*medio ambiente*> ("environment" in Spanish). By saying "culture" instead of "language," the student was demonstrating an internalization of the integral connection between language and culture, and able to extend this literacy work to more of their own linguistic practices.

I found many other instances of learning supported by translingual connections. In one partner word study session, a student asked about the word <*k̓aʔk̓aʔ*>, because they did not recognize some of the letters, so I best approximated a pronunciation to help. Upon hearing the word spoken aloud, the student shared, "It sounds like 'get up!' in my language, Oromo–like when your mom tells you to wake up!" Other students, intrigued by the conversation, chimed in with their own connections and ideas of meaning, until one student observed it sounded like a crow. I explained that it was, in fact, "crow" in Southern Lushootseed, a language indigenous to the land we stood on. One student referred back to the first student's comment about it sounding like "get up," mentioning that a crow's caw could wake someone up (which initiated a raucous chorus of imagined crow alarm clocks). In offering time for multilingual linguistic sensemaking and hypothesized meanings amongst the students *before* defining the word itself, students were able to build off each others' ideas to connect new words to their existing funds of knowledge.

Multilingual support also provided more access points for English literacy skills. In a late afternoon lesson, two Ukrainian students had selected the word <bioluminescence>. From my previous lesson, I noticed that one of the two, Anna, had more confidence in English and often acted as a translator for the other, Ivan. I walked over to them to help with translation, and they

asked me to translate the word into Russian. Using Google Translate, I showed them the word <биолюминесценция> (IPA: /bɪəlʉmɪnɛstsɛntsɪə/). Ivan, previously very quiet, read the Russian word out loud, to which Anna responded in English "Oh, it sounds like <biology>!" Upon making this connection, they excitedly posited that the word had something to do with "life" as they both knew the word <biology>. In this interaction, Ivan and Anna were able to use their L1 knowledge to create meaning in their L2, due to their attunement to morphology from the lesson. Because of the student-directed nature of this section, individual languages, cultures, and practices were elevated as legitimate and important knowledge.

Debrief: "We Are Things That Thrive Together…With Plants Around Us"

The debriefs of each lesson allowed students to synthesize their learning and provided evidence of their updated schema around science, literacy, and identity. In one group that investigated <ecosystem>, students had agreed on the following definitions for each morpheme: "environment, nature" for <eco>, "together" for <sy>, and "stand" for <stem>. Combining these definitions, students decided that <ecosystem> meant "an environment where plants and animals come together to survive and thrive." During the debrief, I prompted them to connect this definition to their own experiences:

> RESEARCHER: This is team Pond, right? How are you all an ecosystem?
> STUDENT 1: Because we are things that thrive together.
> R: Things that thrive together, yeah.
> S1: With plants around us!

Here, a morphological study of <ecosystem> allowed students to see each other as interdependent beings, who not just interact with each other but *require* each other to "thrive." Plus, by adding that they thrive "with plants around" them, they implied that a connection to the environment is integral to their own interconnectedness.

In asking targeted questions about how our work connected to literacy and science, students displayed an attunement to scientific processes. One student remarked that word study is science because "we looked at things, investigated it, and made conclusions." In this group, when I asked if they identified as scientists, every student raised their hand. The answer to this question was not always unanimously "yes," but I observed an increase in "yes" votes when literacy work was explicitly connected to science. In a different group where many students shared they identified as scientists, one student claimed this work is "like reading but a little bit science." They reasoned that their word study counted as science because they studied "a new word, which is an investigation" and the "reading part is when you're breaking it down into different pieces." Another student shared a similar sentiment, adding that "if it was a more complex word it would be more like science because there would be new things." Even if a word was new or challenging, these students implied readiness to investigate, decompose, and recombine, in both science and literacy contexts.

Themes of complexity and newness in science were echoed by many groups, including the students in the following interaction:

> RESEARCHER: Do you think what we did is science? Yeah. Why do you think that?
> STUDENT 1: Because…well we studied, like, we like tried to figure out like, "sciencey" words.
> STUDENT 2: "Sciencey" words.
> R: Yeah, these were definitely "sciencey" words.
> S2: Very… scientific.
> R: And when you look at "sciencey" words from now on, do you think that you'll be able to use some of these strategies?
> S1: Maybe… or I might just know them.

Many layers of connection between science and literacy are revealed in this exchange. Student 1 identified that there exist certain words that are "sciencey" or operate specifically in the realm of science. Student 2 highlighted Student 1's language choice, perhaps implying that using the word "sciencey" is not very scientific behavior. Nevertheless, Student 1 expressed a positive attitude

towards scientific language, asserting that they "might just know" more complex words, a confident identity stance. By their responses, students used the debrief as a way to synthesize their learning and connect it to their existing funds of knowledge. Moreover, the debates that arose at the end around "scientific" language and what constitutes "science" and "reading" suggest that students were provided with a launching point to further engage in this work.

Discussion

In the design and implementation of this curriculum, I focused on how word study in the outdoors can facilitate positive identity formation, and the results show evidence of this. In only a total of eight hours spent with over 50 different students, I learned about students' connections to English, Japanese, Hebrew, Oromo, Russian, and Spanish. Through these conversations around languages, students implicitly and explicitly shared perspectives about family, food, religion, geography, politics, television, and practices, perhaps not even recognizing they had done so. By providing spaces for discussion around language that felt connected to their environment and their various preconceived notions going into the field trip (for many schools, this trip is an integral part of their science curriculum, and is explained to students as such), their identity sharing feels meaningful, valued, and indicative of belonging. In this context, where students' everyday practices and funds of knowledge serve the intellectual pursuit of science understanding, students will naturally see themselves as scientists, not because of what they *will do*, but because of who they already *are*.

Through analysis of the findings, however, a focus on scientific identity development gave way to possibilities for the unique environmental mediation offered through morphological study. Language is connected to the land, as many Indigenous pedagogical practices have long understood (Kimmerer, 2013; Rasmussen & Akulukjuk, 2009). Often, calls for Indigenous language revitalization necessarily include learning on and from the lands and waters, because of

the inherent connections between knowledge, language, storytelling, and environment (Charles, 2022; Chiblow & Meighan, 2022, Desmoulins et al., 2019). Clearly, English did not develop in relationship with the lands and waters where these lessons occurred–Southern Lushootseed has that unique honor. However, when English is the primary language of instruction, and we as educators hope for strong language skills in our students, why not work with the land as a literacy teacher?

When language work is tied to the land, students are taught the same things, but connect to the work in unique ways, in ways that allow them to enter and engage. And when that work helps them describe and mediate a novel environment, that belonging is sustained. A student, in a forest ecosystem, discovers that the etymology of ecosystem implies life, togetherness, and standing up; suddenly, the student sees their community as an ecosystem, understands their interactions with both their classmate standing next to them and the cedar towering above as integrated and important. Their stick-fort building is *ecosydora,* a crow's call is their mom telling them to "wake up!", a bug is glowing because of биолюминесценция. Through word study, the environment begins to communicate in the students' language. Word study on its own often is a rich learning experience, but to achieve the goals demonstrated in this study, namely student identity development, belonging, and environmental mediation, critical curriculum design is necessary. To this end, I propose a curricular framework for "Environmental Word Investigation" (EWI) supported by my findings. In trying to connect science, literacy, identity, and learning, I found it impossible to define each individually in the context of this research without using the others for reference. Science learning occurred because of language and literacy work. Literacy learning required scientific methods and identity sustaining practices. Identity, whether as a scientist or as a reader, was developed through learning experiences, which in turn could only occur as students' identities were supported.

Figure 2

Student Evidence of Connections Within the EWI Framework

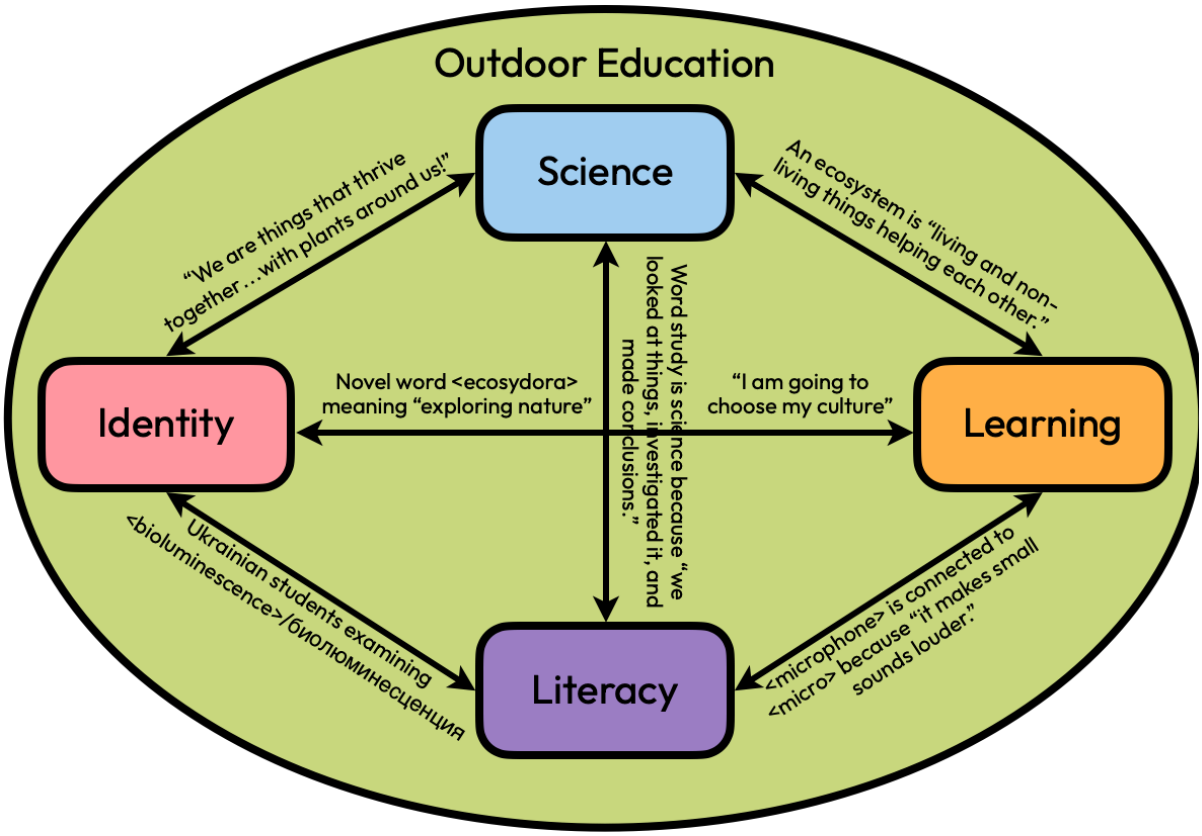
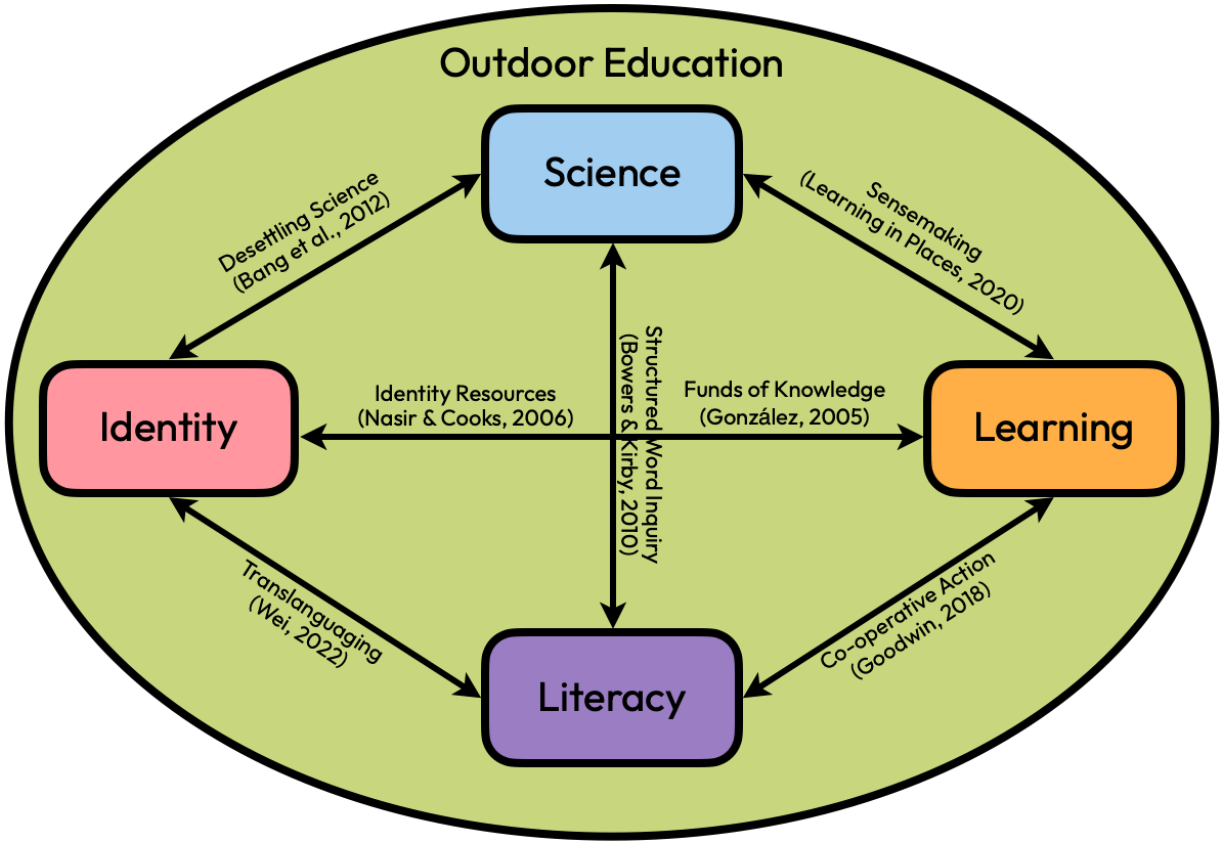


Figure 2, inspired by the Learning in Places (2020) rhizome model, illustrates the EWI framework, with examples of student words and actions that illuminate the connection between concepts. For example, when the two Ukrainian students were able to understand more about the morphology of <bioluminescence> by examining the word in Russian, their *Literacy* development was necessarily supported by their linguistic *Identity.* Or, students connected *Science* with *Literacy* as they identified that we had learned about new words through scientific processes. Interlexical morphological discoveries led to *Literacy Learning*, and *Science Learning* occurred when defining ecological and biological concepts. Each of these moments with students was possible because they occurred in the context of outdoor education, represented by the circle

Figure 3

Theoretical Grounding for EWI



that encloses this framework. This framework is supported by theory, as shown in Figure 3. Each connection has theoretical grounding that helps bridge the concepts, in turn helping to describe and legitimize the corresponding student actions. The Ukrainian students engaged in translanguaging (Wei, 2022) as they developed greater meaning through fluid use of their linguistic repertoires. Structured Word Inquiry (Bowers & Kirby, 2010) is sometimes, rightfully, termed "Scientific Word Investigation" as it is pedagogically and theoretically linked to the scientific process. And again, these theories are able to effectively speak to each other because of the opportunities for land-based learning in outdoor education.

Implications

To name and describe you must first see, and science polishes the gift of seeing.

–Dr. Robin Wall Kimmerer, Braiding Sweetgrass

I propose EWI as a curricular framework in service of student identity development and environmental mediation. I see multifaceted applications for teachers, especially outdoor educators. Lessons using this framework can engender a sense of belonging amongst students, and can support students in seeing themselves as scientists, readers, investigators, ideators, and "outdoorsy people." The excitement that occurs during these lessons is palpable, as students recognize their actions as scientific and literate ones, often contradicting what "science" and "literacy" mean in the classroom context. Through the examples of student interaction and engagement presented in this paper, I hope educators are inspired to build their own word study lessons, whether in science or other interdisciplinary applications. Unfortunately, morphological instruction is under-researched, and the research that discusses literacy in science instruction lacks examples of practice. I designed the EWI framework not only as a synthesis of my work, but also as a planning and assessment tool for educators (see Appendix B).

Through this work, I also envision positive identity implications for outdoor educators themselves. When I began work at IslandWood as a field instructor, I did not personally identify as a "scientist." However, once I began to implement word study lessons, I not only felt more comfortable teaching science lessons to students, but also realized that my work as an educator and a linguist already involved scientific practices. Conversely, many outdoor educators see themselves as *only* scientists, and shy away from identifying their teaching with other disciplines. Using this framework, outdoor educators, and the greater public, can view outdoor education as much a literacy pursuit as a scientific one. In an era of "reading wars" and debates

around the “science of reading,” outdoor education can enter the space as a meaningful, engaging, and academic solution–the “reading of science.”

I hope future research can further investigate literacy work in science, either by examining existing structures or proposing novel ideas. Longitudinal studies might reveal more complex student identity stances, and how literacy work in outdoor education appears and applies in the classroom. Additionally, I implore researchers to study possibilities for students and educators experiencing systematic barriers to outdoor education and land-based learning, and use this research and its interdisciplinary implications to encourage dismantling of such barriers. If “science polishes the gift of seeing” and thus the immense power to truly “name and describe,” let us ensure each student has the tools to envision and design their world with clarity.

References

Anwar, S., Menekse, M., Guzey, S., & Bryan, L. A. (2022). The effectiveness of an integrated STEM curriculum unit on middle school students' life science learning. *Journal of Research in Science Teaching*, *59*(7), 1204–1234. https://doi.org/10.1002/tea.21756

Baker-Bell, A. (2020). We Been Knowin: Toward an Antiracist Language & Literacy Education. *Journal of Language and Literacy Education*, *16*(1).

Bang, M., Medin, D. L., & Atran, S. (2007). Cultural mosaics and mental models of nature. *Proceedings of the National Academy of Sciences*, *104*(35), 13868–13874. https://doi.org/10.1073/pnas.0706627104

Bang, M., Warren, B., Rosebery, A. S., & Medin, D. (2012). Desettling Expectations in Science Education. *Human Development*, *55*(5–6), 302–318. https://doi.org/10.1159/000345322

Baugh, J. (2015). SWB (Speaking while Black). In J. Bloomquist, L. J. Green, & S. L. Lanehart (Eds.), *The Oxford Handbook of African American Language*. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199795390.013.68

Bowers, P. N., & Kirby, J. R. (2010). Effects of morphological instruction on vocabulary acquisition. *Reading and Writing*, *23*(5), 515–537. https://doi.org/10.1007/s11145-009-9172-z

Calabrese Barton, A., & Tan, E. (2018). A Longitudinal Study of Equity-Oriented STEM-Rich Making Among Youth From Historically Marginalized Communities. *American Educational Research Journal*, *55*(4), 761–800. https://doi.org/10.3102/0002831218758668

Calabrese Barton, A., & Tan, E. (2019). Designing for Rightful Presence in STEM: The Role of Making Present Practices. *Journal of the Learning Sciences*, *28*(4–5), 616–658. https://doi.org/10.1080/10508406.2019.1591411

Carlisle, J. F. (2000). Awareness of the structure and meaning of morphologically complex words: Impact on reading. *Reading and Writing*, *12*(3/4), 169–190. https://doi.org/10.1023/A:1008131926604

Charles, B. (2022). Oral Traditions of the Woodland Cree (Nihithawak) in Northern Saskatchewan: Links to Cultural Identity, Ways of Knowing, Language Revitalization, and Connections to the Land. *The Northern Review*, *53*, 23–35. https://doi.org/10.22584/nr53.2022.002

Chiblow, S., & Meighan, P. J. (2022). Language is land, land is language: The importance of Indigenous languages. *Human Geography*, *15*(2), 206–210. https://doi.org/10.1177/19427786211022899

De Los Ríos, C. V., Martinez, D. C., Musser, A. D., Canady, A., Camangian, P., & Quijada, P. D. (2019). Upending Colonial Practices: Toward Repairing Harm in English Education. *Theory Into Practice*, *58*(4), 359–367. https://doi.org/10.1080/00405841.2019.1626615

Desmoulins, L., Oskineegish, M., & Jaggard, K. (2019). Imagining University/Community Collaborations as Third Spaces to Support Indigenous Language Revitalization. *Language and Literacy*, *21*(4), 45–67. https://doi.org/10.20360/langandlit29463

Dunbar-Ortiz, R. (2014). *An Indigenous Peoples' History of the United States*. Beacon Press.

Esmonde, I. (Ed.). (2017). *Power and privilege in the learning sciences: Critical and sociocultural theories of learning*. Routledge.

Flores, N., & Rosa, J. (2015). Undoing Appropriateness: Raciolinguistic Ideologies and Language Diversity in Education. *Harvard Educational Review*, *85*(2), 149–171. https://doi.org/10.17763/0017-8055.85.2.149

Framework: Culture, Learning, and Identity. (2020). *Bothell, Seattle, WA & Evanston, Il: Learning in Places*.

García, O. (2020). Translanguaging and Latinx Bilingual Readers. *The Reading Teacher*, *73*(5), 557–562. https://doi.org/10.1002/trtr.1883

Gibbs, G. R. (2018). *Analyzing Qualitative Data*. SAGE Publications Ltd. https://doi.org/10.4135/9781526441867

Gonzales, G. C., & Machado, E. (2022). Taking the Leap: Supporting Multilingual Writers Through Translanguaging. *The Reading Teacher*, *75*(6), 685–692. https://doi.org/10.1002/trtr.2097

González, N. (2005). Beyond culture: The hybridity of funds of knowledge. In *Funds of Knowledge* (pp. 29–46). Lawrence Erlbaum Associates. https://doi.org/10.4324/9781410613462

Goodwin, C. (2018). *Co-operative action*. Cambridge University Press.

Gray, J., & Morton, T. (2018). Social Interaction and Identity. In S. Walsh, P. Seedhouse, & C. Jenks (Eds.), *Social Interaction and English Language Teacher Identity* (pp. 24–35). Edinburgh University Press. https://www.jstor.org/stable/10.3366/j.ctt1tqxv8c.6

Gutiérrez, K. D., Morales, P. Z., & Martinez, D. C. (2009). Re-mediating Literacy: Culture, Difference, and Learning for Students From Nondominant Communities. *Review of Research in Education*, *33*(1), 212–245. https://doi.org/10.3102/0091732X08328267

Gutiérrez, K. D., & Rogoff, B. (2003). Cultural Ways of Learning: Individual Traits or Repertoires of Practice. *Educational Researcher*, *32*(5), 19–25. https://doi.org/10.3102/0013189X032005019

Halliday, M. A. K., & Martin, J. R. (2004). *Writing science: Literacy and discursive power* (Repr). Routledge.

Holliday, N. R. (2021). Perception in Black and White: Effects of Intonational Variables and Filtering Conditions on Sociolinguistic Judgments With Implications for ASR. *Frontiers in Artificial Intelligence*, *4*, 642783. https://doi.org/10.3389/frai.2021.642783

Kimmerer, R. W. (2013). *Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants* (First paperback edition). Milkweed Editions.

Kiramba, L. K., & Oloo, J. A. (2023). "It's OK. She Doesn't Even Speak English": Narratives of Language, Culture, and Identity Negotiation by Immigrant High School Students. *Urban Education*, *58*(3), 398–426. https://doi.org/10.1177/0042085919873696

McCoy, K., Tuck, E., & McKenzie, M. (Eds.). (2017). *Land Education: Rethinking pedagogies of place from Indigenous, postcolonial, and decolonizing perspectives*. Routledge.

Mulvey, K. L., J. Mathews, C., Knox, J., Joy, A., & Cerda‐Smith, J. (2022). The role of inclusion, discrimination, and belonging for adolescent Science, Technology, Engineering and Math engagement in and out of school. *Journal of Research in Science Teaching*, *59*(8), 1447–1464. https://doi.org/10.1002/tea.21762

Nasir, N. S., & Cooks, J. (2009). Becoming a Hurdler: How Learning Settings Afford Identities. *Anthropology & Education Quarterly*, *40*(1), 41–61. https://doi.org/10.1111/j.1548-1492.2009.01027.x

NGSS Lead States. (2013). *APPENDIX H – Understanding the Scientific Enterprise: The Nature of Science in the Next Generation Science Standards*.

Oliveira, A. W., & Barnes, E. M. (2019). Elementary students' socialization into science reading. *Teaching and Teacher Education*, *81*, 25–37. https://doi.org/10.1016/j.tate.2019.02.007

Omogun, L., & Skerrett, A. (2021). From Haiti to Detroit Through Black Immigrant Languages and Literacies. *Journal of Literacy Research*, *53*(3), 406–429. https://doi.org/10.1177/1086296X211031279

OSPI. (2024). *Washington State Report Card*. Washington Office of Superintendent of Public Instruction. https://washingtonstatereportcard.ospi.k12.wa.us

Paris, D. (2012). Culturally Sustaining Pedagogy: A Needed Change in Stance, Terminology, and Practice. *Educational Researcher*, *41*(3), 93–97. https://doi.org/10.3102/0013189X12441244

Park, J. Y. (2013). Becoming Academically Literate: A Case Study of an African Immigrant Youth. *Journal of Adolescent & Adult Literacy*, *57*(4), 298–306. https://doi.org/10.1002/jaal.241

Rahm, J., & Downey, J. (2002). "A Scientist Can Be Anyone!" Oral Histories of Scientists Can Make "Real Science" Accessible to Youth. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *75*(5), 253–257. https://doi.org/10.1080/00098650209603950

Rasmussen, Derek & Akulukjuk, Tommy. (2009). "My Father Was Told to Talk to the Environment First Before Anything Else" Arctic Environmental Education in the Language of the Land. In *Fields of green: Restorying culture, environment, and education*. Hampton Press.

Richardson, T. (2011). Navigating the Problem of Inclusion as Enclosure in Native Culture-Based Education: Theorizing Shadow Curriculum. *Curriculum Inquiry*, *41*(3), 332–349. https://doi.org/10.1111/j.1467-873X.2011.00552.x

Sannino, A., Daniels, H., & Gutiérrez, K. D. (Eds.). (2009). *Learning and Expanding with Activity Theory* (1st ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511809989

Shanahan, T., & Shanahan, C. (2012). What Is Disciplinary Literacy and Why Does It Matter? *Topics in Language Disorders*, *32*(1), 7–18. https://doi.org/10.1097/TLD.0b013e318244557a

Tulalip Tribes of Washington. (2023). *Colors*. Tulalip Lushootseed. https://tulaliplushootseed.com/colors/

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press.

Wei, L. (2022). Translanguaging as a political stance: Implications for English language education. *ELT Journal*, *76*(2), 172–182. https://doi.org/10.1093/elt/ccab083

Wolter, J. A., & Dilworth, V. (2014). The Effects of a Multilinguistic Morphological Awareness Approach for Improving Language and Literacy. *Journal of Learning Disabilities*, *47*(1), 76–85. https://doi.org/10.1177/0022219413509972

Zoski, J., & Erickson, K. (2017). Morpheme-Based Instruction in Kindergarten. *The Reading Teacher*, *70*(4), 491–496. https://doi.org/10.1002/trtr.1542

Appendix A: Partner Word Study Example Worksheet

I designed this worksheet to guide students in embarking on their own word study, based on the structures of our community word studies. I prepared ten different words in English, Southern Lushootseed, Latin, Greek, and Spanish for study.

bioluminescence

Language: English

What do you **notice**?	What do you **wonder**?
Draw or write what this word **reminds** you of. Try to come up with at least 3 ideas!	
How could you break this word apart into **smaller parts**? What do those parts mean?	

Based on your investigations, what do you think this word means?

Appendix B: Environmental Word Study Planning Tool for Educators