

Relationships in Socio-Ecological Systems Framework

Why is thinking about relationships important for educators?

Interdependent relationships undergird all aspects of socio-ecological systems, are dynamic and shift across time, space, and levels of organization. Research shows that sensemaking across these multiple shifting scales requires intentional scaffolding, particularly for young learners and is necessary for complex socio-ecological systems learning. NGSS practices such as observing, modeling, and data collection can support learners' attention to webs of relationships in and across places and over time. This framework features two aspects of interdependent relationships in socio-ecological systems sensemaking: 1) **quality of social and ecological relationships** that expert scientists, policymakers, and communities think about; and 2) the **base relationships of species and kinds** that undergird interactions in a system. This framework is intended to develop learners' relational habits of mind - that is the routinely sensemaking about interdependent relationships - and support educators, students, and their families develop a language for attending to powered and historicized relationships at the intersections of social and ecological worlds.

How to use this framework

Learner Sense-Making: Plan activities that help learners see and make sense of multiple and interacting relationships in their socio-ecological systems, particularly how humans are interdependent in these places. Engage with families' relationships, knowledges, and practices in the places that are important to their wellbeing.

Planning and Implementation: Plan sequences of activities that extend learners' sensemaking about complex systems utilizing a variety of place-based investigations such as field investigations, community-based research, and research from print and digital media. Routinizing place-designing (mapping learning affordances and constraints in place) can also help you identify the kinds of socio-ecological relationships that shape the multiple learning environments of young people and their families.

Co-Design and Assessment: Co-plan with other educators and families to build robust knowledge of the multiple interacting systems of relationships, power, and historicity within your socio-ecological system. Use this framework to guide your use of formative assessment tools that help you understand how learners are understanding various relationships and how they are using them to reason about complex socio-ecological phenomena, as well as engage in deliberation and decision-making.

Educator Reflection: Reflect on your own understandings about different types of relationships in complex socio-ecological systems. What types of reasoning have you used to think about these relationships? What more do you need to understand and explore in order to better support learners as they identify, locate, explain, and reason about these relationships?

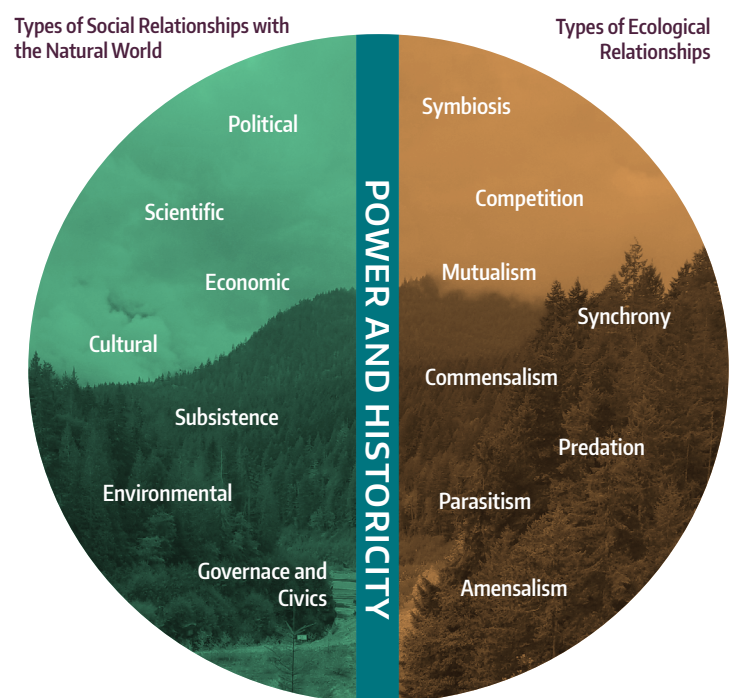
Collaborative Practice: Support field-based science practices that help learners locate, observe, explain, and reason about various relationships across the many places where they learn, including classrooms, homes, neighborhoods, and communities. Scaffold learners to think about complex relationships across multiple scales such as temporal, spatial, and seasonal.

Part 1: Framework for Socio-Ecological Relationships

This framework is intended to help identify the range of social and ecological relationships that scientists, policy makers, and communities think about as they engage in everyday activities and collective deliberation and decision-making. Nature-culture relations - that is the cultural values, activities, learning opportunities, decisions, and interactions - are reflected across both social relationships with the natural world and how scientists study ecological relationships within systems. Typically, science education focuses on ecological relationships where the types of human relations and interactions are invisible to learners. Educators should use this framework to consider 1) what kinds of human relationships are shaping local learning environments (indoors and outdoors), and 2) what kinds of ecological relationships are observable and shape local lands, waters, and interactions with humans. Learners should be able to identify their own social and ecological relationships in and across the many different places they live and learn.

Quality and Types of Social and Ecological Relationships

- a) **Economic relations** include commodification of lands, waters, species, and kinds for profit as well as regional employment and tourism.
- b) **Political relations** include nation-state interactions and policies that affect and govern access to-, ownership of-, and/or the rights of- lands, waters, and more-than-human others.
- c) **Scientific relationships** include the study of socio-ecological systems and components within systems in both natural and controlled environments.
- d) **Cultural relations** include the spiritual, religious, leisure, recreation, and other practices and activities on lands, waters, and with more-than human others. All social relationships with the natural world are cultural.
- e) **Subsistence relations** include the human cultivation of the natural world for food or economic subsistence or ecosystem management.
- f) **Environmental relations** include the use of- or conservation of- lands, waters, and more-than-humans others to protect the health of environments.
- g) **Governance and Civics Relations** include the collective management of lands, waters, and more-than-human others through informed citizenships and civic feedback cycles, observation & data collection.



- h) **Symbiosis** is the interdependent relationship of two dissimilar organisms who live together in a long-term, intimate association. Below are types of symbiotic relationships.
- i) **Competition** is when two or more organisms rely on the same environmental niche or biological need.
- j) **Mutualism** is a symbiotic relationship where both organisms benefit.
- k) **Synchrony** is when species time parts of their lifecycle (reproduction, migration, etc.) based on seasonal changes in behavior in another organism.
- l) **Commensalism** is a symbiotic relationship where one organism benefits and one does not benefit but is unharmed.
- m) **Predation** includes any interaction between two species in which one species benefits by obtaining resources from and to the detriment of the other.
- n) **Parasitism** is a symbiotic relationship where one organism benefits and one is harmed. Many ecologists include parasitic interactions in discussions of predation.
- o) **Amensalism** is a routine interaction in which the presence of one species has a negative effect on another, but the first species is unaffected.

PART 2:

Foundational Conceptual Relationships in Socio-Ecological Systems

“Base relationships” are the basic conceptual building blocks of socio-ecological systems that include pairs of relationships between species, kinds, and places over time.. This framework is intended to help learners identify, collect data about, and reason across the base relationships they directly and indirectly observe in their field investigations and in sense making about socio-ecological phenomena. Educators can use this framework to assess learners’ sensemaking about interdependent relationships and design opportunities for learners to expand their knowledge.

This framework is not intended to reinforce strict taxonomies or categories of life on Earth. Such taxonomies often confuse learners as they try to fit species or kinds within narrow conceptions of living or nonliving beinghood or types of species or kinds that are typical of Western science. This can foreclose meaningful sense making about the behaviors, functions, and structures of particular species and kinds as well as relationships between them.



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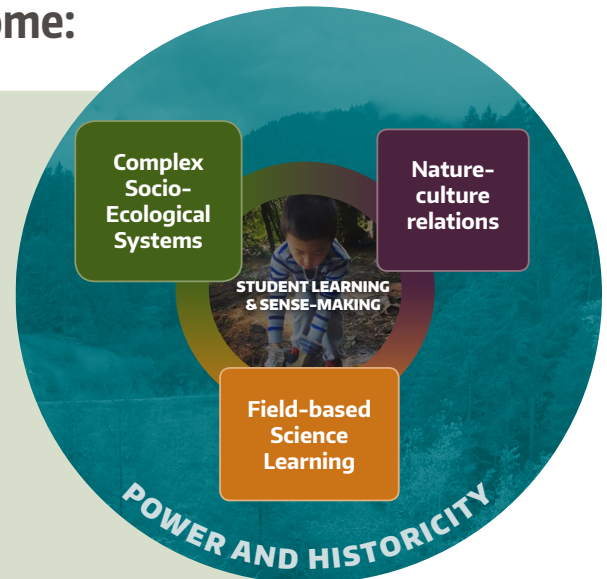
Interspecific Base Relations		
“Interspecific” refers to relationships between species and kinds. These include symbiotic relationships that are predictable as well as novel relationships.	Animal-Human Animal	Animal-Plant
	Animal-Natural Kind (sun, temperature, wind, water, soil)	Animal-Microorganism (bacteria, fungus, virus, etc)
	Animal-Animal	Plant-Human Animal
	Plant-Microorganism	Plant-Natural Kind
	Plant-Plant	Microorganism-Natural Kind
	Microorganism-Human Animal	Microorganism-Microorganism
	Natural Kind-Natural Kind	Human Animal-Human Animal
Place Based Relations		
Places, lands, and waters shape the kinds and qualities of relationships	Animal-Places, Lands, & Waters	Microorganism-Places, Lands, & Waters
	Plant-Places, Lands, & Waters	Natural Kind-Places, Lands, & Waters
	Human Animal-Places, Lands, & Waters	
Intraspecific Relations Across Scales		
Relationships are dynamic and change over multiple temporal scales and between individuals and populations	Ontogenetic - intra and interspecific relationships change across life cycles and across migratory and seasonal patterns.	Phylogenetic - species' adapt to their places, lands, and waters and in their relationships over multiple generations
	Sociogenetic - interactions and relationships over time shape communal life development, including the (re)production of social learning and cultural tools of more-than-humans and humans	
	Agent Level - these are the interactions and relations we typically observe between single subjects of species and kinds.	Aggregate Level - these are the <i>patterns</i> of interactions that happen at a community level (within a habitat or region) and population level (species).

Connections to expert thinking:

Knowledge and knowing is always in relations and increasingly experts engage in multi-disciplinary or trans disciplinary inquiry. *“Local people across the globe are continuously faced with the challenges of adapting and developing their knowledge to cope with local manifestations of regional and global environmental change. Part of this knowledge is locally or regionally maintained, adapted, and transmitted both orally and in practice, but is also in constant interaction with other forms of knowledge”* - Tengo et al., 2014

Connections to the Learning in Places Rhizome:

Complex Socio-Ecological Systems: Complex socio-ecological systems are made up of interacting and interdependent relationships that occur in patterned ways over multiple temporal and spatial scales. Some interactions are also novel as species migrate and inhabit shared places, lands, and waters. While learning about singular species (e.g., life cycle of a butterfly or frog) is common in early childhood science education, it does not support complex systems learning. Rather, observing and making sense of webs of relationships and the role of human and more-than-human species, natural kinds, in and across places is necessary for complex systems learning and decision-making.



Nature-Culture Relations: For understanding relationships in complex socio-ecological systems, it is important to begin with the premise that humans are part of the natural world (not separate from it). What roles do humans (including human artifacts) play in various socio-ecological relationships? How does human decision-making impact these relationships? How does a better understanding of the various relationships in specific places impact human deliberation and decision-making relative to those places? Why is it useful to take the perspectives of other “kinds” involved in relationships-in-place (as opposed to only exploring these relationships from human-centered lenses)?

Field-Based Science Learning: Field-based science practices help to identify and explore socio-ecological relationships. Learners can observe plants, animals, other people, and elements (such as water for example) in specific places, and focus their observations on understanding what relationships they can observe among who and what are in the environment. For example, perhaps a family might be out for a walk and they notice a sidewalk that is cracked and elevated, and then they notice a tree about six feet from the sidewalk. What relationship might there be between the tree and the sidewalk? Are there other “kinds” that are involved in that relationship but that can’t be observed with one’s eyes? How could that relationship be characterized and why? In another example, if a teacher and learners are observing fallen trees in a forest and see bite marks on the trees, and then they notice some water in the same area, what might they predict about the relationships in the area? Who and what is in relationship with who and what? How could they investigate their ideas and make further sense out of their observations?



Power and Historicity: Socio-ecological relationships are powered and have histories that educators should help learners identify and explore. For example, how have relationships among plants and animals been impacted by human activity? Has that changed from Indigenous People’s Time to Nation-State Time (see the Socio-Ecological Histories of Place framework), and if so, how? Learners often only receive narratives of human relationships of ecological harm or consumption. This narrative is both inaccurate to characterize all human interactions, and it minimizes possible ethical and healthful responsibilities and relationships.



Suggested Citation

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