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ORIGINAL PAPER

Hard-rooted to nature: rediscovering the forgotten forest in science education

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Abstract
Learners are more disconnected from the natural environment than ever before. Science education occurs predominantly in classrooms and laboratories, settings that rationalize and deconstruct the natural world in a Cartesian–Newtonian paradigm. This often negates humans' relationality and interdependence with other life phenomena and furthermore negates nonhuman agency. I examine the alienation from the natural world in a screen-dominated society, review ecopsychology studies that show the effect of nature on human mental and physiological health, and address the limitations of anthropocentric arguments for reconnecting students with nature. Examples of learning about microbes in a biology laboratory, and the importance of what I call wild fascination, as methods to reconnect with our "forgotten forest" are discussed. Finally, I argue that environmental outdoor education is not only vital to foster an ecocentric ethic, but that it is a necessity for ensuring a sustainable future for the biotic community.

Keywords Nature experience · Environmental education · Anthropocentrism · Ecopsychology · Science education

Résumé
Les étudiants sont de plus en plus disconnectés de l'environnement naturel, davantage que par le passé. L'enseignement des sciences est présent surtout dans les classes et dans les laboratoires, des milieux qui rationalisent et démantèlent le "milieu naturel" dans un modèle Cartésien et Newtonien. Cela invalide souvent la relationalité humaine et interdépendante avec d'autres phénomènes vivants, et de plus, invalide les organismes non-humains. J'examine l'aliénation de l'univers naturel dans une société dominée par l'écran, une étude critique éco-psychologique qui démontre les conséquences de la nature pour la santé

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mentale et physiologique de l'être humain. Des exemples d'études en laboratoire de biologie sur les microbes, et l'importance de ce que je nomme, "fascination sauvage," comme méthodes de reconnecter avec "la forêt oubliée," sont à l'agenda. Finalement, j'argumente que l'éducation de l'environnement de la nature n'est pas seulement vitale pour favoriser l'éthique éco-centrique, mais que c'est une nécessité pour garantir un futur durable pour la communauté biotique.

Hard-rooted to the natural world

Our brains are hard-rooted to nature. For most of our evolutionary history, *Homo sapiens* led lives permeated by the elements. Our food was hunted or gathered and handmade shelters kept us dry. The stars filled our eyes with soft fascination. Humans followed the phases of the moon with the same familiarity we now dedicate to smart phones and Twitter feeds. Our senses, too, were suffused by the natural world. We smelled petal and pine and awoke to birdsong. In David Abram's words, "For almost all of our cultural evolution, we humans lived as hunters and foragers in a thoroughly animistic context, negotiating rich and often difficult relationships with myriad facets of the multiplicitous surroundings" (Damery 2013, p. 117).

My adult students frequently refuse to pick up pine cones from the forest floor, for fear they are "dirty," and are sure to wipe this away "with assistance from marketers in the business of selling us antibacterial wipes, sprays, gels, soaps, and liquids" (Selhub et al. 2012, p. 160). Our urbanized shift, biophobia, and bacterial fear, further compounded by COVID-19, compel us toward sterility. We are disconnected from the wildness both outside and inside our bodies, a wildness that connects us to a forgotten forest whose lessons are imperative in our current climate of ecological turmoil. How might we experience this forgotten forest? We can remember our own wildness within, engage in immersive nature experience, and through careful attunement with our natural environment the other-than-human members can become active collaborators rather than a diversion or a backdrop.

First, I consider the dominance of indoor, screen-based environments. Ecopsychology studies show the vitally nurturing effect of nature on human mental and physiological health, emphasizing the need to learn outdoors. Second, I attempt to undermine anthropocentric arguments for reconnecting students with nature, and instead promote a pluralistic ecocentrism. How is science anthropocentric? How can we embody our own ecology? How can place and pedagogy be braided together, so that nature becomes a teacher? Reductionist, detached, and human-centered science pedagogy can alienate learners from place, and the larger biotic community, rather than build relationship. Two examples of connecting with the forgotten forest will be outlined. First, the *inner* forest of learning about the microbes that make us who we are and, second, the *outer* forest and the importance of active and intentional nature experience, what I call *wild fascination*, are discussed. Multiple modalities, including photography and poetry, are incorporated to address the crisis of representation and afford alternative engagement with the more-than-human world beyond staid prose.

Finally, I argue that nature-based science is not only vital to fostering an ecocentric ethic, but may be necessary to maintain ecological integrity. Clinical psychologist Anita Barrows (1995) asks us: "What if, from the beginning of life, nature were perceived as teacher, guide, source, as important to us as our families? How differently would we live?" (p. 110). Outdoor learning not only optimizes physiological health, but in conjunction with

a strong sense of place, as well as a mindful and learner-centered facilitation, might influence a way of being in students necessary for a shift toward ecocentric practices and ecological preservation.

At this juncture, some definitions are necessary. Nature is a broad term and cannot be separated from culture (Plumwood 2009), making a strict definition problematic. *Wilderness* is a more specific term, and for my purposes I use the definition put forth by *Wild Pedagogies* (Jickling et al. 2018): "wild places can be characterized in part by an emergent will of its inhabitants to realize their own ends…a place where there is freedom to flourish" (p. 27). In relation to education, *wild* learning is not lack of control or reckless; rather, it is a place for wonder and inner wildness that may actually promote self-regulation, since "with freedom like this comes responsibility to oneself, to others, and to the learning project itself" (p. 66). I should note here that my use of the word *wonder* is not simply a synonym for curiosity; rather, wonder is connected here to mystery, awe and thus admiration.

Creatures of indoor habit

Only recently has our species become indoor-based, sheltered in our screen-dominant, temperature-controlled comfort. In the late 1990s, one study approximated that Americans spent 10% of their life outside buildings (Evans et al. 1998). Another study found that, over one generation, free-roaming territory of children decreased by roughly 90% (Hillman et al. 1990). The average adult from the USA now spends more time in cars than in nature, less than 5% overall; therefore, it is little surprise that depression, obesity, and nearsightedness are becoming increasingly commonplace (Williams 2016).

Many Westerners have heard the stories: How our grandparents or great-grandparents used to play outside from dawn to dusk, whether in vacant city lots or along frozen rivers. Persuaded by their parents from an early age to be outside without supervision, they explored with their immediate senses—waded through streams, smelled the manure or spring blossoms, and told time by the shifting sunlight. My grandma grew up in northern Saskatchewan; her mother used to yell at the kids not to go down to the river because bears were about. Yet that's exactly where the kids went, bolstered by curious excitement that eclipsed their fear. Not long before she died, my grandmother told me the following story, which featured in an exhibition I co-curated at the Museum of Vancouver, called *Wild Things: The Power of Nature in our Lives*:

> I was running to the river when it happened. No more than 12-years-old, I remember stopping in my tracks. The sky had opened, and the rain fell in a dark sheet. Where I stood it was dry, yet in front of me rose a wall of water. I could see the *edge* of the rain. Amazed, my brothers and I ran in and out of the rain over and over again. It had never occurred to me that the rain has a beginning and an end. (Norma Carson)

Some parents and students perceive recess or other outdoor experiences as frivolous play; in reality, as Leo Buscaglia contends, "It is paradoxical that many educators and parents still differentiate between a time for learning and a time for play without seeing the vital connection between them" (Paterson 2010, p. 94). Modern society favors walls over trees as the environment for learning: More controlled, less distraction, and (for many) the digital clock and corporate brands are more familiar than moon cycles and local plant species (Kahn et al. 2002). In this way, nature and its wonder "disappears

into the background as unimportant, not worthy of our attention and whole ways of making sense of the world are lost" (Snowberry et al. 2010, p. 53).

The demands of modern life—screen-based work and play—mean that "in our brave new technology-rich world, we are more likely to be stressed out, anxious, depressed, distracted, and less inclined to embrace benefit-rich natural environments than ever before" (Selhub et al. 2012, p. 36). A study (Park et al. 2010) of Japanese Shinrin-yoku (forest bathing) reveals that, compared to city environs, short forest walks reduce stressful hormone levels, decrease pulse rate and blood pressure, and promote our parasympathetic nervous system—all of which cause us to feel less "anxious, depressed and distracted."

We have quantified numerous nature benefits, including for education: Students perform better on tests when they have a view of the natural world (Li et al. 2016). Even ten minutes of walking or sitting in natural environments produces a measurable positive impact on physiology and psychology for college-aged students (Meredith et al. 2020). Further, exposure to greenspace is linked to myriad health benefits (Twohig-Bennett et al. 2018). Living in proximity to an urban park, even if you never visit the site, correlates to healthier and longer lives with decreased incidents of fifteen major diseases and conditions (Williams 2016). Although correlation does not equal causation, health benefits are clearly seen, even when adjusting for education, employment and income. Proposed mechanisms are "psychological relaxation and stress alleviation, increased physical activity, reduced exposure to air pollutants, noise and excess heat" (WHO 2016, p. ii). The multisensory immersion of proximate nature experience (Fig. 1) offers a large suite of positive cognitive and physical responses.

This raises the question: What qualities of the natural world make us feel less stressed and more restored?

Fig. 1 A spontaneous moment at Georgina Point, Mayne Island, Canada

Soft fascination

"When removed from contact with nature, human beings are missing out on a critical type of rest" (Bratman et al. 2012, p. 124) not offered by instant messaging, Netflix, and Twitter (all media I admittedly use). Wild nature experience can remind us of our humanimality (Freeman 2010), "which supports a more humble and holistic view of humans as fellow animals" (p. 25). Ecopsychology, a term coined by historian and scholar Theodore Roszak (1992), examines the influence of nature on our psychology and physiology. One of the leading theories of the restorative effect of nature is the attention restoration theory (ART), the premise being that "the overwhelming evolutionary experience of human beings as a species involves natural environments, and we are therefore predisposed to resonate with these surroundings, consciously or not" (Bratman et al. 2012, p. 121). Unlike the stress reduction theory (SRT), which proposes that nature stimuli reduce our stress, as shown via physiological response, ART focuses on cognitive responses. Nature experience, ART contends, allows us to replenish our attentional resources.

Nature is a restorative environment. One of the states of attention that leads to restoration is soft fascination. Natural environments provide ample opportunity for soft fascination, experiences that can be healing, revitalizing, and cultivate reflection with little to no effort. From the dawn chorus, or cloud watching, or a murmuring stream, we can regain the ability to focus and concentrate, or "recover the capacity to direct attention" (Joye et al. 2013, p. 2). The distinction between hard and soft fascination is clear: The former are stimuli—including neon signs, an explosive landslide, or interminable Zoom meetings—that might provoke emotional distress, negative responses and/or require concerted attentive effort, while soft fascination involves leaf patterns (Fig. 2), unpolluted (by sight, sound, chemical or otherwise) environments, and ecosystems that are rich and healthy in their complexity. My focus at the moment is on ART as it relates to soft fascination, heightened attunement, and what I call *wild fascination,* although I return later to the role and significance of risk.

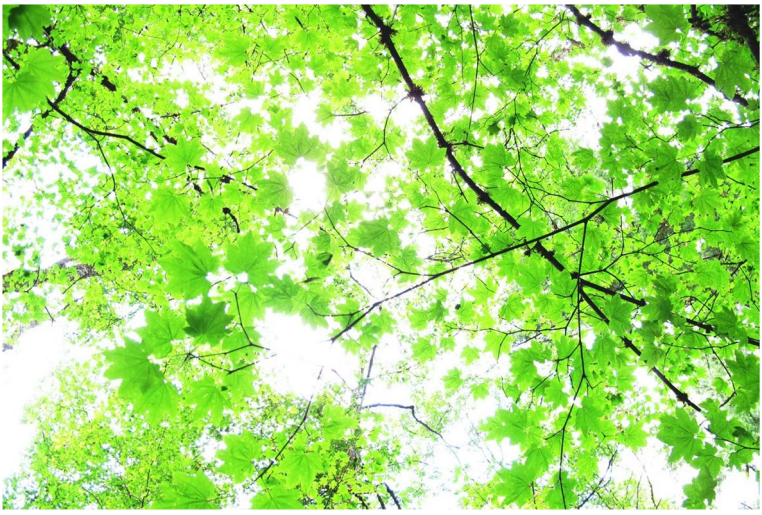

Fig. 2 Vine maple *Acer circinatum* leaves in Surrey, British Columbia

Nature fascinates and focuses attention. Three core attributes of fascination from the natural environment (Joye et al. 2013) are: (1) positive and relaxing affects, (2) little or no effort required to pay attention to (later, I argue that active attention is important), and (3) other distracting phenomena are superseded; in other words, nature steals your attention in a harmonious way. These three core dimensions draw in human attentiveness, reduce brain fatigue, and lift our moods. The following poem elucidates the concept of soft fascination.

Animal Mind

the pulse that runs through the forest
I can't put my finger on it
the presence of the panther
the eagle that glides into memory
the wilderness that undulates through me
softens my veins in savage waves

what does this place offer?
such effortless enrapture
inspires me into stillness
without script or big screen

is it the symmetry
of sword fern fronds
the slow metamorphosis of cloud
a shape whose phantom wanders
I follow to no end

I am held captive
by the composure of trees
65 million leaves on a Douglas-fir
each green shard
attunes the animal in me

or is it the perfect language of birds?
songs that weave my forms together
a river's immortal murmur
is this not my mother's womb?

here I am full
in rhythm with the raven
each wingbeat fills my heart
with a soft fascination
that senses its ancient relation
to roots that hold me
in this wild abandon

Natural environments have just as many (if not more) stimuli than urban landscapes. Their subtle quality compels us to focus with less anxiety, while there is a loss of sensual nuance in high-density urban environments. Concentrated humanity requires voluntary (and involuntary) effort to block overstimulation. Although the causality of

nature-induced benefits is not well understood, the benefits to physiology and disposition, as well as cognitive faculties, are clear. So what does this mean for education?

Avoiding the anthropocentric argument

The easy argument: Students should spend time outside to keep their brains healthy, avoid depression and obesity, and sharpen mental acuity. This is valid, but neglects all nonhuman elements. To change our culture that disregards and denigrates the other-than-human world requires an alternative paradigm that extends ethics to the environment (Leopold 1949), cultivates reciprocity and responsibility toward nature (Kimmerer 2013), and utilizes ecologically informed stories and metaphors to inform this new narrative (Abram 1996).

I contend that human-nature-culture, and the way Western thinking conceptualizes land as property with an extractive-exploitative model, will shift only if we adopt ecocentric principles into education. This includes reducing the focus from human capital discourse (e.g., career success) and underscoring place-based education and ecoliteracy. Ecocentrism is a nature-based philosophy that places inherent value on the natural environment, and thus all living organisms. Alternative philosophic frameworks include multicentrism and counter-centric (Weston 2004). These decenter the human, are less hierarchical, and promote a diversity of centers. My focus on ecocentrism imagines the ecological world as the literal source of life, with humans a peripheral organism that exists only because our ecology (from the Greek *oikos*, meaning the study of our home) is healthy. We should be cognizant of Anthony Weston's critique in two ways: (a) that ecocentrism creates a new binary, and not fall into thinking of humans as separate from their ecology, and (b) that we need to "reverse the usual burden of proof" (p. 31) and assume that nature is an active agent with inherent value.

"Undeniably, our view of the relationship between humans and nature determines the attitudes we develop and the environmental policies we adopt" (Barberán et al. 2016, p. 25), not to mention the actual relationships that we cultivate, and therefore schools and universities can play a pivotal role in how we are cultured in Western society's petri dish. This is a substantial challenge. Such educational models should "resist and disrupt conventional teaching (hierarchal, authoritative, detached, individual, and anthropocentric) and move closer to foregrounding our interdependence with the outside world" (Snowberry et al. 2010, p. 59). Key curricular components would include direct sensorial engagement with nature, an environmental ethic framework that considers nonhumans as moral beings, and a reciprocal approach to learning both from and with nature, such as Goethe's delicate empiricism (Beavington et al. 2018).

What I propose is not a linear behavioral shift—environmental knowledge leads to environmental awareness leads to pro-environmental behavior (Kollmuss et al. 2002)—in individuals resulting from environmentally informed pedagogical practice, but a dramatic re-envisioning of educational institutions in terms of place-based, nature-allied ecocentrism. Since "ontology (how we understand the world to be) and ethics (how we relate to and act on the world) are intimately related" (Bai 2015, p. 137), we need to strive for both an ethical and an ontological shift.

Scientific anthropocentrism and Goethean science

The privileging of mind over body in Western science promotes a nature-human dualism and desensitization from nature (Bai 2012). The scientific method necessitates a detached observer that objectifies life phenomena under study, and for good reason. This approach minimizes bias and gathers data on medical, technological, and numerous other faculties. However, the prestige of verifiable and neutral data suppresses relational connotation. Western science has its place, and its limits, but issues arise when it is posited as the only (read: correct) worldview.

Scientists' measurements do not include the measurer. Francis Bacon (1902) wanted science to be divested from philosophy, and believed knowledge was derived from power over nature. As explained by Pierre Hadot (2006), Johann Wolfgang von Goethe "contradicts Francis Bacon, who sought to force Nature to talk under the torture of experimentation. For Goethe, rather than talk, 'Nature keeps silent under torture'" (p. 149). To torture nature—through vivisection, extractive studies, or the use of fetal bovine serum (Beavington 2019)—is to silence the natural world. The delicate empiricism of Goethean science "makes itself utterly identical with the object" (Goethe 1988, p. 307), so that nature is to be revered, appreciated, and attended to with admiration (Rose 2021).

Goethean science (Holdrege 2005) includes (1) *The Riddle*, where you ask questions and observe the phenomena, (2) *Into the Phenomena*, with a deeper exploration to "gain a many-sided picture of the life of the organism and its relation to its environment" (p. 48), (3) *Exact Picture Building*, using imagination and "mental molding and remolding" (p. 50) to integrate your direct experience and keep close to the phenomena, and (4) *Seeing the Whole* where you realize the wholeness and relationality of the phenomena that "brings us full circle to a more conscious glimpse of the being" (p. 51). As Brent Robbins (2005) acknowledges, "the observation of nature is always also a process of self-discovery" (p. 125). In this way the scientist, through reciprocity with the phenomena under mutual study, is also changed or even transformed. Nature becomes our teacher.

The dominant pedagogy in post-secondary science, as Jeffrey Coker (2017) elucidates, is the lecture-laboratory model, which facilitates an abstract and disconnected experience for learners with (in relation to lecture) low knowledge retention. The subject-object relationship is a one-way street. Conversely, Coker describes place-based learning as "authentic interactions within a local community or natural environment" (p. 73) that promotes learner agency and real-world relevancy.

Conventional science education lays down numerous assumptions. Human objectivity, one path to truth, and using laboratory animals with little to no moral regard beyond instrumental value, are part and parcel of this indoctrination. Ben Spiecker (1987) contends that "Doctrines persist by virtue of certain non-critical attitudes. It is this second necessary condition that prevents us from speaking about 'indoctrination of students in science and mathematics'" (p. 262). If we learn science, but never question Western scientific frameworks and methodologies, we may inevitably hold to this single lens of perceiving and being in the world. Can place-based, holistic-minded pedagogy cultivate reverent, responsible, respectful learners? If we want to develop an eco-holistic, relational, and reciprocal responsibility, the atomistic scientific methodology needs to be shaken and diversified. We need to reevaluate our anthropocentrism, contemplate and implement an environmental ethic, and engage in intentional outdoor learning that blurs the nature/culture divide. One path toward this reality is practicing Goethean science, and another is connecting with our ecological physicality.

Inner forgotten forest: embodying our own ecology

Feminist scholar Val Plumwood (2002) argues that an extensionist model of broadening the ethical umbrella is at odds with an ecological worldview, since it still promotes a hierarchy and centering of ethics that devalues nonhumans. A multispecies ethical framework, with a pluralistic ontology whose foundation is built upon an interdependent and symbiotic perception of the world and its inhabitants, is more akin to an ecological worldview. Nature is part of us. The breath of leaves is our breath, the food we eat interpenetrates our cells, and the bacteria in our intestinal flora is integral to our psychology and physiology.

In environmental education, or more to the point, *education*, to help elicit passion for flora and fauna—and the biosphere at large—it is critical for students to be immersed in sensorial experiences. Outdoor field study steeped in relational and reverential experience can do this (Beavington et al. 2021). Another approach is to engage with our microbial selves.

Nature as kin becomes an extension of our bodies. "Wildness (as opposed to wilderness) can be found anywhere: in the seemingly tame fields and woodlots of Massachusetts, in the cracks of a Manhattan sidewalk, even in the cells of our own bodies" (Cronon 1995, p. 19). Can we look more closely at our cellular makeup? (Important to keep in mind: In an anthropocentric world, looking at ourselves can mire us in ego and hubris, perpetuating the hegemony over nature.) Of the estimated 10–100 trillion cells that comprise our body, more than half of these are bacterial (Sender et al. 2016). The human body is not a single organism, but a bionetwork of tens of thousands of different species. Here, the microscope becomes a vital tool in self-study. Through this lens (Fig. 3), we see who we are: the microbes that enable us to digest food, synthesize vitamins, and regulate our immune systems (MacPherson et al. 2004). I have somewhat vilified technology in this paper, yet the usage of the right tool can evoke wonder and help us transform the singular human story into a mutualistic and interspecies worldview.

The consistent "lack of awareness of microbial life often represents an important gap in our world view of nature" (Barberán et al. 2016, p. 23), and hence there is an opportunity to construct a new narrative that blends the "microbial" and "macrobial" ecosystems. The typical student response to microbes: "yuck" or "gross." When they recognize that their knowledge is incomplete, opportune questions arise: What comprises a human

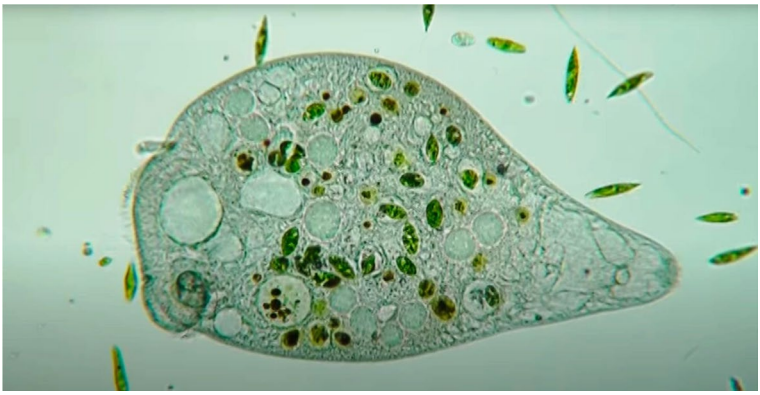

Fig. 3 Various protists viewed under 100X magnification

body? How are we inseparable from microbes and nature? What gifts do they offer us, and what gifts can we offer them?

At Kwantlen Polytechnic University (KPU), where I teach biology, including first-year laboratories, students sample bacteria and fungi and culture them on a petri dish. Over the course of a week, microbe colonies grow to a size visible to the naked eye. This reveals the presence of microbes on their cell phone, fingernail, or shoe—they select the source—yet does it foster a sense of connection or interrelation?

What if the microscope became an instrument for wonder, where students swabbed their own cheeks for cells (rather than using premade squamous epithelial slides) and then told the story of these cells? As Thomas Berry (1999) describes, "Through these instruments of observation we enter profoundly into the most hidden realms of phenomenal existence itself while at the same time these hidden realms enter into our own minds. It is a reciprocal relationship" (p. 81).

Our bodies possess a forgotten forest of microbial ecosystems, with specialized niches found throughout our intermingled human organism. Nature not only exists *on* and *in* our bodies, we *are* nature. Every organism is part of a pulsing, breathing web—an interdependent, interconnected, spiritual entanglement. Recognizing, understanding and appreciating this invisible majority could lead to a significant shift in worldview, one that necessitates a pluralistic ontology, because we are pluralistic organisms. What do our cells have to say to us? Instead of an explicit focus on taxonomy and morphology, learners could reflect on the tens of thousands of other species that live as part of us, contemplate a single bacterium's life inside our body, and even practice gratitude. The hopeful result? Reverence, humility, and a sense of connection.

This activity is easily transferred outdoors. Students can be given a hand lens to study a small patch of dirt. Beneath the twigs and leaves the slow seeker will find millipedes, sow bugs, and nematodes. Even bare dirt is crawling with life: A mere thimbleful holds a hundred million bacteria, and nearly 10 km of fungal hyphae (Luoma 1999). As Raimon Panikkar (1996) affirms, "No ecological renewal of the world will ever succeed until and unless we consider the Earth as our own Body and the body as our own Self" (p. 56). To be outside, unearthing these hyphae of the wood wide web (Simard et al. 1997) can help change the student's orientation such that the earth becomes part of their Self. When I asked Suzanne Simard about having learners connect with local forests, she emphasized looking for details, digging in the soil, and training your eye to spot differences. She also commented: "We are covered in a food web!" (personal communication, March 21, 2021). Let us consider an example of interconnection. Trees communicate via mycorrhizal fungi on their roots, while their branches provide nesting sites for the varied thrush, which feed on earthworms and eat seeds, and poop out these seeds with fresh nitrogen and phosphorus that allow for plants to grow in soil made fertile by voracious earthworms and nitrogen-fixing bacteria. Whether the human body or the forest, microbes are the fundamental ingredient.

Sean Blenkinsop (2005) explains that "there is an ecological relationship in which we are immersed and that this relationship, although often unseen and unacknowledged, is fundamental to our humanity and to education" (p. 303). Microbial organisms, often unseen and unacknowledged, dominate the Earth. All plants and animals harbor microorganisms as a matter of course, and these so-called primitive prokaryotes usually prove essential for any eukaryote's survival. Microbes sustain "global-scale ecosystem services such as carbon sequestration, decomposition, nutrient recycling, and water purification" (Barberán et al. 2016, p. 25). While some microbes are pathogenic, riveting our focus to microbes as germs, the vast majority of microbes are neutral or beneficial

to humans. Before we consider the outer forgotten forest, let us ponder on place and pedagogy.

Nature as a classroom and urbanized assumptions

Where we live and learn shapes our social-cultural-ecological selves. Can an outdoor classroom promote an ecocentric worldview? Not by itself. Today, most students live in an urbanized technocracy with sedentary lifestyles steeped in screen time. The data are startling: Nearly eight hours a day are spent on screen-based devices by 13–18-year-olds (Rideout & Robb 2019), while children spend less than half an hour a day on sports and outdoor play (Juster et al. 2004).

City dwellers should not be neglected from environmental education. Remote wilderness is are not available for most learners. Many schoolyards have grass, trees, and certainly a sky with cloud; while these offer innumerable opportunities for learning and engagement, we as environmental educators need to be aware of the "cultural veils [that] lie between our students and genuine encounters with that urban wild" (Derby et al. 2015, p. 380). As Mary Wells (2017) contends, "We are reared to fear the natural and covet the artificial" (p. 166), which may explain many of my students' refusal to pick up a pine cone with their bare hands.

However, by "refusing to take a critical stance when educating in such environments, we risk sliding along a slippery slope toward passive acceptance of the dominant modes of urbanization—the strip mall, the big stores, and the sprawl—as 'inevitable'" (Derby et al. 2015, p. 384). Students cultured from a young age in a consumer-capitalist cityscape may find little meaning or value in the wilderness, and may not challenge this urbanized assumption, reinforcing their "privileged anthropo-center" (p. 387). "As biophobics," states Wells (2007), "our focus is not on life and the natural course of life; instead we focus on our immediate selves and maintaining control of our surroundings often in utter disregard for what consequences our actions may have in store for us and our environment" (p. 166), which sounds like an apt description of a shopping mall.

Concurrently, we best not assume that learning outdoors instills an environmental or sustainability ethic. While nature experience may encourage positive attitudes toward conservation (Zaradic et al. 2009), "an anthropocentric worldview is not an appropriate place to base a curriculum theory for environmental education" (Blenkinsop et al. 2009, p. 91) because it remains an instrumentalist, human-centered view. Imagine learning about land as teacher via PowerPoint, or how to respect and honor sea stars by dissecting them. Nature as a classroom—experiential, sensorial, interdisciplinary, reciprocal—is a vital component of ecocentric pedagogy, but the teacher's philosophical approach and assumption-based hidden curricula (Beavington 2016) are of equal import. In reference to place-based learning, Owen-Smith (2017) conceives of "the learner as an experiencing, thinking, and feeling human being, one with an exterior *and* interior self" (p. 24). Having explored the interior self, we will now consider the external.

Outer forgotten forest: wild fascination

Immersive nature experience focuses and attunes our attention. Yet co-existent with the wonders of the natural world are poison, thorns, fangs, and disease. Some arthropods are decapitated by a post-coitus mate, or even become a host inside of which insect eggs hatch

and grow. Are such unreasonable acts and assaults on human values to be rejected? Or is there a lesson hidden somewhere in the mad consumption and reproduction of the natural world? We can easily romanticize nature into a relaxing paradise. But we can just as easily see the wilds as wholly separate from us, a bug-ridden, disease-infested world ruled by tooth and claw where civilized humans have no place. Neither view, I believe, is accurate. The natural world is a place where wonder and terror collide, and both are integral to our existence, for nature "demands a response that rises from the wild unconscious depths of the human soul" (Berry 1999, p. 55).

We don't want to embrace a romantic view of nature, nor should we negate the dangers. To do either is the privilege of the detached Western way. Many Indigenous communities do not have a word for wilderness or nature, because that kind of separate place doesn't exist. Berry (1999) explains that "We misconceive our role if we consider that our historical mission is to 'civilize' or 'domesticate' the planet, as though the wildness is something destructive rather than the ultimate creative modality of any form of earthly being" (p. 48). As Thoreau asserted in his pivotal essay, *Walking*, "The most alive is the wildness. Not yet subdued to man, its presence refreshes him" (Emerson & Thoreau 1991, p. 97) with what ecopsychologists now call soft fascination. On the spectrum from tame to wild, using examples with which I have experience, we might have poodle…St. Bernard…wolf, or car…e-bike…trail walking, or desks in a classroom…specimens in a lab…overnight hammock camping in the Amazon Rainforest.

In contrast, hard fascination stems from frenetic cities, dramatic environments, and screen-watching. This type of interaction "precludes thinking about anything else, thus making it less restorative" (Kaplan et al. 2010, p. 49) and includes "watching violence, sex, and intense competition" (p. 49). Soft fascination is following the shadows of songbirds under a sunlit canopy, while hard fascination is a departmental Zoom call where everyone is speaking and no one is muted.

Here, I would like to introduce a new term, *wild fascination*. Unlike the docile effect of soft fascination, where the subject is gently restored by the environment's positive influence on their health and mental acuity, wild fascination is an active state of heightened focus and creativity in the wilderness. Examples of this dynamic relation include rock climbing, kayaking, off trail hiking, and other highly engaged and intently focused activities. The intention of the participant holds utmost importance, approached in a reverential and respectful manner. This preparatory mindset can be mediated through ethnobiological studies, Indigenous worldviews, and/or contemplative practice. This is not the thrill-seeking of bungie jumping or sky diving. Wild fascination is an intermediate state dwelling between passive homeostasis (physically and emotionally safe) and fight or flight (acutely distressed), where moments of silence, receptivity, and attunement all play a role.

Risky play outdoors for children have shown to positively effect risk detection, as well as independence, self-esteem, social health, motor skills, and conflict resolution (Brussoni et al. 2015), and it is reasonable to extrapolate similar benefits for adult learners. As David Abram once told me, "When there is risk, our bodies wake up" (personal communication, July 17, 2017). Wild fascination is a physical, cognitive, emotional, and spiritual journey that recognizes the importance of risk.

Those intimate with deep wilderness may be familiar with what I speak. For decades, my father and I followed a long-standing tradition and hiked up a mountain stream of suitable size, not small enough to be utterly brambled, nor wide enough to render foot passage impossible. As we scramble upstream long stretches of time pass without words. Sweat and blood (although not required) from exertion and scrapes are not deterrents, they bring forth an elementary, ecological aliveness. We jump between riparian stones, clamber sharp

ravines, and scurry across log bridges. Wild fascination is akin to what Chris Beeman and Blenkinsop (2008) describe as meander knowing: "a lateral breadth of awareness and an attunement to the unexpected and rationally unexplained intuitive mode of knowing" (p. 21) which is "not will-directed but receptive…It is not instrumental, but derives its purpose from the act of engagement with the more-than-human world" (p. 22). Each step demands presence and care to avoid slippery rock, current, root, or crevice, yet our eyes linger more often on surroundings. This is a practiced affair. We are on the lookout for wild wonder (Fig. 4)—walls of maidenhair fern on wet cliff faces, sun-ripened salmonberry yet to be found by birds, cedar bark clawed by a creature unknown—as well as wondrous risk—sheer precipices, a wandering bear, or barbed devil's club (devil's club is actually a principal medicinal plant to Indigenous peoples of the Pacific Northwest; Lantz et al. 2004).

In this heightened state, we hold a profound yet relaxed focus, what one might call a Goethean scientist's state of receptive attunement. And while no immediate danger is present, there is always the *possibility*. This rarely brings a sense of fear or anxiety (at least not for my father and me) but rather an alertness and lucidity with the wholeness of nature. In education, cultivating this level of nature attunement may take days, weeks, or longer. Cultural norms regarding biophobia (often inculcated at a young age; Wilson 2012) and nature deficit means both learners and time to attune will vary, an important consideration for the facilitator of learning.

Hazards can take on more threat than feels comfortable. There is a certain degree of real danger. Such a state of adrenaline, anxiety, and adventure should not be perpetual, yet such wilderness quests are important reminders of the wildness in our hearts.

We need only compare these upstream wilderness journeys to the introductory biology field trip at KPU (the only time these biology students learn outdoors their first year, and it's optional), where students must sign liability forms in order to take a *walk in the park*. The fact that most of my students, from an urban population, indicate that this is the first time they have walked through a forest, is only the tip of an extraordinarily deep iceberg. For my part, I always ensure I take students off the path, into an area with some small semblance of the wilderness, so they might encounter the forgotten forest. The concern is the depth of cultural urbanization, where wild fascination has been supplanted by violent films, pornography, extreme competitiveness, and other types of hard fascination that do not offer restoration or reflection. As Robin Wall Kimmerer outlines, "I think that much of higher education today, and I would particularly call out STEM education in hyper-scientific

Fig. 4 My dad (left) during one of our hikes where we follow a mountain stream (right)

institutions, is still profoundly assimilative, because of the intense privileging of Western ways of knowing, to the point of marginalizing other ways of knowing" (personal communication, March 26, 2021). If we want our learners in the natural sciences to better understand the climate crisis, biodiversity collapse, and environmental degradation (and therefore their eco-holistic selves, integral relationship with their local ecosystem, and a sense of care for the natural world), wild fascination can afford such an education.

Cultivating relationship

In the history of humankind, the other is misconstrued—other cultures, other races, other genders. As we continue forward with reconciliation, inclusiveness, and intercultural development, we hopefully become less inclined to discriminate against and bring these other beings harm. The industrial-exploitative model renders the natural world voiceless and inert. When there is a dearth of nature contact, we look elsewhere to fulfill our sensuous needs—Snapchat, Instagram, Amazon Prime. As Abram argues: "we're stuck trying to satisfy all of our craving for otherness—our organism's ancient need for sensuous contact and interchange with the more-than-human earth—we're stuck trying to satisfy that deep longing entirely through our human relationships" (Damery 2013, p. 116–117).

Plants are others. Consider the licorice fern, *Polypodium glycyrrhiza,* whose fronds dangle from the branches of bigleaf maple. In order to come into being and thrive, this pinnate plant must undergo a series of both airborne and sessile adventures. Most of us are unaware that ferns—all plants, in fact—possess two distinct life phases: the spore-producing sporophyte, and the gamete (egg and sperm)-producing gametophyte. When you walk through the forest you commonly see the large sporophyte phase, yet the gametophyte fern is scattered throughout the forest as well, its tiny flattish leaves easily confused with moss or liverworts.

In telling the licorice fern's story, the starting point is arbitrary; I will begin with the spore. Born on the underside of the sporophyte leaflets (Fig. 5), spores take an adventitious journey on the wind currents in hopes of finding suitable calcium-rich substrate for germination. Perhaps one in a million will succeed. The handful that find a patch of soil on, say, a moss-strewn maple branch are reliant on this tree standing upright, on the rain, and enough detritus falling into that soil patch to keep them moist with minerals. Each microscopic spore divides and grows into a gametophyte, which produces sperm in a tiny club-shaped organ called the antheridium, which must *swim* to an egg found in the archegonium. This is no simple task. Sperm requires liquid to be motile, and even then, this flagellated single cell travels exceedingly slow by mammalian standards. Should fertilization occur, this will become an embryo that grows into the dominant sporophyte phase. This "adult" fern contends with space competitors such as epiphytic moss, squirrels scampering over its single frond, hungry insects, floating fungus and other pathogens, not to mention human developers. Its very presence is, in many ways, miraculous.

Is this story enough to instill a sense of kinship with the licorice fern? Arne Naess felt compassion and empathy for a flea that had jumped into chemicals on a microscope slide; can the same happen for a plant or bacteria? Maybe not, but it's a start that needs to be layered with other experience. Direct sensorial engagement can help cement this relation, while Goethean science (outlined previously in this paper), where students enter a state of "receptive attentiveness" (Brook 1998, p. 56) and receive from the fern, offers further connection. An arts-based project where students reflect on their experience (Blades 2016)

Fig. 5 The underside of a licorice fern frond showing the clusters of spores. The scientific name, *Polypodium glycyrrhiza,* means "many footed" in reference to their licorice-tasting creeping rhizomes

might cultivate an even deeper reciprocity, since Western science is more attuned to the mind, while art can better capture the heart.

Being in wilderness compels us "to be humble and attentive in ways that seem more rare in an urban setting" (Derby et al. 2015, p. 385). The restorative power of nature lies in its capacity to capture our voluntary and involuntary attention. So, while our attention is being held, the soft fascination that holds our attention does not require effort, which gives us an opportunity for reflection (Aspinall et al. 2015). Such reflection is vital for learners, as it allows time for integration, to soak up nature's senses, have creative insight, and ponder on what role the learner will play in this world. Wild fascination provides a path toward questioning dominant norms, such as the norms of the culture in which we were raised, a culture that may have abstracted the natural world into a separate and lesser entity. There is little questioning humankind's radical oppression of the natural world. Paulo Freire (1996) wrote that to regain our humanity requires "a pedagogy which must be forged *with*, not *for*, the oppressed" (p. 30). The invitation here is to forge a nature-based pedagogy in collaboration with the natural world.

When we are present and attuned to the forest, then "Small events bec[o]me sources of excitement—an ant crawling up a blade of grass, a flutter of motion produced by a breeze, a shifting of light, the crossing of a cloud shadow" (Sullivan 2000, p. 223). When students hear the collective rustling of billions of leaves, a bee nestled inside a flower's corolla, or the sharp down stroke of a raven's wing, they might say, in the words of Buddhist Thich Nhat Hanh, "Listen, listen; this sound brings me back to my true self" (as cited in Nachmanovitch 1990, p. 93). As an educator, the conditions to create such possibilities include: spacious intentionality, an invitation to engage beyond the cognitive faculties, and a reversal of emphasis from grades and learning outcomes to learner-centered facilitation and more authentic assessment. Giving students time to linger with the forgotten forest, their ability to focus enhanced by soft fascination, allows nature to work its mysterious yet captivating hold on us, and opens a window toward a holistic world of interconnection.

Concluding thought

The current state of our species is one of turmoil and transition. Alongside (or perhaps because of) the ecological devastation being enacted upon our air, water, soil, forests, and oceans, many human societies are saddled with poverty, hunger, fear, terrorism, and war. Our ancestors "were not dealing with the adjustment to disruption and even the termination of a geobiological period that had governed the functioning of the planet for some 67 million years" (Berry 1999, p. 10). Nature is the foundation of our existence, the air in every breath of plant, animal, and bacteria, the skin of our bodies and that of the Earth, the river veins that carry fluid from mountain to ocean and heart to limb. Without the natural world, humankind becomes inevitably extinct, and the bacteria reclaim the world that is already theirs.

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