Chapter 3: Educational Standards and Graduation Requirements

To be effective, education for environmental literacy needs to be integrated throughout the curriculum in every classroom in Oregon and include sustained opportunities for students to participate in outdoor learning experiences. To facilitate this process, the following Environmental Literacy Strands were developed that articulate a comprehensive content and skills learning framework. It is expected that environmentally literate students, upon graduation from twelfth grade, will demonstrate proficiency in each of these five strand areas with evidence that these proficiencies were acquired outdoors.

In a companion document, these Environmental Literacy Strands have been aligned with the Oregon Academic Standards, making it possible to identify where the learning content for cultivating environmentally literate citizens is supported. Intent was given to using language in the Environmental Literacy Strands that appears in both state and national standards. We recommend that these strands be incorporated across all curricular areas and grade levels in support of existing Oregon Academic Standards.

Central to the Oregon Environmental Literacy Plan is the **importance of learning outdoors and in the community**. Educators foster learners' innate curiosity and enthusiasm, providing them with early and continuing opportunities to explore their environment. Beginning close to home, learners forge connections with, explore, and understand their immediate surroundings. The sensitivity, knowledge, and skills needed for this local connection provides a base for moving out into larger systems, broader issues, and an expanding understanding of causes, connections, and consequences.

The instructional strategies necessary for implementing education for environmental literacy are addressed specifically within Chapter 4: Professional Development.

These Environmental Literacy Strands were developed with input from the Environmental Literacy Task Force and working groups. Much of the material was adapted from Oregon Academic Standards, NAAEE (2010) *Excellence in Environmental Education Guidelines for Learning* (K-12) and Cloud, J. (2010) *Education for Sustainability Standards*, Cloud Institute.

The Environmental Literacy Strands are organized into five, broad areas:
1) Systems Thinking
2) Physical, Living and Human Systems
3) Interconnectedness of People and the Environment
4) Personal and Civic Responsibility
5) Investigate, Plan and Create a Sustainable Future

The Five Environmental Literacy Strands and their Elements:

1) Systems Thinking: Students apply systems thinking skills to study various types of systems and issues from a holistic perspective, striving to understand the relationships and interactions among the systems' parts. Students use the knowledge gained to consider the implications, and consequences of choices on the economic, ecological and social systems within which they live, in order to optimize outcomes for all three systems.

NOTE: Systems Thinking is purposefully placed as the first strand. Systems Thinking, with its overarching set of habits, concepts, tools, and skills, is applied throughout education for environmental literacy because this skill provides the foundation for understanding the whole and the interrelationships amongst the parts. Systems Thinking is not limited to any one subject and can be practiced through all curricular areas. The Partnership for 21st Century Skills considers systems thinking – the ability to "analyze how parts of a whole interact with each other to produce overall outcomes in complex systems" – a critical skill for all students. http://p21.org/documents/P21_Framework_Definitions.pdf page 4 [see Appendix A for more information on systems thinking]

a. **Systems Structure.** Understand the complex structure of systems and how system structure determines outcome. Describe the facets of a system's structure, and model changes to that structure.
   ▪ Dynamic systems are made up of a group of interdependent parts that change over time, producing an outcome.
   ▪ The relationship between the parts of a system (its structure) will determine its outcomes/behaviors.
   ▪ To change the outcomes of a system the structure needs to be changed.
   ▪ Complex systems are made up of smaller sub-systems.
   ▪ Dynamic systems have circular feedback loops; one part affects another and so on until the effect feeds back to the original part (i.e., A effects B, B effects C, which comes "back" to effect A and the cycle begins all over again).

b. **Habits of the Systems Thinker**. Understand, identify examples and opportunities, and apply the Habits of a Systems Thinker, assisted by knowledge of systems thinking concepts and tools (see Appendix C – Systems Thinking).
   ▪ Surface and test assumptions.
   ▪ Use understanding of system structure to identify possible leverage actions.
   ▪ Recognize the impact of time delays when exploring cause and effect relationships.
   ▪ Identify the circular nature of complex cause and effect relationships.
   ▪ Recognize that a system's structure generates its behavior.
   ▪ Consider how mental models affect current reality and the future.
   ▪ Consider both short and long-term consequences of actions.
   ▪ Consider an issue fully and resist the urge to come to a quick conclusion.
   ▪ Change perspectives to increase understanding.
   ▪ Check results and change actions if needed: "successive approximation."
   ▪ Observe how elements within systems change over time, generating patterns and trends.
   ▪ Find where unintended consequences emerge.
   ▪ Seek to understand the "big picture."

c. **Strategic responsibilities of systems thinking.** Apply the Habits of a Systems Thinker and systems thinking techniques to real world decision-making.
- Practice the Habits of a Systems Thinker and systems thinking skills while envisioning, designing, planning, acting and assessing the whole system.
- Explain how our own actions or lack of actions affect the systems we are in.
- Recognize that mental models are developed over time from an individual's experiences and surroundings and, as such, a person's perspective can be limited by them.
- Use your understanding of mental models when developing action plans.
- Explore a system's structure to develop a deep understanding to effectively plan actions to achieve positive systemic impacts.
- Consider intended and unintended, short and long term consequences to determine if the "risk is worth the reward" and develop a plan to mitigate the risk as much as possible.
- Make choices by considering implications and consequences of those choices on the economic, ecological and social systems within which they live.
- Monitor the system's outcomes over time, adjusting as needed to maintain and or improve the desirable outcomes of the system.
- Ask probing questions when things don't work out as planned; re-examine the understanding of the system's structure and propose changes.

2) Physical, Living and Human Systems: Students understand Earth systems' characteristics, including physical, living and human systems.

a. **Structure, function, interaction and change in physical systems over time.** Explain the dynamic and interconnected nature of Earth's physical systems.
- Describe the structure and composition of Earth's atmosphere, geosphere, and hydrosphere.
- Explain changes in matter, including physical and chemical properties of elements and compounds, and the global carbon cycle.
- Identify the properties of energy, including the transfer of energy, energy transformation and conservation, and the laws of thermodynamics.
- Describe the cycling of matter and energy between system components over time.
- Provide evidence for geologic, climatic, and environmental changes over time.
- Explain climate – Sun/Earth relationships, including processes that drive and regulate climate variability, and interrelationships of climate and other Earth physical and living systems.
- Describe the ocean's influence on weather and climate and the interrelationships of the ocean and other Earth physical and living systems.
- Analyze Earth system indicators of sustainability.

b. **Structure, function, interaction and change in living systems over time.** Explain the dynamic and interconnected nature of Earth's living environment.
- Explain the structure and function of organisms, populations, communities, ecosystems, and biomes.
- Explain the principles of ecology, including biodiversity, carrying capacity, habitat sources and sinks, population dynamics, and ecosystem change.
- Discuss heredity and evolution, including species change and the process of natural selection.
- Describe how matter and energy flow in organisms, including biogeochemical cycling and processes by which plants and animals obtain energy and materials for growth and metabolism.
- Explain the interdependence of plants, animals, and environment, and how adaptation influences survival.
- Analyze ecological indicators of sustainability.

c. **Structure, function and interconnected nature of human systems over time.** Explain the dynamic and interconnected nature of political, economic, social and cultural systems.
- Compare and contrast the structure and function of political systems, including:
  - o Organization and responsibilities of governments, and how they interact at the local, state, tribal, national and global levels.
  - o Roles and activities of political parties, interest groups and mass media, and how they affect the beliefs and behaviors of local, state, and national constituencies.
  - o Concepts of political power, authority, conflict and conflict management.
  - o Relationship between government and citizens and ways that civic participation occurs in local, state, tribal, national, and global communities.
  - o Functions and processes of governments and their impact on societies and citizens, including how different levels of government provide services and protect citizens.
  - o Concepts of public, private, and the common good, and how different governments define, support, and limit each.
  - o Situations for common interests among nations and global collaboration.
- Compare and contrast the structure and function of economic systems, including:
  - o Allocation of scarce resources through individual choice, market interaction, and public policy, and how allocation decisions result in both costs and benefits to individuals and societies.
  - o Definition of economic terms (e.g., elasticity, substitution, externalities, regulation, legislation) and identification of examples of them in the current economy with particular attention to the uses of natural resources.
  - o Histories, philosophies and patterns of different economic systems and activity and their effects on environment, equity, prosperity and diversity of cultures.
  - o Economic input-output analysis and life cycle analysis of resource use, manufacturing and end-of-life options (i.e., recycling, disposal, remanufacturing) of products.
  - o Human decisions about consumption, production, distribution and disposal of goods and services and their effect on the sustainability of Earth's natural, economic and social systems.
  - o Relationship between public and private ownership and the commons, including, but not limited to characteristics of the commons and property.
  - o Relationship between property ownership, entrepreneurial creativity, and economic growth, and how these can be balanced with the common good.
  - o Consumption and consumer choices, including impact of consumption choices on the health of a place, impact of consumption choices on the health of the individual, media's role in shaping and influencing consumption patterns, and consumption patterns over time.
  - o Economic indicators of sustainability.
- Compare and contrast the structure and function of social and cultural systems, including:
  - o Characteristics of diverse cultures, how cultures change over time.
  - o How experiences and places may be interpreted differently by people with different cultural backgrounds, at different times, or with other frames of reference.
  - o How different people understand the concept of the commons and the types of measures needed to maintain its health.
  - o How individuals relate to others, including relationships between individual identity, family, society and culture.
  - o Issues of responsibility, fairness and equity, especially as they relate to intergenerational relationships, environmental conditions, consumer choices, resource use, and sustainability.
  - o How individual and societal actions can value or depreciate the worth or potential of other human beings.
  - o How an individual's perception of the environment is influenced in part by individual traits and group membership or affiliation.
  - o Influence of individual and group actions on the environment, and how groups can work to

promote and balance interests.
- o Societal values and principles, including shared and conflicting societal values.
- o Social indicators of sustainability.
- ▪ Analyze the social, cultural and economic indicators of sustainability.

3.) Interconnectedness of People and the Environment: Students understand the interdependence between the environment and humans, including the interconnectedness of human well-being and the environment.

a. **Sense of place, region, nation, and global community.** Explain sense of place as the connection between people and a place, and that sense of place encompasses the interrelationships among patterns of human settlement, social and cultural relationships, and the natural world. Analyze the characteristics of their community and region and the interconnectedness of regions and the global community, such as:
  - ▪ Analyze the characteristics of their community and region, including:
    - o Spatial concepts of location, distance, direction, scale, movement and region.
    - o Natural features of the community and region, including, but not limited to flora, fauna, climate and geologic features such as soils and watersheds.
    - o Patterns of distribution and arrangement of settlement.
    - o Cultural and economic heritage and current character of the community and region, including, but not limited to livelihoods associated with the regional economy and local food and transportation systems.
    - o Continuity and changes of a place over time.
    - o Physical and human characteristics of places and regions, and their connections and interdependence.
    - o Why places and regions are important to human identity.
    - o Interconnectedness of physical and human regional systems.
  - ▪ Analyze the interconnectedness of physical and human regional systems and the global community, including:
    - o Major physical and human features of the Earth and their relationships.
    - o Human and physical aspects of places and regions as they relate to development over time, how they are important to human identity, and how they serve as symbols to unify or fragment society.
    - o How knowledge of this region can be applied to the study of others regions in other parts of the world.
    - o Interdependence among renewable and nonrenewable resource use at the local, regional, national, and global scales.
    - o Causes of human migration and the impact of human migration on physical and living systems.
    - o Economic, cultural, and environmental factors that influence changes in population, including, but not limited to food production capacity, medical advances, and disease control, and the consequences of the resulting increases or decreases in population.
    - o How differing points of view, self-interest, and global distribution of natural resources play a role in conflict over territory.
    - o Conflicts involving use of land, economy, and competition for scarce resources, different political view, boundary disputes, and cultural differences within and between different geographical areas.

b. **Interrelationship between the environment and human activities.** Analyze how changes in the environment affect human systems (e.g., political, social, cultural, economic), how human activities and systems change the environment, and the interrelationship between environmental quality and human health and wellbeing.
  - Analyze how changes in the environment affect human systems, including culture and language, economic systems, political systems, social interactions, human health and well-being.
  - Analyze how human activities and systems (social, cultural, political, and economic) change the environment, including its physical systems (e.g., atmosphere, ocean, climate, soil, landforms) and living systems (e.g., ecosystems, biodiversity, carrying capacity).
  - Explain the interrelationship between environmental quality, including air quality, water quality and quantity, biodiversity, climate change, disease vectors, and natural disasters, and human health and wellbeing, including the ability to produce and access nutritious food, access shelter, and achieve mental and physical health.
  - Describe the ability of humans to shape and control the environment by creating knowledge and developing new technologies, including agricultural and food systems, transportation systems, waste management systems, communication systems, energy systems, human habitation systems and other decisions and practices.

c. **Resource distribution and use.** Analyze how resource distribution and use can influence cooperation, competition and conflict, and shape political, economic, physical and social environments, including issues related to national security and conflict over territory.
  - Evaluate the relationship of the environment to national security, including energy sources, food security, and climate change.
  - Describe how human cooperation and competition for resources shape the earth's political, economic, physical, and social environments.
  - Explain the dependence of humans on renewable and nonrenewable natural resources for life, sustenance and a suitable quality of life.
  - Describe how differing points of view, self-interest, political and economic systems, and global distribution of natural resources play a role in conflict over territory.
  - Explain how competition for scarce resources can lead to conflicts between and within geographic areas, including conflicts involving use of land, food, water, energy sources, boundary disputes and human migration.

4) **Personal and Civic Responsibility:** Students understand the rights, roles, responsibilities and actions associated with leadership and participation that lead toward healthy, sustainable environments and communities.

a. **Rights and responsibilities of citizenship.** Analyze the rights and responsibilities of citizenship and their importance in making choices within both the local and global contexts.
  - Explain the personal, political, and economic rights of U.S. citizens.
  - Describe the personal responsibilities of citizens in their community, state, and nation.
  - Analyze civic ideals (e.g., freedom, rule of law, equality, responsibility, civic participation, equity, respectful deliberation).
  - Compare and contrast different views on individual responsibility to the commons.
  - Explain the importance of civic dispositions such as trust, honesty, patience, self-discipline, respect and open-mindedness.
  - Examine whether individuals' civic obligations ever require them to subordinate their personal interests or desires for the public good.
  - Evaluate how conflicts can arise between individual rights and other societal interest such as a healthy environment and a sustainable community.

b. **Sense of personal responsibility.** Identify and describe the notion of personal and group responsibility, how the effects of actions reach into the future, and the importance of fulfilling personal responsibilities. Demonstrate a willingness to participate thoughtfully and effectively in decision-making.
- Explain the notion of responsibility and identify some of their personal responsibilities, comparing their view of their responsibilities with commonly accepted societal views.
- Evaluate actions in terms of effects that reach into the future.
- Analyze some of the effects that their actions and the groups they belong to (e.g., family or school class) have on the sustainability of the environment and their community.
- Evaluate the importance of fulfilling personal responsibilities for themselves, society, people in other places, the commons, and other living beings.
- Demonstrate a developing self confidence in their effectiveness as citizens (self efficacy), including:
  o How individual and group action can create beneficial and purposeful change, meet individual needs, and promote the common good.
  o Ways in which citizen action and public opinion influence policy decisions concerning the environment.
  o Examples of how citizen action has had an effect on environmental quality and sustainability.
  o How students of their own age have affected environmental quality and sustainability.
  o Ways in which their own actions have made a difference.
- Demonstrate a willingness to work individually and collectively toward resolution of issues and to participate thoughtfully, respectfully, and effectively in decision-making.
- Explain ways in which the decisions of one generation create opportunities and impose constraints for future generations.
- Apply the strategic responsibilities of systems thinking to address real world decision-making (see Strand 1.c.)

5) **Investigate, Plan and Create a Sustainable Future:** Students apply the 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 and respectful deliberation, and use creativity to imagine, invent, or make connections previously unrecognized or unknown.
- Form and evaluate personal views, including:
  o Identify personal mental models about the world and recognize that mental models are guiding constructs that change over time with new knowledge and applied insight.
  o Articulate multiple sides of an issue and propose defensible conclusions that address multiple and diverse perspectives.
  o Communicate, evaluate and justify personal views.
  o Evaluate personal beliefs and values using criteria such as personal wellbeing, equity, social and environmental welfare, economic vitality, and concern for other living beings.
  o Consider viewpoints that differ from their own, and information that challenges their positions.
  o Evaluate whether and how differing viewpoints might affect their own views.
  o Apply a global perspective to analyze contemporary and historical issues.
  o Evaluate the strength of conclusions, differentiating reasoning based on a full set of facts from reasoning based on incomplete information, opinions, fear, bias, or exaggeration.
- Engage in informed and respectful deliberation of local, state, tribal, national, and global issues, including:

- o Demonstrate knowledge of diverse cultural, linguistic, and artistic expressions.
  - o Communicate and collaborate cross-culturally.
  - o Work with people who have different perspectives.
  - o Seek to determine the interests that underlie people's positions and behaviors.
  - o Participate cooperatively and productively in work teams to identify and solve problems.
  - o Display initiative and demonstrate respect for other team members to complete tasks.
  - o Exhibit work ethic and performance, including the ability to be responsible and dependable.
  - o Practice "upstream problem identification" and systems thinking.
- Apply creativity to imagine, invent, or make connections previously unrecognized or unknown, including:
  - o Demonstrate a willingness to be flexible.
  - o Explore connections, consider analogies, and synthesize ideas to uncover new ways of thinking about the topic.
  - o Generate new ideas, using novel combinations or connections between previous notions.
  - o Seek opportunities to express ideas and emotions.
  - o Explore concepts that connect economic opportunities and job creation, sustain the community, and enhance the environment, including, but not limited to innovations in food production, energy generation and use, transportation, and water management.

b. **Evaluate accuracy and reliability of information sources.** Evaluate the quality, completeness and reliability of information from primary and secondary sources, including:
  - Acquire, organize, analyze and evaluate the quality of information from primary and secondary sources.
  - Apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources.
  - Identify logical errors and spurious statements in everyday situations such as political speeches or commercial advertising.
  - Look for and explain flaws such as faulty or misleading use of statistics, misrepresentation of data or biased selection of data to support a claim.
  - Explain why some research results are judged to be more credible than are others.
  - Identify sources of bias in interpretation, funding sources, and research procedures.

c. **Identify, investigate and analyze strategies that address challenges and create desired futures.** Investigate a current issue or problem, determine various perspectives on the issue or problem, identify and evaluate alternative solutions and courses of action, and propose solutions or actions.
  - Investigate a current issue or problem, determining various perspectives on the issue and problem, including:
    - o Define and clarify the issue so that its dimensions are well understood, using a variety of unbiased sources.
    - o Develop a method to explore the relationships between key dimensions of the issue.
    - o Identify key individuals and groups involved, including individuals and groups impacted by the issue.
    - o Explain various perspectives on the issue and the reasoning behind them.
    - o Examine contextual elements that shape the topic under investigation and identify historical antecedents or contemporary parallels.
    - o Analyze characteristics, causes, and consequences of the issue.
    - o Develop and utilize indicators to measure movement toward or away from goals.
    - o Use the idea of cumulative effects to explain why one set of changes or human actions cannot be considered in isolation from others.
    - o Identify the most upstream problems to address within their sphere of influence.
  - Identify and evaluate alternative solutions and courses of action, and propose solutions or support

actions including:

- o Synthesize different perspectives, types of data, and means of analysis to propose solutions or courses of actions.
- o Apply knowledge from functional relationships, modeling, and statistical analysis to evaluate different approaches or courses of action.
- o Use methods such as cost/benefit analysis, cumulative effects analysis, environmental impact analysis, ethical analysis, and risk analysis.
- o Propose action strategies that are likely to be effective in particular situations and for particular purposes.

d. Demonstrate decision-making and citizen action. Analyze the need for action, plan and implement an action strategy if warranted, evaluate the results of actions, and reach evidence-based conclusions.
- ▪ Evaluate the need for action, including:
  - o Evaluate whether action is warranted in specific situations, accounting for factors such as available evidence about the concern and proposed solutions; scale of the concern; legal, social, economic, and ecological consequences; and alternatives to citizen action.
  - o Identify different forms of action that citizens can take, including consumer choices, resource use choices, writing letters to the editor, drafting legislation/ordinances/policies, communicating with decision-makers, environmental stewardship projects.
  - o Speculate about the likely effects of specific actions and the likelihood these actions will resolve a specific concern.
  - o Evaluate whether personal involvement in particular actions is warranted, considering factors such as their own values, skills, resources and commitment.
  - o Communicate decisions clearly, articulating well-reasoned arguments supporting their views and decisions.
- ▪ Plan and take action, including:
  - o Envision a desired endpoint.
  - o Develop plans for individual and collective action.
  - o Articulate clear reasons and goals for action.
  - o Articulate measures for success consistent with their abilities and the capabilities of the groups involved.
  - o Decide whether the plan should be implemented immediately or at another time, modified or abandoned; and carry through with action when appropriate.
- ▪ Identify, compare, and evaluate the results of actions (outcomes and response); then reach an informed and supported conclusion, including.
  - o Analyze the long and short term consequences of actions (or inaction).
  - o Consider the intended and unintended consequences of action on self and others, and the environment.
  - o Analyze actions, evaluating apparent effects in terms of action goals, ethics, and broader societal goals.
  - o Articulate "lessons learned" from taking action.
  - o Account for some of the difficulties they encountered in evaluating the results of actions.

Graduation Requirements

(Adapted from Oregon Department of Education) In January of 2007, the Oregon State Board of education voted to adopt new high school graduation requirements. These new requirements are designed to better prepare each student for success in college, work, and citizenship. To earn a diploma, students will need to successfully complete the credit requirements, demonstrate proficiency in essential skills, and meet the personalized learning requirements. Students will also have the option to earn credit for proficiency. A phase-in schedule (2007 – 2014) has been created to allow students, families, schools and teachers to adequately prepare to meet these new requirements.

The essential skills are process skills that cross academic disciplines and are embedded in the content standards. The skills are not content specific and can be applied in a variety of courses, subjects, and settings. Proficiency of essential skills could be demonstrated through an environmental literacy lens.

Essential skills include:
1) Read and comprehend a variety of text
2) Write clearly and accurately
3) Apply mathematics in a variety of settings
4) Listen actively and speak clearly and coherently
5) Think critically and analytically
6) Use technology to learn, live, and work
7) Demonstrate civic and community engagement
8) Demonstrate global literacy
9) Demonstrate personal management and teamwork skills

Students are also responsible for Personal Learning which includes:
- ✓ Plan and Profile – With the help of adults, students develop a plan for the classes and experiences they will need to prepare for their post-high school goals. They will document their progress and accomplishments along the way.
- ✓ Career-Related Learning Experiences – Students participate in experiences that connect the classroom with workplace and community.
- ✓ Extended Application – Students apply knowledge and skills related to their interests and goals by demonstrating critical thinking, problem solving, or inquiry in real-world contexts.

An environmental literacy context should be used to support students in satisfying their personalized learning diploma requirement, in learning beyond the classroom and forming connections to the adult world.

In adopting the new diploma requirements, the Oregon State Board of Education stated the following: "A key feature of the future diploma will be wider use of proficiency, ensuring that all students will have the opportunity to choose to earn credit by demonstrating proficiency." In order to enhance the relevance of education for students, the State Board also broadened the definition of what could qualify as courses that meet math and science requirements of the diploma. In a decision paper published in 2007 the Board endorsed the concept of meeting math requirements through courses such as Integrated Math, Applied Math, Construction Math, and Business Math as long as they meet the content threshold of Algebra I or higher. Similar flexibility is encouraged in courses offered for science credit. The addition of recognizing "Environmental Literacy" as a context to assist students in satisfying diploma requirements in math and science by demonstrating proficiency should also be explored.

As the new Oregon Diploma requirements are phased in, many districts are considering alternatives to the traditional academic course work in math, science, and language arts. In conjunction with the national Math-in-CTE curriculum integration model sponsored by the National Center for Research in Career and

Technical Education, Oregon has been working to enhance mathematics, science, and other core academic concepts embedded in Career & Technical Education (CTE). CTE program courses, integrated academic course sequences, and project based learning are delivery models in which students may earn credit or partial credit by successfully demonstrating that they have met academic area content expectations. These integrated approaches give students the opportunity to apply academic content in real-world situations to demonstrate proficiency.

Students may demonstrate proficiency inside the classroom, outside of the classroom where hours of instruction may vary, through documentation of prior learning, by appropriate examination, or by any combination thereof. Credit for Proficiency is well suited to support education for environmental literacy as a vehicle in student pursuit of the Oregon Diploma.

Essential skills, personal learning, and Credit for Proficiency all present flexible options for aligning existing graduation requirements with the Plan. Examples for how skill requirements might be met and assessed through environmental literacy activities should be further developed and disseminated. In developing these examples, priority for skills and activities should be given to the Environmental Literacy Strand components that are not satisfied by existing Oregon Academic Standards. Final consideration should be given to creating a new graduation requirement for environmental literacy following Maryland's proposed plan as an example (Robelen, 2010). We further recommend that graduation requirements be developed to include outdoor experiences.

Appendix A: Systems Thinking

The Waters Foundation (http://www.watersfoundation.org) has provided a great deal of background on systems thinking and how it can be integrated into schooling. The Waters Foundation articulates three critical elements:

Tools of Systems Thinking
(http://www.watersfoundation.org/index.cfm?fuseaction=content.display&id=136)
- behavior-over-time graphs
- connection circles
- causal loop diagrams
- stock/flow maps
- iceberg
- computer models
- computer simulations
- ladder of inference

Key Concepts of Systems Thinking
(http://www.watersfoundation.org/index.cfm?fuseaction=content.display&id=137)

- **Mental Models**
  Our beliefs, assumptions, and ideas about how things work. Mental models are often hidden, even from ourselves.
- **Dynamic System**
  Systems, which change over time, are dynamic. Growth, decay, and oscillations are the fundamental patterns of systems.
- **Change Over Time**
  There are patterns in the world that we can understand, with a little effort. These patterns are usually generated by interconnectedness.
- **Feedback**
  The real world often operates in circular causality, not just cause and effect.
- **Leverage**
  How can I generate viable options and solve real problems in a complex and interconnected world?

Habits of a Systems Thinker
(http://www.watersfoundation.org/index.cfm?fuseaction=search.habits)
- Surface and test assumptions.
- Use understanding of system structure to identify possible leverage actions.
- Recognize the impact of time delays when exploring cause and effect relationships.
- Identify the circular nature of complex cause and effect relationships.
- Recognize that a system's structure generates its behavior.
- Consider how mental models affect current reality and the future.
- Consider both short and long-term consequences of actions.
- Consider an issue fully and resists the urge to come to a quick conclusion.
- Change perspectives to increase understanding.
- Check results and changes actions if needed: "successive approximation."
- Observe how elements within systems change over time, generating patterns and trends.
- Find where unintended consequences emerge.
- Seek to understand the "big picture."