

Revitalizing Natural History Education by Design

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Responding to Trombulak and Fleischner's (2007) call for a natural history renaissance, this paper explores how we might better design learning environments that are potent, transformative, and connective, and that ultimately deepen one's practice of natural history. We offer eight design principles that are inspired by the study of living systems and distilled from the shared wisdom of many generous educators, mentors, and facilitators, intended to support a growing movement to revitalize our approach to designing natural history education.

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“H. G. Wells had it right when he said that we are in a race between education and catastrophe. This race will be decided in all of the places, including classrooms, that foster ecological imagination, critical thinking, awareness of connections, independent thought, and good heart.”

David Orr (2004) in *The Learning Curve*

We are wired to learn. Anthropologists (Hall 1977, Wells 2004) remind us that *learning* is one of our most basic evolutionary survival mechanisms (we don't jump particularly high or run very fast). Over the last 60,000 years, humans have inhabited every continent and thousands of different ecosystems – from desert to arctic. Yet our biological make-up has changed very little in this time (Glantz and Pearce 1989). Humans have learned to survive in these extreme environments – creating knowledge, stories, myths, languages, and ways of life deeply connected to and reflective of the unique features of a given place.

Long before we were able to go to the market to meet our basic needs for food, clothing, and shelter, and even before the advent of agriculture, humans had evolved the capacity to be keen observers of and participators in the natural world. The landscape was our ancestral classroom, and learning functioned to prepare the next generations to meet their daily needs. Our very survival as a species depended on it.

We believe that it still does. Throughout the world, fragmentation, isolation, and disconnection have become unspoken underpinnings of many human communities. As a result, our connection to life-sustaining processes and our capacity to see “the whole” has diminished. The effects of these trends manifest in countless ways – from habitat destruction to rising rates of clinical depression to the increasing gap between the rich and poor, to systemic racism and oppression to global climate change to war and violence. Never in history have we stood where we do now – with the knowledge, technology, and power to fundamentally alter the geological, biological, cultural, and atmospheric processes upon which we rely for survival. At this critical moment in time, we are in need of a different approach to education and learning – one that reveals connections, strengthens relationships, and recognizes the whole.

And it is here that we turn to natural history. Natural history has been described and defined in a wide variety of ways (see Thomas Fleischner's excellent essays [2001, 2005] that track the historical development of this term). While there tends to be broad agreement that natural history concerns itself with direct observation, description, and comparison of natural features and phenomena, we embrace a more expansive view of natural history – one described by Barry Lopez (1989) that is “as old as the history of the interaction of people with landscape.” At its core, we view natural history as a *practice* (similar in some ways to meditation or even medicine). As such, it is much more than a “subject” or “discipline.” As Fleischner (2001) suggests, natural

history is a practice of “intentional, focused attentiveness and receptivity to the more-than-human world.”

Basically, we see the practice of natural history as one doorway into the study of wholeness – an inquiry that strives for depth as well as breadth and a commitment to deepen our sense of connection and belonging to this world. Our brains are patterned to learn about nature and our instincts drive us to observe, connect, and align ourselves with natural rhythms and cycles.

This article is the first of a proposed two-part series that offers our response to Trombulak and Fleischner’s (2007) timely call for a natural history renaissance. We begin with a central question that they pose: *How can we hone our abilities to convey wisdom and respect, awareness and appreciation for the natural world?* This poignant question gets to the heart of what we believe is needed – a refined, intentional, and ecological approach to educational *design*.

When we speak about design, we put it forward in the broadest sense – a unifying concept that David Orr (2007) has described as “quite literally the remaking of the human presence on earth.” Design is a deliberate and creative process that addresses key elements and the relationships between them. Done well, educational design asks us to consider whole systems in which learning occurs and to “solve for pattern,” a term coined by Wendell Berry (1982) that asks us to look to the future and that our design doesn’t create new problems or reinforce existing ones.

In the sections that follow, we offer eight design principles inspired by the study of living systems and distilled from the collected wisdom and experience of many generous educators, facilitators, and mentors that we’ve had the opportunity to work with and learn from. These principles also draw from our own experience as reflective practitioners and facilitators in a wide variety of contexts. Over the past years we’ve experimented with these principles while working with intergenerational groups, adults, and children in formal and informal settings and as faculty members associated with the University of Vermont’s Field Naturalist Graduate Program. We feel confident that these principles can form the bedrock of a diverse, creative, and holistic approach to designing natural history education.

Good design begins with and emerges from clear intention. We find principles to be particularly helpful in the design process as they have the capacity to unite

intention and process. In other words, the means and the ends are intertwined. For us, these principles serve as guideposts, reminding us of our core intentions while pointing us in the direction of time-tested practices.

As you read through these principles and their accompanying descriptions, you’ll notice they are all interwoven and interconnected. We believe these interconnections bring integrity to these principles. However, as guideposts they still allow space for creativity and flexibility. Principles are transferable across audiences, contexts, and scales. We acknowledge there is a danger in offering a finite set of design principles. We are not suggesting these principles are exhaustive, nor should they be construed as a definitive recipe or set of instructions. On the contrary, we hope these principles serve as a starting point for dialogue to further our collective capacity to design potent learning environments. Our goal is not to present a pedagogical dogma, but rather a set of principles that can inform and enable creative and emergent practices and approaches.

1. Reestablish Relevance

What kind of picture does “natural history education” conjure up in your mind? For many, this term invokes an image of a group of naturalists wearing binoculars and carrying hand lenses. They’re walking slowly – identifying plants and animal sign, digging soil pits, or examining bedrock layers. And for many inspired naturalists, this isn’t a far cry from an enthralling day in the field (ourselves included).

Observation and awareness will always be fundamental to natural history. Yet over the years, the field has become disconnected from its origins as a practice that is critical to our basic needs, survival, and well being. As a result, the field of natural history has lost much of its relevance and runs the risk of extinction.

Many authors have lamented the decline of natural history in recent years (Noss 1996, Futuyma 1998, Pyle 2001). George Bartholomew (1986) noted striking evidence of this trend in *Webster’s Third New International Dictionary*, which defines natural history as “a former branch of knowledge embracing the study, description, and classification of natural objects...” (emphasis added).

In an age of climate change, peak oil, food shortages, economic instability, and an increasing gap between rich and poor, it seems fair to ask: Can the practice of natural history make a difference?

To reestablish relevance, we need to find ways to re-apply the wisdom of nature and the fruits of natural history to human needs and the health and well being of larger living systems. In the past 3.8 billion years, living organisms have evolved elegant and holistic strategies for survival. As Janine Benyus (2002) describes, “failures are fossils, and what surrounds us is the secret to survival.” We need to recognize natural history as a pragmatic participatory practice that is fundamental to discovering the secrets of sustainability. Following the lead of ecological design and permaculture, we need to intentionally join forces with farmers, economists, politicians, builders, landscapers, healers, teachers, and more to explore how natural history can inspire ways of living and working that link our cultural and natural systems explicitly.

Trombulak and Fleischner (2007) have called for a re-birth and revitalization of natural history. Fundamentally, this means bringing natural history back to *life*. We believe that this will only come when natural history, which was once recognized as crucial to life and survival, is reintegrated into our daily life. One way to revitalize and regain relevance is to re-emphasize our own participation in natural history, expanding our focus from learning *about* nature to learning *with* nature.

The practice of natural history can be easily reflected in our daily actions and manifested in the practical skills that can move us toward a more sustainable society. These skills are often referred to as “primitive skills.” Perhaps this is not a bad name. As Stanley Diamond (1993) reminds us, the root of the word primitive is *prima*, meaning primary. These are the skills that are primary to survival. They help us to meet our basic needs while caring for (or at times even improving) the health of the system. Yet for many people, “primitive skills” conjure up images of survival courses that lead participants off into the woods with only the clothes on their back. While those experiences can be valuable, today’s suite of primitive skills looks somewhat different than it did thousands of years ago (though some have remained constant) and might include natural building, preserving food, tool-making, lactofermenting, sprouting, spinning, composting, seed-saving, knitting, weaving, bee-keeping, foraging, hunting, and rooftop or forest gardening.

While some of these skills are not typically thought of as being connected to the practice of natural history, we suggest a more expansive view. Natural history is not just about observation – it is also about participation. It

is part of the fabric of our being. Furthermore, a passion for any one of these skills can be a doorway into something much larger. For example, natural building requires knowledge that falls squarely into the traditional domain of natural history: soil textures, properties of wood, climate patterns, and much more. Participating in activities that link our personal needs with the health of our local living systems can be a starting point for bringing natural history back to life.

2. Start in Place

The reintegration of natural history into our daily lives naturally shifts our focus toward the places we inhabit. We see that an in-depth understanding of our particular place – the flora, fauna, climate, culture, and physical features that make it unique – is fundamental to our ability to design elegant ways of living that promote sustainability and vitality. As Van der Ryn and Cowan (2007) explain: “Ecological design begins with the intimate knowledge of a particular place. Therefore, it is small-scale and direct, responsive to both local conditions and local people. If we are sensitive to the nuances of place, we can inhabit without destroying.”

This is the first step in embracing a worldview where we begin our work by asking, as Wendell Berry (2004) has:

What is the nature, what is the *genius*, of this place? What, if we weren’t here, would nature be doing here? What will the nature of the place permit us to do here without exhausting either the place itself or the birthright of those who will come later? What, even, might nature help us to do here? Under what conditions, imposed both by the genius of the place and the genius of our arts, might our work here be healthful and beautiful?

We use the term *place* to mean the geographic context in which nature and culture intertwine and unfold. This integration of nature and culture reflects our belief that humanity is inseparable from the natural systems on which it depends, and to study them in isolation reinforces an artificial dichotomy. Just as human culture is shaped by natural processes, so are the unique natural features and character of a place influenced by human inhabitation.

Natural history has a rich tradition of being place-based. For most of human history, Indigenous People have developed a deep understanding and relationship with the local landscape, and it is reflected in cultural

traditions. Stories, myths, rituals, ceremonies, dances, songlines, and many other cultural practices have long mirrored and transmitted this knowledge and relationship with place (Abram 1997, Brody 2001, Nelson 2008).

Dudley Patterson, a Western Apache horseman, describes this phenomenon to anthropologist Keith Basso (1996):

Wisdom sits in places. It's like water that never dries up. You need to drink water to stay alive, don't you? Well, you also need to drink from places. You must remember everything about them. You must learn their names. You must remember what happened at them long ago. You must think about it and keep on thinking about it. Then your mind will become smoother and smoother. Then you will see danger before it happens. You will walk a long way and live a long time. You will be wise. People will respect you.

Emphasis on place has also been reflected in the Western approach to natural history. Henry David Thoreau built his cabin near the shore of Walden Pond and immersed himself in a participatory, place-based study on how to live deliberately. As David Orr (1992) has written,

Walden is a model of the possibility of unity between personhood, pedagogy, and place. For Thoreau, Walden was more than its location. It was a laboratory for observation and experimentation; a library of data about geology, history, flora, fauna; a source of inspiration and renewal; and a testing ground for the man. *Walden* is no monologue, it is a dialogue between a man and a place. In a sense, *Walden* wrote Thoreau. His genius, I think, was to allow himself to be shaped by his place, to allow it to speak with his voice.

Part of the beauty, utility, and practicality of this approach to natural history education is that places are defined at the human scale: the backyard, the neighborhood, the block, the park, the quarry, the farm, the woodlot, or the town. At the human scale we can actually see and track the impacts of our actions. We

can make connections to where our food comes from and where our waste goes. We can be in intimate relationship with the critical life-sustaining processes that support us. We can make palpable the connections between seemingly disparate elements of a landscape: grassland birds and milk production, water quality and parking lots, soil composition and the subtle tones and flavors of a wine variety, bedrock geology and bird habitat.

Furthermore, when our learning is place-based and at human scale, we learn that we can make a noticeable difference. A recent study of political participation by Frank Bryan (2004) shows that citizens will participate when the political arena is *small* enough for them to make a difference and there are issues at stake that really matter to them. Size (not mobility, level of education, or other socioeconomic factors) is the most reliable indicator of political participation. The smaller the community, the greater the participation. This is a lesson that should be considered as we design our learning environments. As Bryan (2003) says, "Active citizens are not born. They are raised."

3. Engage the Senses

"Our several senses, which feel so personal and impromptu ... reach far beyond us. They're an extension of the genetic chain that connects us to everyone who has ever lived; they bind us to other people and to animals, across time and country and happenstance. They bridge the personal and the impersonal, the one private soul with its many relatives, the individual with the universe, all of life on earth."

-- Diane Ackerman (1990) in *A Natural History of the Senses*

One hallmark of natural history has always been careful observation and attentiveness to natural phenomena *in situ*. Whether we are scrutinizing the tracks of a bobcat, listening to the calls of alarmed birds, or discerning the texture of soil composition, natural history challenges us to harness *all of our senses* and describe patterns as carefully as possible.

Perhaps it is fairly obvious that nurturing sensory awareness is at the heart of natural history education. However the results that emerge from this practice are far-reaching and not always readily apparent. Still we believe they are worth mentioning – as linking these benefits to the practice of sensory awareness can provide added motivation and incentive to further

develop these skills. Furthermore, these outcomes are also goals in themselves and are clearly linked to other principles described below.

First, to truly observe, deeply listen, and engage the senses requires that one become present in the moment and quiet the chattering mind. This practice can lead to what Dudley Patterson (in Basso 1996) described as one's mind becoming "smoother and smoother." While the benefits of engaging our senses in natural settings have long been observed, the specific mechanisms that explain this pattern are still under investigation (Kaplan 2001). Experiments conducted by Roger Ulrich and colleagues (1984, 1991, 1995) have led to the suggestion that peaceful natural settings can affect people in calmative, restorative ways. An alternative mechanism is suggested by Kaplan (1995) who offers "attention restoration theory" to explain the benefits that come from engaging with natural settings. In this theory, fatigue and irritability that often result from prolonged *directed attention* (too many hours in front of your computer) can be mitigated through a form of *indirect attention* akin to fascination. Natural settings provide endless sources of fascination – providing restoration for a fatigued mind. Regardless of the specific mechanisms, there is general agreement among researchers that engaging our senses in natural environments is good medicine and can be beneficial to mental health (Taylor and Kuo 2009).

Second, at its most basic form, engaging our senses raises our level of awareness, often shifting our focus away from ourselves and creating the conditions for a deeper, more empathetic relationship with nature. Those who study human relationships have known for years that deep listening is an essential foundation of healthy relationships (Carlson 1997, Bailey 2004). Many have found the same to be true for our relationships with the natural world. In his book *The Spell of the Sensuous*, David Abram (1997) describes the importance of sensory experience as a practice:

The senses are our most immediate access to the more-than-human world. If we ignore or devalue sensory experience, we lose our primary source of alignment with the larger ecology, imperiling both ourselves and the earth in the process. Sensory experience, when honored, renews the bond between our bodies and the breathing earth.

This bond is strengthened when we engage all of our senses with attentiveness and receptivity; when we slow down and taste what it means to be alive in the present moment.

Finally, and perhaps most obviously, our sensory awareness is central to our capacity to learn the language of the land. Our ability to find ways of living that are in healthy relationship with our local ecology is dependent upon our ability to engage our senses to detect the complex patterns, rhythms and cycles of our place. We cannot begin to understand the genius of a place if we do not start by engaging our senses.

4. Commit to Curiosity

As the fields of learning theory and neuroscience continue to offer greater insights into the learning process, the importance of curiosity has become increasingly apparent (Kashdan 2004, Sansone and Thoman 2005, Silvia 2008). At its most basic level, curiosity functions to motivate learning and exploration (Silvia 2006) and has been linked to increased concentration and retention.

Ultimately this research suggests that authentic engagement needs to be the starting point for learning and practicing natural history. This presents a serious educational design challenge for two central reasons. First, curiosity operates on the individual level. One person's passion can be another's indifferent shrug. Second, curiosity levels vary over time. A once-interesting subject can eventually become boring, confusing, or even aversive (Silvia 2008). Herein lies the challenge for educators. How do we teach natural history in a way that nurtures and sustains curiosity for *all* students?

Committing to curiosity necessitates one-on-one interactions and requires flexibility. It demands a systems approach to learning rather than the linear outcome-based "lesson" model that has become standard in most courses and schools. Lessons begin with the answers already written, whereas a systems approach that is grounded in curiosity allows us to ask big questions about natural history that never feel finished, and embrace the complexity and incompleteness of the answers we discover.

Curiosity isn't confined to a specific discipline or field of study. Rather it tends to lead the learner toward integration in the most natural sense. The places we inhabit offer infinite doorways through which one can begin to explore and understand the vast web of

interconnected relationships, patterns, processes, and principles that exist in the natural world. For example, individuals who are passionate about animal tracking can easily be led by their own questions (and a little bit of mentoring) to learn about the assemblages of trees, shrubs, low-growing plants, and enduring features (for example, bedrock, soil, and aspect) that provide food and shelter for the animals that they're tracking. This is often just the beginning. Following the thread of curiosity will inevitably lead to a whole network of questions that reveal the complex systems and interactions between seemingly unrelated objects or phenomena. Time and time again, we've witnessed people integrating and synthesizing complex concepts when guided by their own curiosity (and supported by mentors).

While this shift may seem rather basic, we have found it to be challenging on a number of different levels. At the systemic level, most schools that we have visited or worked in tend to function as an expertocracy – with teachers serving as the “gatekeepers” of knowledge and deciding themselves what is worthy of exploration. In these situations, learning occurs through instruction (derived from the Old English word *instruere* meaning “to pack in and pile on”) rather than by way of true education (derived from the Middle English word *educare* meaning “to lead out or to draw forth”). At an individual level, committing to curiosity requires educators to let go of the power and control that we've grown accustomed to that comes from setting the agenda, determining what others should learn, and being the source of the answers. This approach allows (or forces) us to abandon our preconceived lessons and solutions, to turn off the tape recorder, and to become active learners alongside our students. It requires us to make the shift from expert to practitioner.

In practical terms this requires that teachers and mentors focus on asking questions instead of offering answers. For many natural history educators, this translates into a shift away from the classic “drag and brag” approach (where an educator drags students through the field and brags about all that they know). While a didactic approach can be appropriate on certain occasions, if overused it can deaden curiosity by robbing learners of the opportunity to discover, integrate, and construct their own meaning. Our design challenge is to create a context where curiosity and discovery can flourish.

5. Design for Emergence

Designing natural history education that sustains curiosity, discovery, and creativity requires a shift from

an expert-based, linear model of education (instructive, didactic, outcome-based) to a more complex, flexible, and participatory approach. We refer to this process as *designing for emergence*.

Emergence is the process by which new properties, patterns, ideas, and structures arise in complex living systems (Goldstein 1999). Emergence is used by psychologists to explain the development of human consciousness (from interactions between several billion brain cells) and by ecologists to explain the coordinated movement of flocks of birds and schools of fish. In each of these cases, the new meta-level pattern or property is greater than the sum of its parts and is not under central control. Emergence comes about in natural systems through networks of relationships and by a process of self-organization.

When applied to natural history education, designing for emergence focuses on *creating conditions* for learning to occur, rather than prescribing specific outcomes. It involves providing unstructured time for learners to explore and self-organize. Designing for emergence reminds us that new ideas, discoveries, and possibilities cannot be predicted. Rather, they arise out of relationships, which require a depth of connection that goes beyond the knowledge and understanding gained from memorization and regurgitation. (We do recognize the importance of setting clear learning outcomes. Yet equally important, and too often absent from our educational design, are learning experiences and environments that cultivate creativity and emergence.)

Traditional educational programs often rest on the assumption that we know exactly what needs to change and what needs to be learned. This can leave the impression that there is only one right answer to a question and only one correct way to solve a problem. Yet the study of living systems shows us that this is rarely the case. Evolution leads to a multiplicity of complex solutions, which are only limited by the available diversity present in a population.

Designing for emergence holds the promise of multiple solutions, relationships, ideas, networks, and possibilities. True education shouldn't lead to assimilation, homogenization, or hubris. Rather it should create the conditions for learners to stand on our shoulders, to surprise and surpass us, and to combine ideas into new forms and structures. This approach offers a suite of benefits. First and most obviously, it nurtures curiosity and sustains engagement. Second, it promotes creativity and invites new ways of looking at

things rather than reinforcing the same old habits of mind. Emergent design welcomes different points of view and critical inquiry. Diversity (in all forms) is recognized as adding value, richness, and perspective. It recognizes that in a community of learners, each individual holds a key to unlocking the next discovery, and each person's discovery might be different.

While it's imperative to recognize that emergent design requires a high level of flexibility, it's important not to confuse this with being unprepared or assuming that one doesn't need to plan. On the contrary, emergent design requires careful and considered preparation. Furthermore, emergent design does not suggest that educators need not be "informed" about the subject of study. We believe that this approach requires that an educator be both informed and passionate about the content that is being explored, yet still be humble enough to recognize our never-ending state of ignorance, and possess a willingness to explore unfamiliar and sometimes uncharted territory.

When educators nurture curiosity and encourage exploration of a place, participants often discover new patterns and connections. Place-based learning environments where the outcomes aren't predetermined allow curiosity and creativity to flourish and provide prime opportunities for emergence and discovery.

6. Reintegrate the Whole

The same fragmentation that divides our society (between rich and poor, people and nature, races, religions, political parties, and social classes) and that underlies our most pressing problems is often reflected in our mainstream approaches to learning. Students frequently learn one subject at a time and in learning communities with others the same age. Most educational models are linear and most courses have prerequisites. From an early age, most of us are taught that learning occurs in schools. When the bell rings, we switch subjects. This approach emphasizes understanding the parts (the subjects and disciplines) rather than the relationships that connect these subjects. This fragmented approach to learning has resulted in the decoupling of learning from living and a belief that we can only solve problems by reducing the whole to its constituent parts.

When designed thoughtfully, natural history education can be an antidote for this fragmentation. Natural history is inherently transdisciplinary, and it often begins at a place-based scale where one can more easily get a sense of the connections and complexities inherent

in living systems. Furthermore, natural history education also nurtures our ability to weave together traditionally separate fields of study into a coherent and interconnected narrative.

The holistic approach fostered by the practice of natural history reminds us that no effort to restore ecological balance and integrity will succeed if it does not also address the social inequities and human suffering that run rampant in our communities. Similarly, no effort to end social inequities and combat human suffering will be successful without clean air, water, and healthy and balanced ecosystems. To unite these efforts and bridge the divides that impede our efforts for change, we need an inclusive approach to natural history education. This requires that we consider the larger system in which learning occurs and ask ourselves: *Who are we serving? Who has access? Who is not here? What's preventing us from convening a more inclusive and diverse community of practice?* Often these questions are seen as beyond our control. However, to ignore these issues will limit the potential that natural history offers to connect people across differences and deepen relationships by sharing a common language of the land.

Reintegrating the whole also reminds us to design beyond the end of our courses or programs. Learning doesn't end when class is dismissed, and it is not confined to the classroom. Energy and matter are constantly flowing between learners and their environment. Our food, work, buildings, clothes, shelter, transportation, and communities are key aspects of our learning environment.

Although many programs inspire learning, excitement and enthusiasm often taper off once the program is over, and old habits of mind reestablish themselves. Recent research suggests that many learning experiences fail to manifest long-term changes in daily life because of an inability to support individuals in incorporating their discoveries into the practice of their daily lives (Cushing 1998, Cushing 1999, Bell 2003). Maintaining different behaviors or world views in a cultural environment that tends toward assimilation can be exhausting and requires networks of support.

As essential as it is to "plant seeds" for learning, it is equally critical to cultivate conditions that foster germination and continued growth. By thinking about our design at multiple scales (individual, family, community, and society) and creating opportunities for ongoing mentorship, support, and practice, our programs can strengthen networks of teachers and learners. When networks of support are present, these

individuals often give back to the learning community by bringing their own diverse set of gifts and experiences to guide, mentor, and design opportunities for others. In this way we lessen the necessary resource input (including time, energy, and cost of additional teachers) and create educational opportunities that are “yeasty.” By reintegrating the whole, we can design more efficient, resilient, and regenerative learning environments and communities.

7. Emphasize Relationships

The practice of natural history provides the chance to consider the elegance, complexity, and importance of relationships within living systems. Organisms are connected to one another and the physical components of their environment in sometimes subtle yet often profound ways that only the careful study of complex systems can reveal. The more we study systems, the more we begin to understand that the whole really is more than the sum of its parts. As Fritjof Capra (2008) points out, this is precisely because of *relationships*: “All the essential properties of a living system depend on the relationships among the system’s components. Systems thinking means thinking in terms of relationships. Understanding life requires a shift of focus from objects to relationships.”

Part of the richness of natural history is that it not only highlights relationships, its practice has the capacity to *deepen* relationships. When we immerse ourselves in natural systems and learn the language of the land, we form emotional attachments to our place. Although this bonding may be discouraged by scientists who advocate rigorous detachment, we suggest that natural history is expansive enough to encourage this deepened connection as an entirely human and natural outcome. As E. O. Wilson (1984) has suggested, there may indeed be an instinctive and deeply rooted bond between humans and other life forms. He coined the term *biophilia* (which translates to *love of life or living systems*) to describe the deep connections that human beings subconsciously seek with the rest of life.

As we design learning environments, we should also pay attention to the powerful role that human relationships play in the practice of natural history. Etienne Wenger (1999) coined the term *community of practice* to describe the process of social learning and the shared cultural practices that emerge in groups with a common purpose or set of learning goals. These social relationships offer the opportunity to deepen our practice of natural history by sharing stories, discoveries, insights, and questions, and holding each

other accountable for the commitments we make and the edges that we explore. Some of the strongest learning communities we have encountered are those that create the conditions for personal relationships to flourish.

When relationships are nurtured *within* our learning communities, we often find the safety required to take risks, make mistakes, or go out on a limb. We’re often more willing to accept and offer feedback and to harness the benefits of multiple perspectives. Strong networks of relationships allow us to tap into a sense of collective understanding, intelligence, and creativity that is often unavailable when we’re learning in isolation.

This is also true among teachers and facilitators. Bryk and Schneider (2002) developed a series of surveys to measure *relational trust* – the sense of respect and trust among members of a learning community. Their research found that relational trust (not curriculum, technique, or budget) is the best predictor of a school’s capacity to create an effective learning environment.

8. Lead with Values

The practice of natural history offers far more than an intellectual understanding of living systems. For some, the sense of rootedness that emerges from their relationship with place can best be described as love. Yet, this is not the only human value attributed to the practice of natural history. There are many more. Over the years we’ve asked many fellow practitioners what their practice has taught them. The list continues to grow: gratitude, vitality, humility, patience, rapture, compassion, awareness, heightened sensitivity, playfulness, empathy, balance, knowledge of self, reverence, resiliency, hope, health, courage, vision, caretaking, sacredness, intuition, and of course, love.

As we come to understand what it means to become connected to the natural world, there is a shift that accompanies this awareness. We face the inevitabilities of what it means to be alive. We grasp the complexity and interdependence of living systems. We recognize our own place in the fabric of life. We witness birth and death, joy and suffering. We are attuned to the beauty, rhythms, cycles, and preciousness of life. Nature serves as a mirror, reflecting and encouraging exploration of that which needs attention in our lives. These experiences heighten our sensitivity, and naturally draw out human qualities that are inherently rooted in our relationship to nature. These are the true gifts and wisdom of nature.

These gifts often elicit a desire to be of service to something much greater than ourselves. As Jon Young described in a recent conversation with us about his work mentoring hundreds of students of natural history, “A natural outcome of this practice is that we become caretakers and peacemakers.” This urge to give back is part of the reciprocal nature of the practice of natural history – what Thomas Fleischner (2001) has called “the spiral of offering.”

As designers of learning environments, we believe it is critical for each of us to embrace and embody the human qualities and values that emerge from the practice of natural history. By leading with our values, we can recapture the *soul* of natural history – restoring a sense of meaning, service, and moral purpose that is deeply rooted in our relationship with nature.

Moving from Principles to Practice

Any discussion of design principles naturally leads to questions about how these principles can be applied to specific approaches and practice. Clearly there is no one right way. Our research has revealed a myriad of different approaches that weave these principles together into powerful learning environments. In each of these cases, the specific design varies significantly in response to the local conditions and is reflective of the natural and cultural fabric of a given place. Still, there are certain practices (or elements of design) that seem to work particularly well and are found across many different approaches. In a subsequent article, we intend to offer a set of specific practices, frameworks, core routines, and designs that have inspired our own practice and that integrate and reflect the principles above.

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