



Montana State
University
MSSE Program
by Mary Sellars

NEPAL 2023: Place, Pilgrimage, and Pedagogy

REFLECTIONS ON DAYS WALKING IN THE HIGH
HIMALAYAS, READING THE LAND, AND ACCOMPANYING
CURRICULUM GUIDE FOR SCIENCE TEACHERS



Top: Gokyo Village

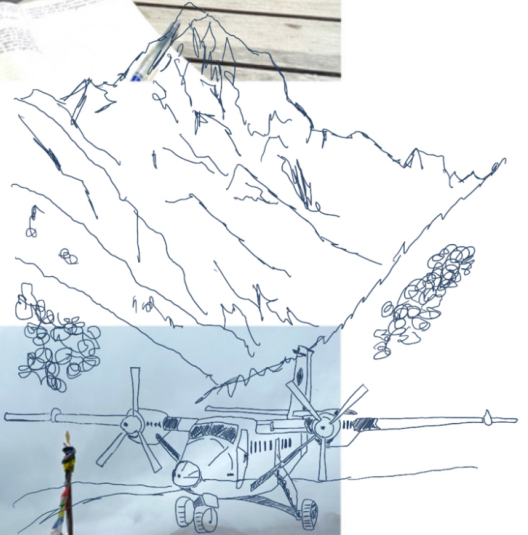
Bottom: Suspension bridge in Sagarmartha National Park



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“So far from the nearest sea, I am taken aback by the sight of a purple land crab, like a relict of the ancient days when the Indian subcontinent, adrift on the earth's mantle, moved northward to collide with the Asian land mass, driving these marine rocks, inch by inch, five miles into the skies”

- The Snow Leopard, Peter Matthiessen (1978)



Top: Journal writing at a teahouse lunch break
Bottom: Stupa outside Dole Village





I picked up a bird book in Kathmandu and left it in my suitcase as every pound counts when flying into the high alpine airport of Lukla. My first days in Nepal, the holy lands and birthplace of Buddha began with early morning drives on bumpy back roads. All went well and calmly; my plane landed clean on a tarmac that emerged from cavernous dark green hills, layered rice paddies, and jagged alpine cliffs. The quietness and dullness of the clouds hanging over the highlands starkly contrast with the scents and sounds of Kathmandu.



On the last day of September, I learned of the land crabs of Nepal, the history that smashed ocean-bound perimeters, stretching Earth over 8,000 meters vertically into the heavens, where the birds don't even go. I put on the silks, dyed with indigo and marigold. I prayed that each good deed done had sown something down the line for my future. That I may be harvesting apples for years to come. That from then on I may live in the sunshine.

When I arrived on Nepalese soil, I was so tired and felt steeped in a full moon hangover that I could just sleep and eat endlessly. I hoped that the stars and the planets would go easy on me with this one, wishing for tranquility, perseverance, and peace in the hills. I envisioned that the days would pass easily beneath my feet like hay fields out the window of the train. Like steam, the rain clouds hung heavy in the sky, above the beeping horns of motorbikes, the end of the monsoon season lighting the way for a, hopefully, uneventful few weeks of weather. I look to the North like a headlight, a swan leading the flock.

Nepal lies on the migratory route for many species of Siberian birds. Named "The Great Trans-Himalayan Bird Migration" more than 150 species of birds will make their way to Nepal's Tarai wetland region during the month of October. If there is something that could ease my fears about group dynamics and tough conditions, it is being able to watch something in the sky day to day.

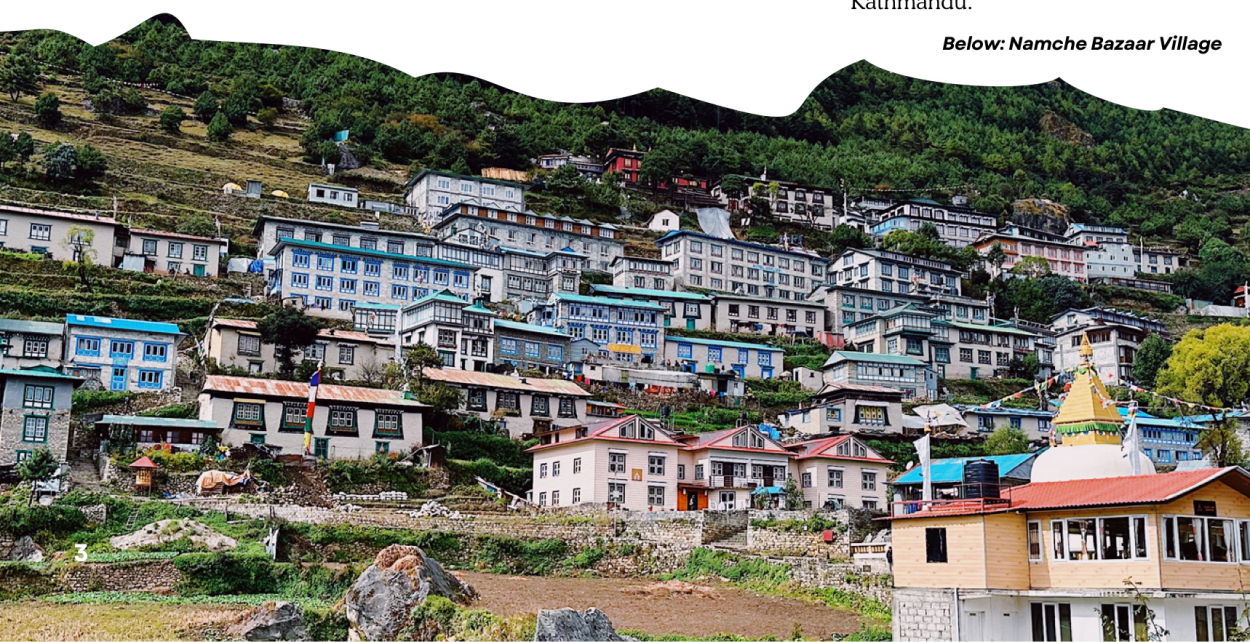
Nepal's topography rises from 70 m above sea level to almost 8,850 m across a minuscule 100 km, but its biodiversity is comparable to countries spanning far greater areas. The country boasts remarkable avian diversity, with over 880 recorded bird species, surpassing the count found in the continental United States.

As our planet continues to change rapidly, along with rapid development and urbanization Nepal is losing critical habitat for birds. Other contributing factors to the decline are pesticide use in neighboring countries with larger-scale agricultural practices such as India and China.



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Below: Namche Bazaar Village




I come to the Khumbu region to walk, to trace its rises and falls with my feet. As many have done before, in pilgrimage, in a relationship with some god or the Buddha, or simply to reach home. It is the antidote to a culture filled with summit dreams and reaching for the top. In relation to the land, I never want to conquer or forget where to stop and take in the view. The moving meditation of walking, using minimal gear, and moving in a way that is neither rushed nor leisurely in the mountains gives inspiration. I try to find silence, watching the dynamic skies reveal and shroud the illuminated mountains above again and again throughout my mornings of trekking. Learning to walk with the rhythms of the Himalayan days, we wake early when the clouds have revealed the albino mountain faces. I have never seen white reflecting the sun so brightly, and I don't know if I will again. Even in the early days of the trek, I knew I would feel homesick for those scenes. The day shifts like waves hitting a beach; the sky turns grey to black, misty and wet, then suddenly sunny and humid.

To love a place is not enough. We must find ways to heal it - Robin Wall Kimmerer



Autumn colors staring into Chole Mountain

In Rhododendron and Juniper forests, sandwiched between too many waterfalls to count, I look down into abysmal drop-offs to the river below. The path is mostly rock and cobblestone, which sometimes evokes the scenery of Scotland or Ireland instead of Southeast Asia. The trail can become congested with porters, dzo (the name for a crossbred ox and yak), and other foreign hikers, mainly from Europe and America. The trail crosses back and forth via suspension bridges over the Dudh River, which translates to the "milk" river, aptly named for its opaque frothy water. The clouds move in and out and over us as we walk. Language and names are numerous, and I have to keep notes to remind myself where I am and who is who in these early days as we climb in altitude.



We cross into Sagarmartha National Park, a protected region over 1,100 square kilometers. Secure mountain ecosystems are crucial sanctuaries for global biodiversity, containing regions with exceptionally rich, unique, and endangered species. Moreover, mountains encompass approximately 30% of the world's key biodiversity areas, playing a crucial role in sustaining global biodiversity. Mountain and alpine ecosystems comprise almost 30% of the Earth's non-iced-over land cover, and conserving them is vital to preserving the Earth's biodiversity.

Sagarmartha National Park was established in 1976, stretches from eastern Nepal to the autonomous Tibetan Plateau, and houses the highest peak in the world. Additionally, the park includes a 275 km² buffer zone, emphasizing the conservation of forests and wildlife and the development of alternative energy methods. More than two-thirds of the park is characterized by barren land at elevations exceeding 5,000 meters (16,000 feet), with 28% designated as grazing land and the remaining 3% covered by forests. The climatic zones within the park range from temperate and subalpine conditions above 3,000 meters (9,800 feet) to alpine conditions above 4,000 meters (13,000 feet), representing the upper boundary for vegetation growth. Above 16,000 feet is snow, rock, and some species of moss and lichen. We hike to the sounds of pika (*Ochotona himalayana*) squeaking and the Alpine chough (*Pyrrhonorax graculus*) calling above the tree line.

Mt. Sagarmartha

What's in a name of the highest mountain on earth?

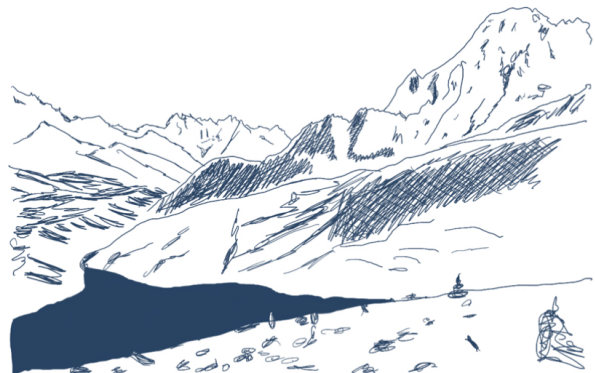




Mt. Everest, Sagarmartha, etc.

On the Tibetan side, the highest mountain in the world has been known for centuries as Mount Chomolungma, or Qomolangma, which translates to "Goddess Mother of the World." On the Nepal side, the mountain is called Sagarmatha, which means "Goddess of the Sky." Nepal and Tibet were incredibly insular at the time of the first western survey of the Eastern Himalayas, so the Indian standard terms for the mountain, "Devadhunga" and "Gaurisankar," were suggested as possible names, but it was found that they were applied to more than one peak locally. When the British Royal survey reached the mountain in the 19th century, it was debated what name was most commonly used for the tallest mountain on Earth. The concentration of many different cultures throughout the region led them to conclude that one name should be applied to the mountain. In 1865, the Royal Geographical Society decreed it would be called "Mount Everest," named for Sir George Everest, the predecessor of Andrew Scott Waugh, who conducted the first formal western survey of the mountain. Everest himself never sought eyes on the mountain.

I worked with a guide in Botswana who told me, "There is no greater respect than to call something by its name," and he meant it in reverence for the many traditional tribal names for the animals and plants we tracked, but also their scientific names. I try to remind my students of this when we are researching animals in Yellowstone National Park. Names are important; they tell us about the history of the place, and many movements are occurring globally to rename locations after their indigenous, historic names. I transition between calling the big mountain "Everest" and "Sagarmartha," but I also appreciate the diversity of many people calling it many different names.



The beyul of Solukhumbu

*The cobblestone paths of
villages in Sagarmartha
National Park, Nepal*

We learn in an evening chat with a local Sherpa anthropologist, in a hot tearoom along the trek, that these lands were inhabited by Sherpa people leaving Tibet following a prophecy by the Buddha to find a peaceful place following three rules: 1) no killing of animals 2) no quarreling 3) be peaceful, an epic search for beyul.

A beyul is a Buddhist term for a place of refuge and peace. Protective forces and deities are believed to watch over these lands through snowstorms, mountain mists, and the presence of the elusive snow leopard (*Panthera uncia*). Solukhumbu, or the Khumbu region, which encompasses Sagarmartha National Park, was inhabited by the Sherpa community during their migration from Tibet in the 15th and 16th centuries, fleeing religious persecution. Finding sanctuary in the valley, they established a new homeland. The presence of Buddhist monasteries and revered mountains has attracted numerous spiritual pilgrims to Solukhumbu for hundreds of years.

When walking these mystical paths under the shadows of the world's tallest mountains, it is easy to see why these lands are so admired and attract visitors the world over. White-capped mountains blend with indistinguishable clouds, like smoke off the summit, like the white rabbit in the hat; they appear just to disappear again. Infinite in the Himalayas, helicopters hissing in my ear, reminding me the way is up.





Namche Bazaar

I awoke at 11,280 feet in Namche Bazaar on the fourth day of the trek. This is an essential day in the trek toward higher elevations like Gokyo Ri and Everest Base Camp: the acclimatization day. Our group hikes up and over the ridge behind Namche to a small village called Khumjung, which is also the site of the Edmund Hillary School. Edmund Hillary was, of course, the first person to summit Everest in 1953 alongside Tenzing Norgay. Tenzing Norgay was a Sherpa mountaineer who came to Nepal as a child and began climbing in 1935 as a high-altitude porter.

Hillary did something few explorers have done when reaching new lands and heights: he hoped to elevate Norgay and the Sherpa people alongside himself following the feat.

Opened in 1961, the Khumjung school was the first in the region built by Hillary and is now maintained by the Himalayan Trust, like most of the schools in this region. Hillary founded The Himalayan Trust in the 60's and functions as a foreign nonprofit based out of his home country of New Zealand. Their primary goal is establishing schools, health care centers, and clean water in the high Himalayas.

Khumjung looks up at Ama Dablam, a 6,812-meter peak that usually dominates the skies above but is veiled behind thick mists that rain down on my head and backpack today. I ponder someday in the future when I may be dry again, and it feels very far away. We get to visit with the schoolchildren, many of whom live in boarding-style hostels as their home villages are more than a day's walk away. The children I visit at these remote schools in Nepal are kind, with exceptional English, manners, and smiles for days.

Out of the congested rainclouds where our teahouse sat in Namche emerged Kongde Ri in our last minutes before leaving. We then started slowly toward Dole, a remarkably small village in the Dudh Kosi River Valley at over 4000 meters. It is a long and arduous hike that takes us along the edge of hillsides and looks into the shadows of Sagarmatha and Lhotse. The way these mountains hang over us even at these high altitudes stretches my ideas of the bounds of this Earth.

*Namche Bazaar sits at
3,440 meters and stares
into Kongde Ri
Behind the ridge sits
Khumjung Village*



In traditional Sherpa culture, it is believed that the mountains should not be climbed and that doing so was unholy and disrespectful to the gods. On this day, I saw the first edge of the top of Everest - towering at over 8000 meters, and I wondered what would ever possess someone to want to go to the top. The location where our group was resting for the night in Dole, at over 4000 meters, is a common first spot to experience symptoms of altitude sickness. According to NASA, at this height, most acclimatized people will lose, on average, 20% of their sea-level abilities to cognitively function. It was the first sight that I started to feel a change in my breathing, quicker and more shallow breaths. I have been to the top of fourteens in Colorado before, but I immediately turned around and had never slept higher than 3000 meters before this trip. The changes in energy level are palpable, and it's easy to worry about how one's health may be affected by the strenuous climbing and lack of pressure driving oxygen into your blood.



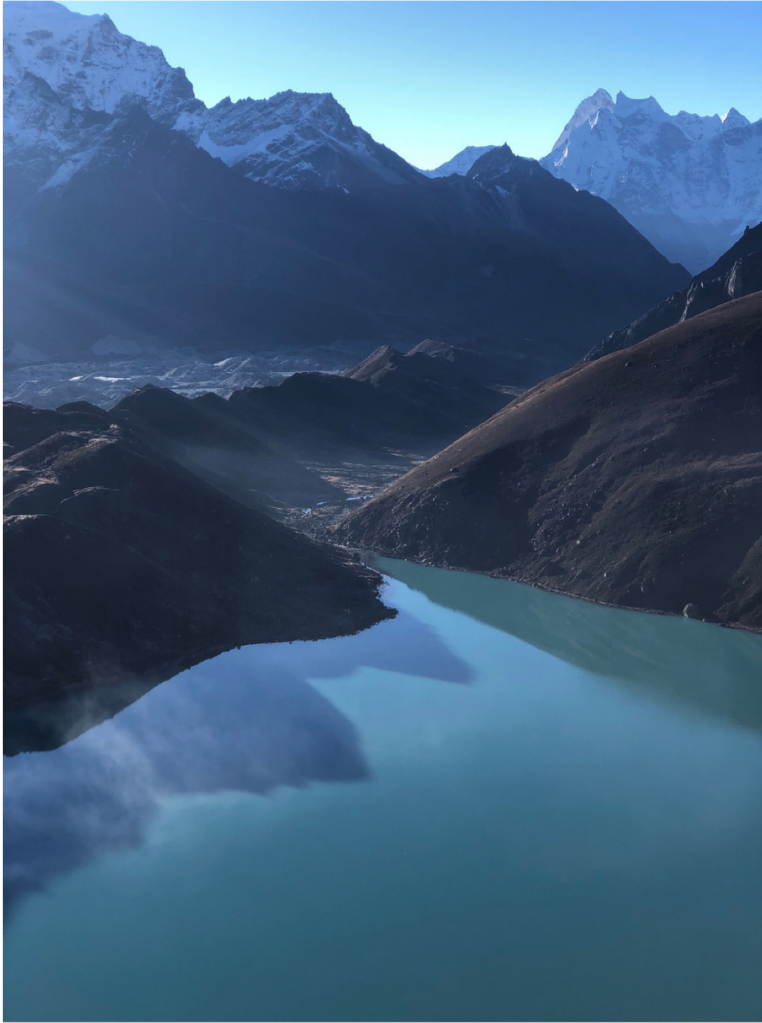
Dudh River

On October 6th, the trail was kind and gentle to me. I stood eye to eye with a pair of Golden eagles (*Aquila chrysaetos*) flying high in the caverns of the river thousands of meters below. We stayed higher and higher as we approached our ascent of Gokyo Ri. Up this high, the rhododendron is turning red and gold in a rushed autumn way, beckoning winter and another monsoon season. Here, the granite is so gray it is almost blue, like my veins and the rushing river.



Tok Tok Teahouse stop

Place-relational Learning



Facing the chain of Gokyo lakes from Gokyo Ri

"Every farm woodland, in addition to yielding lumber, fuel, and posts, should provide its owner a liberal education" -Aldo Leopold

Prayer flags blew in the wind, and the clouds rolled over a vast landscape in minutes that would have taken us many days to cross on foot. I'm finding solitude wherever I can, as I need those moments to process the magnitude of this place and experience. It is accessible on the trail, putting one foot in front of the other for many miles to forget where I am and what I am here for. I remind myself of this through reading my book, writing in my journal, and painting the scenes that pass me day to day. It is a method I have honed in leaning into the experience and cultivating my relationship with a place. I refer to this as place-based learning for a teacher in the role of student.

Recently, I learned the term "place-relational learning" over the more popularized "place-based learning." Place-relational moves the content of a class past just observing and osmosing information, into intentional action, into community connectedness and participation. The rise in standardized testing and a uniform curriculum has eliminated many local nuances from the educational system, stripping away the physical context of learning for numerous students. This has underscored the critical necessity for schools to prioritize the significance of community and the concept of place in education. It is only within a place-relational learning framework that we can provide students with the tools necessary to confront imperialistic attitudes that have led to the displacement of native people and the degradation of ecosystems.



**Edmund Hillary School Khumjung Village, Nepal
and Namche Bazaar**



As I continue to grow in my role as a professional educator and to practice my skills as a student in graduate school, I draw on ways to deepen my experiences in the land within a place-relational framework. Outdoor and field-based science experiences gain impact when students are guided into increasing their knowledge of the land they are studying, recreating in, and helping to steward. Field trips have long been the cornerstone of an academic year, providing the observational skills and experience to complement what students learn in their daily school classrooms. I believe if you ask many people what the most impactful experience of their educational journey was, they will point you to a field trip. One personal goal I find in place-centered learning is incorporating an interdisciplinary lens through literature and service, making art, and walking the land. Many teachers or administrators may reflect that a science-focused course has no space for literature and art. I believe the strength of place-based learning is that it encourages many fundamental skills of being a scientist by fostering a curious and active mind.

As a student of place-educational experiential learning since I was in elementary school, it was in my mid-twenties that I began to apply the principles to my own experience of living, working, and teaching in places. If I want to be a role model for students in the field, I have to fulfill those expectations of myself. I scaffold this by writing in my field journal, keeping a list of the birds, and painting the landscapes. Whenever possible, I swap stories with my guides and ask questions about what I should expect to see and how these days compare to past seasons. The phenology of it all.



I want to leave a record of this place, who I was when I experienced it, what it gave me, and how I left it. I hope these notes are something I can return to, even if I never get to experience the high Everest region of Nepal again. These chronicles will steer my experience in the next place I choose to live and learn. These are the elements that go into how I craft my lessons and teaching style; I want students to leave with skills and a framework that enriches their experiences at home and in other opportunities to travel.

The facets of learning emphasized in place-relational learning have twofold advantages for increasing mindfulness for students and equity for students from alternative, especially native backgrounds. Outdoor educators can use mindful place-based education to help deepen student and teacher experiences of place to encourage students to critically examine power structures and strive for more profound learning experiences. Practices such as studying traditional ecological knowledge, indigenous ways of knowing, and non-western scientific methodologies are precious to students historically disenfranchised from STEM classes in school. Coincidentally, these tactics are also helpful in building literacy skills such as reading and writing, which are highlighted by NGSS as paramount to success in science classes. All of these are examples of how teachers help build students who are globally and environmentally literate citizens.

I take lessons from the land, the mystical and spiritual that hangs all over this place, the assemblage of thousands of years of ancient teachings, evenings spent chatting with my peers, the sun peeking through the clouds, the small forests of bryophytes coating the ground, tea breaks, and dry clothes.



Edmund Hillary School Khumjung Village, Nepal



View from the top of Gokyo Ri

And on my birthday, I woke at 3:30 AM to climb up to Gokyo-Ri. I don't know if it was the altitude or my choice of gnocchi for dinner the night before, but I definitely wasn't feeling my best. Either way, I stayed near the front of the pack for the dark, short-cutting switchbacks up the steep mountainside. Aside from the heavy breathing, snot rockets, and occasional need to spit, the climb was challenging but doable. There were times I hung back from the leading group, but far enough in front of others that I felt as though I were alone on the mountainside, stars, deep breaths, and darkness. As I reached heights over 5000 meters, my mind became dizzy and a little delirious, in a pleasant way, requiring each step to be thoughtfully placed as the winds grew more robust and the air grew colder.

Slowly, a warm, hard sun began to crest from gaps in the mountains toward the East, illuminating Everest and Lhotse and the rest of the stretching eastern Himalayas on the border of Tibet. Something in the alpine glow emerged from the long night as I crested the summit, that made me feel completely reborn, and I began to spontaneously weep. I wept in a heaving and sobbing way on that day, tears of joy and disbelief and the kind of way you can only feel at these edges of the world. I cried and felt, ironically, like a newborn seeing the light for the first time. Standing alone at the top of the mountain, I saw clearly what I needed to be doing to tell these stories, help cultivate these relationships, practice this work, heal the land, and inspire others. I spent some time at the top, watching the sun crest and shine in oranges and marigolds through gaps in the mountains.

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Up the trail, and back down again- some people would instead do a loop, but I've always loved the spirit of an out and back, that each step I came up, I go back down, that maybe it provided the equilibrium we seek, a sort of neutrality of the land and my mind. It eases me like I've solved some profound mathematical equation, like all the debts have been settled, and like all that is left is the soft hum of the universal sound. This time, the colors of hills painted in rubies and autumn humus.

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Nepal Curriculum Guide

I built the curriculum that follows out of my experience teaching in the Greater Yellowstone Ecosystem field and my experiences as a student of place in many parts of the world. The 5 E framework of lesson building can be loose or more defined. I offer a multitude of lesson plans that are based around taking a group of high schoolers to learn about the Khumbu region and Sagarmartha National Park. An essential tenet of place-based education is helping students foster a local-to-global context for learning, which inevitably builds agency for them. I feel this personally through my work and the lessons I teach on wildlife ecology and conservation in Montana I choose to use species-specific issues in the form of Nepal's threatened vulture and snow leopard populations because learning about charismatic fauna helps students build empathy for the natural world and the complex systems that function here. The curriculum also focuses on writing and drawing exercises, group discussion, and observation as essential science skills outlined by NGSS. The lessons on geology and altitudinal biodiversity connect and help students frame the complexities of this area of the world, which can easily be compared to the Rocky Mountains of North America or wherever you may be teaching.

Developing a sense of place through field science allows for better community-led conservation efforts to be realized and fosters creativity and agency for students. I want my students to know that there are many ways to be a scientist and that, actually, all of us are scientists, artists, and stewards of the land every day if we choose to be.





Aldo Leopold's 10 Tenets of Place-based Knowing

Why is place-relational learning important? Place-based and place-relational learning emphasizes opportunities to study the culture, conduct natural investigations, problem-solve, engage with real world internships or work, and actively participate in their community.

From a teaching perspective, place-based education makes use of the surrounding phenomena which is intimate to all students and develops curricula out of that. All of these points aid students in practicing inquiry and investigation.

1. Wondering and Questioning- Questioning what is observed out-doors, and wondering about how that which is observed relates to the surrounding elements, can expand awareness.

2. Knowing Local History- The evidence of past and current human uses of the land can be examined and clues to local history can be uncovered.

3. Observing Seasonal Changes- By being conscious of the seasons and the accompany changes that they bring, observers can discover what is happening at the moment

4. Listening Intently- By stopping periodically along the trail, one can make more connections to the elements of the ecosystem.

5. Counting and Measuring- Simple counting and measuring exercises can result in fascinating revelations in the surroundings.

6. Empathizing with and Personifying Nature- One way of relating to living and nonliving elements of the environment is to envision them as "persons" worthy of empathy creatively.

7. Connecting Elements in Cycles- When nature and culture are viewed as interconnected circles or cycles, and their makeup and structure are carefully considered, new discoveries often result.

8. Finding Beauty- For beauty to be "in the eye of the beholder," time must be set aside to look for and find it.

9. Seeking Solitude for Reflection- Time alone, away from others in the group, can provide reflection opportunities to absorb the meanings of the place and consider humanity's role in the process of life.

10. Improving Land Health- Action projects can be physically, intellectually, and emotionally satisfying and help the land and local community.

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- Place-based learning can also be referred to as community-oriented schooling, ecological education, or bioregional education. Place-based education is a response to feeling alienated from nature and human nature. The term "landfullness" (described by Molly Ames Baker), also relates to these place-based ideas.
 - It's important to emphasize that not all environmental education, outdoor education, service learning or experiential education programs are place-based or, place-relational. Place-based learning brings with it its own pedagogy that can be applied to many different subject matters and grade levels.

Lesson: Nepal Geology & Erosion

No discussion of the region of Everest is complete with at least some diving into the geology of the area. The Khumbu region contains 14 peaks that are over 8000 meters tall, evidence of the highest uplift rate on the whole planet. It also contains the most number of glaciers outside of the world's polar regions. It is an area hallmarked by moraines and glacier valleys, as much as it is famed for its towering peaks.

Sandy layers of ocean floor were uplifted into Himalayan mountain ranges via the Indian subcontinent smashing against the rest of Asia, some 55 million years ago. The mountains continue to uplift, causing them to grow larger year after year.

Students will explore the geological processes and tectonic plate movements that have shaped the landscape of Nepal and the Everest region, gaining an understanding of the dynamic forces that contribute to the formation of the world's highest peaks.

Engage: Begin with a discussion on the significance of Mount Everest and Nepal's diverse geological features. Show captivating visuals, including maps, images of the Himalayas, and diagrams illustrating tectonic plate boundaries. Encourage students to share any prior knowledge or questions about the region.

Explore: Divide students into small groups and provide them with geological maps, diagrams, and hands-on rock samples. In a guided activity, have them identify key geological features and correlate them with the tectonic plate boundaries in the Everest region.

Explain: Lead a class discussion to explain the tectonic plate movements responsible for the formation of the Himalayas, emphasizing the collision between the Indian and Eurasian plates. Use multimedia presentations, animations, and real-life examples to clarify geological concepts such as subduction, uplift, and faulting. Connect these processes to the unique geological formations observed in Nepal. Have students look for evidence of erosion, dig in soil, and write down the characteristics.

Elaborate: Erosion poses a significant challenge in Nepal due to geographical, climatic, and anthropogenic factors. The country's rugged topography, steep slopes, and high mountains make it susceptible to soil erosion. Intense monsoon rains in Nepal exacerbate the problem by triggering landslides and accelerating soil loss.

Extend: Mountain & Stream watershed model activity.

NGSS Standards:

HS-ESS2-3:

Earth Systems: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

HS-ESS2-2:

Earth Systems: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

HS-ESS3-1:

Earth and Human Activity: Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

HS-LS2-7:

Ecosystems: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Lesson: Altitudinal Biodiversity

Altitudinal biodiversity refers to the variation in species diversity and ecosystems as one moves up or down a gradient of elevation. This phenomenon is particularly evident in mountainous regions, where changes in altitude result in distinct climatic and ecological zones. As elevation increases, temperature, precipitation, and other environmental factors undergo significant shifts, leading to the establishment of unique flora and fauna adapted to specific altitudinal ranges. Altitudinal biodiversity plays a crucial role in maintaining ecosystem resilience and provides valuable insights into the adaptation strategies of organisms in response to changing environmental conditions.

Students will understand the relationship between biodiversity and altitude, exploring how varying elevations impact the variety of plant and animal life in different ecosystems.

Engage: Introduce the concept of altitude and its impact on climate, vegetation, and wildlife. Altitude influences biodiversity by creating distinct ecological zones with varying environmental conditions, such as temperature and precipitation, shaping the unique adaptations of flora and fauna at different elevations. What are the key factors influencing altitudinal biodiversity patterns in the Khumbu region, and how do these factors contribute to the unique assemblage of species at different elevations? How does this compare to other mountainous areas, like the Rocky Mountains?

Explore: Use maps and diagrams to illustrate different altitude zones (lowland, mid-altitude, high altitude). Have students create a list of factors that may vary based on elevation: temperature, humidity, precipitation, soil composition, solar radiation, wind shadowing, heat retention, disturbance frequency, type of rock, topography, history of geology, latitude.

Explain: Share information about Nepal's diverse altitude range. Discuss the biodiversity in Nepal and how it changes as you move from lowlands to high mountains. Use provided visuals to highlight specific species found at different altitudes. Have students brainstorm reasons why biodiversity varies with altitude compared to latitudinal variation in biodiversity.

Elaborate: Take students outside to observe local plant and animal life. Ask students to identify and note the diversity they watch and discuss how altitude might influence it. Encourage students to reflect on the significance of altitude in shaping biodiversity. Discuss the importance of maintaining biodiversity for the overall health of the planet.

Extend: Assign a research project where students investigate a specific altitude zone and its associated biodiversity. They can present their findings in the next class. By the end of the lesson, students should have a clear understanding of how altitude influences biodiversity and its importance in maintaining balanced ecosystems.

NGSS Standards:

- The lesson plan involves developing a basic model of altitude zones and their impact on biodiversity, aligning with the practice of developing and using models (HS-ESS2-7).
- Analyzing pictures and information on flora and fauna at different altitudes corresponds to the practice of analyzing and interpreting data.
- The concept of altitude influencing climate and ecosystems aligns with the crosscutting concepts of scale, proportion, and quantity, as well as systems and system models.
- The lesson also touches on the human impact on Earth systems, especially in the context of biodiversity and conservation.

• Disciplinary Core Ideas:

- ESS2.C: The Roles of Water in Earth's Surface Processes
- ESS3.C: Human Impacts on Earth Systems

Lesson: Vultures & Human Wildlife Conflict

Vultures play a crucial role in ecosystem dynamics by efficiently scavenging and disposing of carcasses, thus preventing the spread of diseases, regulating population numbers of other scavengers, and maintaining overall ecological health through their indispensable role as nature's cleanup crew.

Studying human-wildlife conflict is crucial for developing effective conservation strategies, as it provides insights into the complex interactions between humans and wildlife, helping to mitigate conflicts, preserve biodiversity, and foster sustainable coexistence between people and wild animals.

Vulture populations in Nepal have faced a drastic decline due to factors such as habitat loss and indiscriminate use of diclofenac in livestock, highlighting the urgent need for conservation measures to safeguard these essential scavengers and maintain ecological balance in the region.

Engage: Begin with a brief discussion on the importance of biodiversity and the interconnectedness of ecosystems. Review concepts related to altitudinal biodiversity in Nepal. Introduce the concept of vulture population declines in Nepal, providing basic information on the causes and consequences. Pose the question: "Why should we be concerned about the decline of vulture populations?"

Explore: Distribute copies of Aldo Leopold's essay, "On a Monument to the Pigeon." Have students read the essay individually, emphasizing the historical context and Leopold's perspective on the passenger pigeon's extinction. Discuss key points from the essay as a class, encouraging students to share their interpretations and reflections. Guide the discussion to draw connections between Leopold's essay and Nepal's current situation with vultures. Explore the parallels and differences.

NGSS Standards:

- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
 - Evaluate various solutions to reduce the impacts of human activities on biodiversity and ecosystem health.
- LS4.D: Biodiversity and Humans
 - Analyze and interpret data regarding the impact of natural and human-made disturbances on biodiversity and ecosystem resilience.
- ESS3.C: Human Impacts on Earth Systems
 - Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Explain: Provide students with resources on the specific factors contributing to vulture population declines in Nepal, such as diclofenac use, habitat loss, and poaching. Facilitate a class discussion on potential solutions and conservation efforts to address vulture declines. Explore the concept of human-wildlife conflict in the context of vultures. What are the primary conflicts, and what strategies can be employed to mitigate these conflicts while ensuring the conservation of vulture populations?

Elaborate: Introduce the concept of human-wildlife conflict and its relevance to avian species, including vultures. Discuss instances of human-wildlife conflict related to vultures, such as poisoning, deliberate killing, or competition for resources. Have students brainstorm and discuss potential strategies for mitigating human-wildlife conflict involving avian species. How do we balance conservation for endangered species and human-wildlife conflict concerns?

Extend: Initiate a discussion on the crucial role of community-based conservation initiatives in mitigating human-wildlife conflict. Highlight the significance of local communities as critical stakeholders in fostering coexistence. Delve into ways in which communities can actively participate.

- Organize a field trip to a local zoo or wildlife rehabilitation center to observe and learn about vulture conservation efforts firsthand.
- Spend time observing vultures' behavior and studying detritivores' role in the ecosystem.

Lesson: Literature & Nature Journaling

Students will engage with Peter Matthiessen's "The Snow Leopard" through nature journaling and phenology, gaining a deeper understanding of the book's themes and connecting the text to real-world observations of nature. By combining the exploration of "The Snow Leopard" with nature journaling and phenology, students will deepen their understanding of the book's themes, experience the thrill of nature exploration the work of a field biologist, and develop a stronger connection to the natural world. "Have you seen the snow leopard? No! Isn't that wonderful?" - Peter Matthiessen

Engage: Ask students if they have ever heard of or seen a snow leopard or another rare animal. Share the quote by Peter Matthiessen: "Have you seen the snow leopard? No! Isn't that wonderful?" What does that mean to them, having been living in a natural environment and developing their definitions of "wildness"? Discuss the excitement and mystery surrounding the snow leopard and elusive species in general for field biologists. Show images or videos of snow leopards and other wildlife in their natural habitats. Discuss the concept of nature exploration and seeing animals one is studying in their natural environment.

Explore: Provide an overview of the book, emphasizing the author's journey and reflections on nature and spirituality. How does this relate to our lessons on TEK and ways of knowing? Review Grinnell journaling techniques, show students examples of nature journals, and encourage them to develop their style. Introduce the concepts of nature journaling and phenology, linking them to the book's themes. Ask students to jot down thoughts, emotions, and nature descriptions in their journals. Discuss passages as a class, emphasizing the author's observations and connections with nature.

Explain: Assign relevant chapters from "The Snow Leopard" for independent reading. If we have time and resources, watch this lecture from author Harry W. Greene. How does the way we write about nature affect how we protect it? Review topics like keystone species, umbrella species, ecosystem services, and engineers, and discuss how different art forms can be used to change public perception and increase protection.

Elaborate: Introduce the concept of phenology and its relevance in understanding natural seasonal changes. Provide resources for students to identify local plants, animals, and seasonal patterns. Ask students to record phenological observations in their nature journals. Have students imagine encountering a snow leopard or another wild animal. Prompt them to consider the sensory experience, the animal's behavior, and the surrounding environment. Encourage research on the chosen animal's characteristics.

Extend: Discuss how creative expression enhances their understanding of the animal and its environment. Assign a reflection essay where students connect their nature journal entries and phenological observations to themes in "The Snow Leopard." Have students related this to other data types? Is qualitative data valuable here? How can writing be used to collect data?

NGSS Standards:

HS-LS2-6:

Ecosystems: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions.

HS-LS2-2:

Ecosystems: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity.

HS-ESS3-2:

Earth and Human Activity: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

This can be adapted to be about any book your students are reading or one they pick themselves!

Lesson: Traditional Ecological Knowledge

Students need to understand the global perspectives that exist in conservation. The National parks in the USA are a standard adopted in many countries globally. These various cultures often take a more holistic approach to science and conservation, a skill that is helpful to hone for students. Often, local and indigenous practices in science also include the responsibilities and tenets of self-management that are only sometimes the primary goal of academic learning. To understand the ecosystems of Nepal in a global context, we will examine TEK and discuss what science means to us. How do we apply a bio-cultural approach to conservation? How do areas like Nepal, Costa Rica, and Hawai'i, rich in culture and biodiversity, interact with conservation?

Engage: Traditional Ecological Knowledge (TEK) refers to the cumulative, experiential knowledge and practices concerning their environment developed by indigenous and local communities over generations. This knowledge encompasses a deep understanding of ecosystems, biodiversity, and the interconnections between humans and nature. Begin the lesson by asking students about their understanding of traditional knowledge related to the environment. Discuss any experiences they may have had with ways of knowing or indigenous communities.

Explore: Divide students into small groups and provide them with case studies or examples of TEK in Nepal.

Examples could include sustainable agricultural practices, traditional medicine, or wildlife conservation methods. Each group should research and present their findings, discussing how TEK contributes to environmental sustainability. Encourage students to think critically about the practical applications of TEK in the modern world.

Explain: Discuss how TEK differs from Western scientific knowledge and explore the strengths and limitations of each approach. Provide additional examples from different cultures worldwide to broaden the understanding of TEK.

What methods are used in TEK that are also used in Western science?

How can we apply these types of observations in our scientific notes?

Is there an application of the scientific method in TEK? Can you give examples?

Elaborate: Have students write a story in the style of the oral tradition story from the Himalayas about some of our concerns for the environment we are studying today. What would be essential to warn future generations or our peers about?

Extend: As a group or in small groups, read the provided oral traditional story "When the Deer Go Away"

What was trying to be communicated here to others? How might stories like this be necessary for conservation before colonization and western influence in the Eastern Himalayas?

NGSS Standards:

HS-ESS3-1: Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources result from past and current geoscience processes.

HS-ESS3-4:

Evaluate or refine a technological solution that reduces the impacts of human activities on natural systems

HS-ESS3-5:

Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

These NGSS standards highlight the interdisciplinary nature of the lesson, integrating environmental science, cultural understanding, and ethical considerations. The lesson encourages students to apply scientific principles to real-world issues and promotes an appreciation for diverse ways of knowing about the environment.

