

The Five Environmental Literacy Strands and their Elements^{8, 19, 20}

1) Systems thinking

Students study systems and issues holistically, striving to understand the relationships and interactions between each system's parts. They use the knowledge gained to assess the effects of human choices on economic, ecological and social systems, and to optimize outcomes for all three systems.

- a. System structure. Understand how the complex structure of a system determines its outcome. Describe a system's structure, and model changes to that structure.
 - Dynamic systems consist of interdependent parts that change over time and produce outcomes.
 - Complex systems are made up of smaller subsystems.
 - The relationship between the parts of a system (its structure) determines its outcomes and behaviors.
 - Changing the outcomes of a system requires changing its structure.
 - Dynamic systems have circular feedback loops (e.g., A affects B; B affects C; and C affects A, beginning the cycle again).
- b. Habits of systems thinking. Understand the habits of systems thinking, and identify opportunities to apply them.
 - Question and test assumptions.
 - Use understanding of system structure to identify possible leverage actions.
 - Recognize the impact of time delays on cause-and-effect relationships.
 - Recognize the circular nature of complex cause-and-effect relationships.
 - Understand that a system's structure generates its behavior.
 - Consider how mental models affect current and future reality.
 - Consider short- and long-term consequences of actions.
 - Consider issues fully, resisting the urge to come to a hasty conclusion.
 - Seek new perspectives to increase understanding.
 - Check results and change actions as needed (successive approximation).
 - Notice how system elements change over time, generating patterns and trends.
 - Identify where unintended consequences emerge.
 - Seek to understand the big picture.

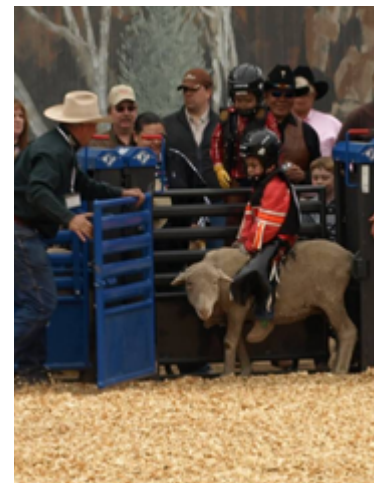
- c. Strategic responsibilities of systems thinking. Apply the habits and techniques of systems thinking to decision-making.
 - Envision, design, plan, act, and assess outcomes with the whole system in mind.
 - Explain how human action or inaction affects the systems in which we live.
 - Recognize that mental models develop gradually from our experiences and surroundings and can therefore limit our perspective.
 - Draw on an understanding of mental models when developing action plans.
 - Explore system structures to deepen understanding and to plan actions that achieve positive systemic impacts.
 - Consider the intentional and unintentional short- and long-term consequences of actions in order to determine whether the rewards are worth the risks, and develop a plan to mitigate risk as much as possible.
 - Consider the effects of human choices on economic, ecological and social systems.
 - Monitor system outcomes, and make adjustments where necessary to maintain or improve desirable outcomes.
 - Ask probing questions when things don't work as planned; reexamine the system's structure and propose changes.



2) Physical, living and human systems

Students understand the characteristics of Earth's physical, living and human systems.

- a. Structure, function, interaction and change in physical systems. Explain the dynamic and interconnected nature of Earth's physical systems, including:
 - The structure and composition of the atmosphere, geosphere and hydrosphere
 - Changes in matter (physical and chemical properties of elements and compounds; the global carbon cycle)
 - The properties of energy (e.g., transfer of energy; energy transformation and conservation; the laws of thermodynamics)
 - The cycling of matter and energy between system components
 - Evidence for geologic, climatic and environmental changes over time
 - Climate (Sun-Earth relationships; processes that drive and regulate climate variability; interrelationships of climate and Earth's other physical and living systems)



- The influence of oceans on weather and climate; interrelationships of oceans and Earth's other physical and living systems
- Earth systems' indicators of sustainability

b. Structure, function, interaction and change in living systems. Explain the dynamic and interconnected nature of Earth's living systems, including:

- The structure and function of organisms, populations, communities, ecosystems and biomes
- The principles of ecology, including biodiversity; carrying capacity; habitat sources and sinks; population dynamics; and ecosystem change
- Heredity, evolution, species change, and the process of natural selection



- Matter and energy flow in organisms (i.e., processes by which plants and animals obtain energy and materials for growth and metabolism; biogeochemical cycling)
- The interdependence of plants, animals and the environment, and how adaptation influences survival
- Ecological indicators of sustainability

c. Structure, function and interconnectedness of human systems. Explain the dynamic and interconnected nature of political, economic, social and cultural systems.

- Compare and contrast the structure and function of political systems, including:
 - The organization, responsibilities and interactions of governments at local, state, tribal, national and global levels
 - The roles and activities of political parties, interest groups, and mass media, and their effect on the beliefs

and behaviors of local, state and national constituencies

- Concepts of political power, authority, conflict and conflict management
 - Relationships between government and citizens, including forms of civic participation in local, state, tribal, national and global communities
 - The impact of government functions and processes on societies and citizens, including how different levels of government provide services and protect citizens
 - Concepts of public, private and common good, and how governments define, support and limit each
 - Instances of common interests among nations and global collaboration
- Compare and contrast the structure and function of economic systems, including:
- Allocation of scarce resources through individual choice, market interaction, and public policy; and the cost and benefits of these decisions to individuals and societies
 - Definition of economic terms (e.g., elasticity, substitution, externalities, regulation, legislation) and examples of these terms as they relate to the current economy, with particular attention to the use of natural resources
 - The history, philosophy and patterns of various economic systems and activities, and their effects on equity, prosperity, cultural diversity, and the environment
 - Economic input-output analysis and life cycle analysis of resource use, manufacturing, and end-of-life options for products (i.e., recycling, disposal, remanufacturing)
 - The production, distribution, consumption and disposal of goods, and the effect of these human choices on the sustainability of Earth's natural, economic and social systems
 - The relationship between public and private ownership and the commons, including characteristics of the commons and property
 - Relationships between property ownership, entrepreneurship and economic growth, and how these can be balanced with the common good

- Consumption and consumer choice (e.g., how consumption choices affect the health of places and people, and how the media shape consumption patterns)
- Economic indicators of sustainability

→ Compare and contrast the structure and function of social and cultural systems, including:

- The characteristics of diverse cultures, and how they change over time
- How experiences and places are interpreted by people with different cultural backgrounds; at different times; or with other frames of reference
- How different people understand the commons and the types of measures needed to maintain its health
- How individuals relate to others, including relationships between individual identity, family, society and culture
- Concepts of responsibility, fairness and equity, especially as they relate to intergenerational relationships, environmental conditions, consumer choice, resource use, and sustainability
- How individual and societal actions value or devalue the worth and potential of other human beings
- The influence of individual traits and group affiliations on perception of the environment
- The effect of individual and group actions on the environment, and how groups can work to promote and balance their interests
- Shared and conflicting societal values and principles
- Social indicators of sustainability

→ Analyze the social, cultural and economic indicators of sustainability.

3) Interconnectedness of people and the environment

Students understand the interdependence of humans and the environment, and appreciate the interconnectedness of environmental quality and human well-being.

- a. Sense of place, region, nation and global community. Explain “sense of place” as the connection between people and a place, encompassing the interrelationships

between patterns of human settlement; social and cultural relationships; communities and regions; and the natural world.

→ Analyze the characteristics of their community and region, including:

- Spatial concepts (location, distance, direction, scale and movement)
- Natural features, including flora, fauna, climate, and geologic features such as soils and watersheds
- Distribution and settlement patterns
- The cultural and economic heritage, and current character, of the community and region, including local food and transportation systems and livelihoods associated with the regional economy
- Continuity and changes in places over time
- Physical and human characteristics of places and regions, and their connections and interdependence
- Why places and regions are important to human identity

→ Analyze the interconnectedness of physical and human regional systems and the global community, including:

- Relationships between Earth’s major physical and human features
- How the human and physical aspects of places and regions relate to development and human identity, and serve as symbols that unify or fragment society
- How knowledge of one region can be applied to the study of others
- The interdependence of renewable and nonrenewable resource use at the local, regional, national and global scale
- The causes of human migration, and its impact on physical and living systems
- Economic, cultural and environmental factors that influence population changes (including food production capacity, medical advances, and disease control), and the consequences of these changes
- The roles that self-interest, differing points of view, and the global distribution of natural resources play in territorial conflicts





- Conflicts involving land use, economics, resource competition, political views, boundary disputes, and cultural differences within and between geographic areas

- b. Interrelationships between the environment and human activities. Analyze how environmental changes affect human systems; how human activities and systems change the environment; and the connection between environmental quality and human well-being.
 - Analyze how environmental changes affect political, social, cultural, economic and health systems.
 - Analyze how human activities and systems change Earth's physical systems (e.g., atmosphere, ocean, climate, soil, landforms) and living systems (e.g., ecosystems, biodiversity, carrying capacity).
 - Explain the interrelationships between environmental quality—including air quality; water quality and quantity; biodiversity; climate change; disease vectors; and natural disasters—and human health and well-being, including the ability to produce and access nutritious food, to access shelter, and to achieve and maintain mental and physical health.
 - Describe the human ability to shape and control the environment by developing new knowledge and technologies, including agricultural and food systems; transportation systems; waste management systems; communication systems; energy systems; and habitation systems.
- c. Resource distribution and use. Analyze how resource distribution and use shape our political, economic, physical and social

environments, and how they influence cooperation, competition, territorial conflict, and national security.

- Explore the relationship of the environment to national security, including energy security, food security, and climate change.
- Describe how human cooperation and competition for resources shape our political, economic, physical and social environment.
- Explain human dependence on renewable and nonrenewable natural resources for life, adequate sustenance and quality of life.
- Describe the roles that differing points of view; self-interest; political and economic systems; and global distribution of natural resources play in conflicts over territory.
- Explain how resource competition leads to conflicts between and within geographic areas (e.g., land use, food, water, energy sources, boundary disputes, and human migration).

4) Personal and civic responsibility

Students understand the rights, roles, responsibilities and actions associated with leading or participating in the creation of healthy environments and sustainable communities.

- a. Rights and responsibilities of citizens. Analyze citizens' rights and responsibilities and their importance in making choices locally and globally.
 - Explain the personal, political and economic rights of U.S. citizens.
 - Describe the personal responsibilities of citizens in a community, state and nation.
 - Analyze civic ideals (e.g., freedom, rule of law, equality, responsibility, civic participation, equity, respectful deliberation).
 - Compare and contrast views on individual responsibility to the commons.
 - Explain the importance of civic dispositions, including trust, honesty, patience, self-discipline, respect and open-mindedness.
 - Consider whether civic obligations require individuals to subordinate their interests or desires to the public good.
 - Evaluate how conflicts arise between individual rights and societal interests,

such as a healthy environment and a sustainable community.

b. Sense of personal responsibility.

Identify and describe personal and group responsibility; the effect of human actions on the future; and the importance of fulfilling personal responsibilities by participating thoughtfully and effectively in decision-making.

→ Explain the notion of responsibility; identify basic personal responsibilities; and compare their view of their own responsibilities with commonly accepted societal views.

→ Evaluate responsibilities in terms of their short- and long-term effects.

→ Analyze the effects that they and the groups they belong to (e.g., family or classroom) have on environmental and community sustainability.

→ Evaluate the importance of fulfilling personal responsibilities for themselves, as well as for society, the commons, people in other places, and other living beings.

→ Develop self-confidence in their effectiveness as citizens (self-efficacy) by understanding:

- How individual and group action can create beneficial change, meet individual needs, and promote the common good
- How citizen action and public opinion can influence environmental policy
- How citizen action has affected environmental quality and sustainability
- How students of their own age have affected environmental quality and sustainability
- Ways in which their own actions have made a difference

→ Show a willingness to work individually and collectively to resolve issues and to participate thoughtfully and respectfully in decision-making.

→ Explain how the decisions of one generation create opportunities for, and impose constraints on, future generations.

→ Apply the strategic responsibilities of systems thinking to real-world decision-making (see Strand 1c).



5) Investigate, plan and create a sustainable future

Students apply civic action skills that are essential to healthy, sustainable environments and communities.

a. Work with flexibility, creativity, openness and perseverance. Form and evaluate personal views; engage in informed deliberation; and use creativity to make previously unrecognized connections.

→ Form and evaluate personal views:

- Identify personal mental models about the world, and recognize them as guiding constructs that change in response to new knowledge and applied insight.
- Articulate multiple sides of an issue, and propose defensible conclusions that address diverse perspectives.
- Evaluate, communicate and justify personal views.
- Evaluate personal beliefs and values, using such criteria as personal well-being; equity; social and environmental welfare; economic vitality; and concern for living beings.
- Consider differing viewpoints, and assess credible information that challenges their positions.
- Evaluate whether and how differing views should affect their own views.
- Apply a global perspective to contemporary and historical issues.
- Evaluate the strength of conclusions by differentiating evidence-based reasoning from reasoning based on incomplete information, opinions, fear, bias, or exaggeration.





→ Engage in informed and respectful deliberation on local, state, tribal, national and global issues:

- Demonstrate knowledge of diverse cultural, linguistic and artistic expressions.
- Communicate and collaborate cross-culturally.
- Work with people who have different perspectives.
- Seek to identify the interests that underlie people's positions and behaviors.
- Cooperate productively in work teams to identify and solve problems.
- Display initiative and demonstrate respect for other team members while completing tasks.
- Exhibit a strong work ethic, including responsibility and reliability.
- Apply upstream problem identification and systems thinking.

→ Think creatively to make previously unrecognized connections:

- Explore connections, consider analogies, and synthesize ideas to arrive at new ways of thinking.
- Explore concepts that connect economic opportunities and job creation with sustainable communities and a healthier environment (e.g., innovations in food production, energy generation and use, transportation, and water management).

- Generate new ideas by making novel connections between concepts.
- Demonstrate flexibility.
- Take opportunities to express ideas and emotions.

b. Assess the accuracy and reliability of information sources. Evaluate the quality of information from primary and secondary sources.

- Gather and organize relevant data.
- Use basic logic and reasoning skills to evaluate the reliability of information.
- Identify logical errors and spurious statements in everyday communications, such as advertising and political rhetoric.
- Look for and explain logical flaws in arguments, such as faulty or misleading use of statistics; misrepresentation of data; and biased selection of data to support a claim (cherry-picking).
- Explain why some research results are more credible than others.
- Identify sources and evidence of bias in interpretation, funding sources, and research procedures.

c. Identify and analyze strategies that address challenges and create desired futures. Investigate problems, evaluate possible solutions, and propose actions.

- Investigate differing perspectives on a current issue:
 - Consult various unbiased sources to define and clarify the dimensions of the issue.
 - Develop a method to explore relationships between key dimensions of the issue.
 - Identify key individuals and groups, including those who are affected by the issue.
 - Explain various perspectives on the issue and the reasoning behind them.
 - Examine contextual elements that shape the issue, and identify historical antecedents or contemporary parallels.
 - Analyze the characteristics, causes and consequences of the issue.
 - Develop and use indicators to measure movement toward or away from goals.
 - Use the concept of cumulative effects to explain why specific changes or human actions cannot be considered in isolation from others.



- Identify the most upstream problems to address within their sphere of influence.

→ Identify and evaluate alternative courses of action, and propose solutions or support actions:

- Synthesize various perspectives, data, and methods of analysis to devise solutions or actions.
- Use knowledge of functional relationships, modeling, and statistical analysis to evaluate options.
- Use cost/benefit analysis, cumulative effects analysis, environmental impact analysis, ethical analysis, risk analysis and related methods.
- Propose and justify actions that are likely to be effective.

d. Demonstrate effective decision-making and citizen action. Analyze options, plan actions, evaluate outcomes, and reach evidence-based conclusions.

→ Evaluate the need for action:

- Decide whether action is warranted, based on available evidence about the issue and proposed solutions; the scale of the concern; the legal, social, economic and ecological consequences; and alternatives to citizen action.
- Identify options for citizen action, including consumer choices; resource use choices; writing letters to the editor; drafting legislation, ordinances or policies; environmental stewardship projects; and communicating with decision-makers.
- Speculate on the probable effects of specific actions and the likelihood that they will resolve the problem.
- Decide whether to take personal action, based on their own values, skills, resources and commitments.
- Communicate decisions clearly and support them with reasoned arguments.

→ Plan and take action:

- Envision a desired endpoint.
- Articulate clear reasons and goals for action.
- Develop a plan for individual and collective action.
- Set measurements for success that are consistent with the abilities of the groups involved.



- Decide whether to modify the plan—and when and whether to implement it—and take appropriate action.

→ Identify, compare and evaluate results (outcomes and responses) to reach an evidence-based conclusion:

- Analyze the long- and short-term consequences of action and inaction.
- Consider the intended and unintended effects of action and inaction on themselves, others and the environment.
- Evaluate the apparent effects of actions in terms of action goals, societal goals, and ethics.
- Articulate lessons learned.
- Account for any difficulties in evaluating the results of actions.

Graduation Requirements (adapted from Oregon Department of Education)

In January 2007, the Oregon State Board of Education voted to adopt new high school graduation requirements that will better prepare each student for success in college, work and citizenship. To earn a diploma, students must complete the credit requirements, show proficiency in essential skills, and meet personalized learning requirements. Students will also have the option of earning credit for proficiency. The phase-in schedule (2007 to 2014) allows students, families, schools and teachers to prepare for these new requirements.

Proficiency in essential skills could be demonstrated through environmental literacy. Essential skills are “process skills” that cross