LTER and SMILE Activity Notebook

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SMILE and LTER

Why Conduct Long Term Ecological Research?

You might be wondering why it is important to conduct long term ecological research. Many studies conduct research over a year, a season, or even part of a season. While these studies provide valuable information, some questions cannot be answered with data gathered over such a short time frame. Questions about changes in weather patterns and climate are difficult if not impossible to answer without long term data. However, if we gather data on climate or temperature over a long period of time, decades to centuries, we begin to see patterns and trends that would be impossible to determine otherwise.
One problem with conducting long term ecological research is that "It Takes A Long Time". Protocols must be clearly determined so that data can be gathered in the same manner over time, even as the people collecting the data change. Also, long term study results and findings are not available within a year or even a few years, which can make it difficult to convince people to contribute to something where they won't necessarily see the results. When conducting long term ecological research it is important to recognize your role in the bigger picture. Even if what you are doing in the moment seems small and insignificant, it is important to realize that the overall goal cannot be reached without your contribution.

Key Concepts in Long Term Ecological Research

Grades 4, 5, 6

LTER Science: Things change even though we cannot always see it happening. Long-term predictions based on observations at one point in time are not always accurate. We need special methods to either speed up the process or to observe these changes. Not every job is completed in a few minutes. Things don't happen the same everywhere; the rates of change can differ.

Growth: All living organisms grow. Plants need light to grow; other organisms need food. Different organisms grow at different rates, depending on individual requirements and environment. Variables affect all organisms differently even within the same ecosystem. Plants (and scavengers) use nutrients from dead things to grow.

Mortality: Everything grows toward death. Parts of organisms die, as do entire organisms. Some organisms are very long-lived, such as the 12,000 year old Creosote bush (*Larrea tridentata*) discovered in the Mojave Desert of California. Others are very short lived such as a species of mayfly, the *Dolania americana* (Ephemeroptera), which lives for only 5 minutes in the adult stage.

Decomposition: We would be climbing over dinosaurs if organic things didn't decompose. Decomposers take "dead" things and turn them into nutrients for living things to eat. Depending on the environment, the same material can decompose at different rates. In the same environment, different materials can take different time frames to decompose.

Cycles: Both nutrients and water cycle in ecosystems. Nutrients are released by decomposition, and are taken up by growing plants, then released again. Ecosystems that recycle quickly and efficiently are more productive than ones that recycle more slowly or less efficiently.

Key Concepts in Long Term Ecological Research

Grades 7, 8, 9

LTER Science: There are several ways to see long-term change. We can watch something directly or we can assemble things in different stages of change into a sequence. Each method has strengths and weaknesses. We can often learn more if we compare our observations to those of others. The differences can give us ideas about factors controlling a process.

Growth: Plants need sunlight, air, water, and soil nutrients to grow. Other organisms need air, nutrients, energy, food, and water to grow. These organisms grow because of what they eat. All organisms follow a sigmoidal growth pattern-no organism grows indefinitely. At some point, limiting factors (including replacement of dead parts) stop the growth process.

Mortality: Organisms stop growing, age, and then die. Different factors other than age can cause mortality. When organisms compete with each other, some will often die. Accidents can be an important cause of mortality. Long-term predictions about mortality are sometimes rendered obsolete when surprise variables like climate change, or pest and disease outbreaks become active. Because of links in the system, the death of a single organism can positively or negatively impact the whole ecosystem.

Decomposition: Decomposition specialists break down dead material and process it into useable forms. Some chemical compounds are decomposed, others are created-or composed. Chemicals in the dead material can determine how fast it decomposes. Different decomposers are active at different stages of decomposition. Decomposers in different environments can have different rates of decomposition.

Cycles: Nutrient cycling is affected by many factors such as climate, the organisms doing the decomposition, and the types of materials being decomposed.

Key Concepts in Long Term Ecological Research

Grades 10, 11, 12

LTER Science: Studying things over the long-term can help us put changes in a temporal context. The invisible present is an example. We cannot always directly observe a change; we may need to find proxy data to make estimates. We can often learn more if we compare our observations to those of others. The differences can give us ideas about factors controlling a process.

Growth: Growth in plants is influenced by many factors including the environment and competition between plants. Increase in mass is hard to measure directly, but there are allometric relationships that can help us make these predictions. There is often a relationship between the mean size of plants and the density of plants. Growth is often seasonal. When animals eat they can only convert so much of their intake to growth. This tends to decrease as animals age (the energy pyramid). There are often long-term records of growth in the organisms we are studying.

Mortality: Mortality often helps us predict how large a biomass will accumulate or how large a population of organisms gets. We can construct a life table of organisms to try to understand if a population in increasing, decreasing, or stable. Often organisms interact to cause cyclical change in populations and biomass. Or one individual can suppress the growth of other individuals, causing them to die. Often, mortality is a long process set off by some factor not readily visible. A mortality spiral is common.

Decomposition: Decomposition rates can change over time as different parts are decomposed at different rates. Fungi and invertebrates are the most abundant decomposers. There are several processes involved in decomposition including leaching, respiration, fragmentation, and formation of stable organic matter (humus).

Cycles: Decomposition can release nutrients but it can also tie up nutrients. Decomposition can lead to humus, which can modify the soil in ways beyond adding nutrients such as increasing soil depth, and increasing the water holding capacity of the soil. Nutrients are taken up in mineral form. Response to nutrient limitations is also controlled by the degree of competition between plants.

LTER History-The HJ Andrews Experimental Forest Site

In 1980 the National Science Foundation established the Long Term Ecological Research (LTER) program, providing support to stations such as the HJ Andrews Experimental Forest that conduct long term ecological research. The NSF also supported new LTER site developments. There are currently 26 LTER sites throughout the world, representing diverse ecosystems and research.

The HJ Andrews Experimental Forest, also known as The Andrews, is situated in the western Cascade Range of Oregon in the 15,800-acre (6400-ha) drainage basin of Lookout Creek, a tributary of Blue River and the McKenzie River. Elevation ranges from 1350 feet (410 m) to 5340 feet (1630 m). Broadly representative of the rugged mountainous landscape of the Pacific Northwest, the Andrews Forest contains excellent examples of the region's conifer forests and associated wildlife and stream ecosystems. The research program has been diverse throughout the history of the Forest, with the dominant themes changing over the years. Long-term field experiments and measurement programs at The Andrews have focused on climate dynamics, streamflow, water quality, and vegetation succession. Currently researchers are working to develop concepts and tools needed to predict effects of natural disturbance, land use, and climate change on ecosystem structure, function, and species composition. Today, several dozen university and federal scientists use this LTER site as a common meeting ground, working together to gain basic understanding of ecosystems and to apply this new knowledge in management policy.

The Andrews began under the USDA Forest Service administration in 1948, and is currently administered cooperatively by the USDA Forest Service Pacific Northwest Research Station, Oregon State University and the Willamette National Forest. Funding for research is provided by the National Science Foundation (NSF), US Forest Service Pacific Northwest Research Station, Oregon State University, and others.

Sources: http://www.lternet.edu/, http://www.lternet.edu/sites/and, and http://www.fsl.orst.edu/lterhome.html/

SMILE History

Who Are We?
SMILE stands for Science and Math Investigative Learning Experiences. The SMILE Program is a partnership between Oregon State University and 14 Oregon school districts -- mostly rural -- to provide science and math enrichment for underrepresented and other educationally underserved students in grades 4-12.

What Do We Do?
The purpose of the program is to increase the number of educationally disadvantaged students and those from groups with low high school graduation rates who graduate from high school qualified to enroll in college and pursue careers related to science, math, health, engineering, and teaching.
The program functions as a "pipeline", taking students from 4th to 12th grade and ultimately into post-secondary education. The SMILE Program conducts a year-round schedule of activities designed to provide hands-on science experience, strengthen students' knowledge, and raise students' academic and career aspirations. OSU resource faculty and The SMILE Program professional staff provide scientific and pedagogic expertise, access to equipment, mentoring, computer networking, teacher training, and administrative support; the schools provide energetic students and dedicated teachers.

SMILE Facts
SMILE began in 1988, serving 80 students in four middle schools. Today, the program serves more than 700 elementary, middle, and high school students, along with 60 teachers, in 35 schools. The areas served are poor, largely rural, and educationally under-served with significant numbers of American Indian and Hispanic students. Per capita income and educational achievement (rate of high school graduation, percent with college degrees) are below state averages.

Source: http://smile.oregonstate.edu/aboutUs_index.htm

The LTER/SMILE Partnership

Through the Schoolyard LTER program, Andrews LTER is working with The SMILE Program to bring its research and expertise to SMILE teachers. During SMILE teacher workshops, LTER scientists and graduate students share their research, and provide content background and activities the teachers can use with their students. Andrews scientists have participated in teacher workshops since 1994, providing technical expertise and talking with teachers about designing schoolyard investigations. In a teacher workshops held at the Andrews Experimental Forest in May of 1994, 2001, 2003, and 2006, Andrews scientists and graduate students described their research and demonstrated research techniques on a variety of topics including measurement of tree growth and mortality, bird research including determination of habitat suitability, caterpillar and butterfly diversity, data collection technology at the Andrews, litter decomposition, riparian measurements, and stream sampling.

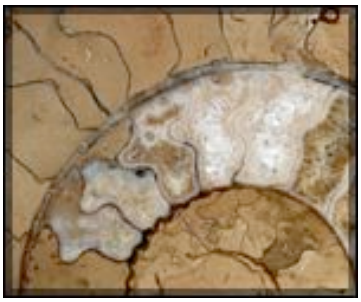
Elementary SMILE clubs attend the Elementary Outdoor Science Adventure Camp, EOSA, and use materials from LTER to develop their skills through a schoolyard science program. They learn skills related to the camp curriculum for each year. Year 1 focuses on Non-living factors in living communities such as water and nutrient cycles, sunlight's role in supporting life and driving weather cycles. The Living year focuses on predator-prey relationships, food webs, competition for resources and growth cycles.

Middle schools participated in two long-term research projects at their own schools. The first project was a Daffodil project in which each school was given a certain number of Daffodils with the idea that factors of emergence and flower bloom could be determined. Before the project was started, all the teachers had to agree on protocols. The teachers were then given daffodils to plant at their schools. Based on the protocols, it is hopeful that the students will be able to compare the data and begin to determine the factors affecting flower growth. The second project is a detritus and decomposition study. Each school was given a "leaf litter bag" in which pine chips were placed, and then the entire bag was placed in a local stream. Again, comparisons will be made across sites, and eventually across years. These projects are intended to educate on all aspects of long term ecological research, including methodology, the difficulties in making comparisons across different regions, and comparisons of data across long time scales.

Source: http://www.fsl.orst.edu/lter/edu/schoolyard/smile.cfm?topnav=125

Oregon Benchmarks and National Science Standards

On the following pages we have provided a simple guide to the Oregon Science Benchmarks and National Science Standards by grade level. We have included a list of activities provided in this notebook that address each applicable Benchmark or Standard. In the *Activities* section of this notebook you will also find that we have included the relevant Benchmarks and Standards addressed in each activity. That way you may go to the *Benchmarks and Standards* sections and identify an activity which addresses the benchmarks and standards you wish, or, you may go to the *Activities* section and choose an activity for other reasons (time, prep, enjoyment, familiarity, etc.) and have a quick reference there about the Benchmarks and Standards you may address. We hope this cross referencing is helpful.



Oregon Benchmarks-Benchmark 2 (Grade 5)

<u>Physical Science:</u>

Matter
Understand structure and properties of matter.
Understand chemical and physical changes.
Identify substances as they exist in different states of matter.
Describe the ability of matter to change state by heating and cooling.
Activities: Adventures in Density, Water Models, Schoolyard Habitat Cloud Experiment, Soil and My Backyard, Soil Stories, The Basis of Acids, The Incredible Journey, Why Do We Study Soils?

Force
Understand fundamental forces, their forms, and their effects on motion.
Describe and compare the motion of objects.
Identify examples of magnetism and gravity exerting force on an object.

Energy
Understand energy, its transformations, and interactions with matter.

Identify forms of various types of energy and their effects on matter.
Describe examples of energy transfer.
Activities: Resource-Go-Round

Life Science:

Organisms
Understand the characteristics, structure, and functions of organisms.
Group or classify organisms based on a variety of characteristics.
Describe the function of organ systems.
Describe basic plant and animal structures and their functions.
Activities: Adaptation Artistry, Air Plants, Aqua Bodies, Aquatic Organisms, Feeder Frenzy, Life in the Fast Lane, Migratory Mapping, Signs of Fall, Sunlight and Shades of Green, Tree Life Cycle, Who Was That Masked Bird?, Why Do We Study Soils?

Heredity
Understand the transmission of traits in living things.
Describe the life cycle of an organism.
Activities: Adopt a tree, Life in the Fast Lane, Signs of Fall, Tree Life Cycle

Diversity/Interdependence
Understand the relationships among living things and between living things and their environments.
Describe the relationship between characteristics of specific habitats and the organisms that live there.
Describe how adaptations help a species survive.
Activities: Adaptation Artistry, Adopt a Tree, Air Plants, Aqua Bodies, Aquatic Organisms, Bird Beak Buffet, Bird Behavior Scavenger Hunt, Feeder Frenzy, Home is Where the Forest Is, Home Sweet Home, Life in the Fast Lane, Migratory Mapping, Mud City, Sunlight and Shades of Green, Who Was That Masked Bird?

Earth and Space Science:

The Dynamic Earth
Understand the properties and limited availability of the materials which make up the Earth.
Understand changes occurring within the lithosphere, hydrosphere, and atmosphere of the Earth.
Identify properties and uses of Earth materials.
Describe patterns of seasonal weather.
Identify causes of Earth surface changes.
Activities: Resource-Go-Round, Schoolyard Habitat Cloud Experiment, Soil and My Backyard, Soil Stories, Soil-The Great Decomposer, The Basis of Acids, The Incredible Journey, Water Models, Why Do We Study Soils?

The Earth in Space
Understand the Earth's place in the solar system and the universe.
Describe the Earth's place in the solar system and the patterns of movement of objects within the solar system using pictorial models.

The Universe
Describe natural objects, events, and processes outside the Earth, both past and present.

Scientific Inquiry:

Forming the Question/Hypothesis
Formulate and express scientific questions or hypotheses to be investigated.
Make observations. Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations.
Activities: Adopt a Tree, Bird Beak Buffet, Bird Feeder Projects, Feeder Frenzy, Home is Where the Forest is, Home Sweet Home, Life in the Fast Lane, Migratory Mapping, Resource-Go-Round, Schoolyard Habitat Cloud Experiment, Signs of Fall, Soil and My Backyard, Soil Stories, Soil-The Great Decomposer, Sunlight and Shades of Green, The Basis of Acids, Why Do We Study Soils?

Designing the Investigation
Design safe and ethical scientific investigations to address questions or hypotheses.
Design a simple scientific investigation to answer questions or test hypotheses.
Activities: Adopt a Tree, Bird Feeder Projects, Feeder Frenzy, Life in the Fast Lane, Resource-Go-Round, Schoolyard Habitat Cloud Experiment, Signs of Fall, Soil and My Backyard, Soil Stories, Soil-The Great Decomposer, Sunlight and Shades of Green, The Basis of Acids, Why Do We Study Soils?

Collecting and Presenting Data
Conduct procedures to collect, organize, and display scientific data.
Collect, organize, and summarize data from investigations.
Activities: Adopt a Tree, Bird Beak Buffet, Bird Feeder Projects, Feeder Frenzy, Home Sweet Home, Life in the Fast Lane, Resource-Go-Round, Schoolyard Habitat Cloud Experiment, Signs of Fall, Soil and My Backyard, Soil Stories, Soil-The Great Decomposer, Sunlight and Shades of Green, The Basis of Acids, Why Do We Study Soils?

Analyzing and Interpreting Results
Analyze scientific information to develop and present conclusions.
Summarize, analyze, and interpret data from investigations.
Activities: Bird Beak Buffet, Bird Feeder Projects, Feeder Frenzy, Home Sweet Home, Life in the Fast Lane, Migratory Mapping, Resource-Go-Round, Schoolyard Habitat Cloud Experiment, Signs of Fall, Soil and My Backyard, Soil Stories, Soil-The Great Decomposer, Sunlight and Shades of Green, The Basis of Acids, Why Do We Study Soils?

Source: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.

National Science Standards (Grades K-4)

Unifying concepts and processes
Systems, order and organization. Evidence, models, and explanation. Change, constancy, and measurement. Evolution and equilibrium. Form and function.
Activities: Adaptation Artistry, Adopt a Tree, Adventures in Density, Air Plants, Aqua Bodies, Aquatic Organisms, Bird Beak Buffet, Bird Behavior Scavenger Hunt, Feeder Frenzy, Life in the Fast Lane, Signs of Fall, Soil Stories, Sunlight and Shades of Green, Water Models, The Basis of Acids, The Incredible Journey, Tree Life Cycle, Who Was That Masked Bird?

Science as Inquiry
Abilities necessary to do scientific inquiry. Understandings about scientific inquiry.
Activities: Adopt a Tree, Bird Beak Buffet, Life in the Fast Lane, Bird Feeder Projects, Feeder Frenzy, Home is Where the Forest Is, Home Sweet Home, Migratory Mapping, Resource-Go-Round, Schoolyard Habitat Cloud Experiment, Signs of Fall, Soil and My Backyard, Soil Stories, Soil-The Great Decomposer, Sunlight and Shades of Green, The Basis of Acids, Why Do We Study Soils?

Physical Science
Properties of objects and materials. Position and motions of objects. Light, heat, electricity, and magnetism.
Activities: Adventures in Density, Resource-Go-Round, Soil and My Backyard, Soil Stories, The Basis of Acids, The Incredible Journey, Why Do We Study Soils?

Life Science
Characteristics of organisms. Life cycles of organisms. Organisms and environments.
Activities: Adopt a Tree, Air Plants, Aqua Bodies, Aquatic Organisms, Bird Beak Buffet, Bird Behavior Scavenger Hunt, Feeder Frenzy, Home is Where the Forest Is, Home Sweet Home, Life in the Fast Lane, Migratory Mapping, Signs of Fall, Sunlight and Shades of Green, Tree Life Cycle, Who Was That Masked Bird?, Why Do We Study Soils?

Earth and Space Science
Properties of earth materials. Objects in the sky. Changes in earth and sky.
Activities: Resource-Go-Round, Soil and My Backyard, Soil Stories, Soil-The Great Decomposer, The Incredible Journey, Why Do We Study Soils?

Science and Technology
Abilities of technological design. Understandings about science and technology. Abilities to distinguish between natural objects and objects made by humans.
Activities: Feeder Frenzy, Home Sweet Home, Resource-Go-Round

Science in Personal and Social Perspectives
Personal health. Characteristics and changes in populations. Types of resources. Changes in environments. Science and technology in local challenges.

Activities: Air Plants, Aqua Bodies, Home is Where the Forest Is, Life in the Fast Lane, Resource-Go-Round, Soil and My Backyard, Soil Stories, The Incredible Journey, Why Do We Study Soils?

History and Nature of Science
Science as a human endeavor.
Activities: Sunlight and Shades of Green, Who Was That Masked Bird?

National Science Standards (Grades 5-8)

Unifying concepts and processes
Systems, order and organization. Evidence, models, and explanation. Change, constancy, and measurement. Evolution and equilibrium. Form and function.

Science as Inquiry
Abilities necessary to do scientific inquiry. Understandings about scientific inquiry.

Physical Science
Properties and changes of properties in matter. Motions and forces. Transfer of energy.
Activities: Adventures in Density, Resource-Go-Round, The Incredible Journey

Life Science
Structure and function in living systems. Reproduction and heredity. Regulation and behavior. Populations and ecosystem. Diversity and adaptations of organisms.
Activities: Adaptation Artistry, Bird Beak Buffet, Bird Behavior Scavenger Hunt, Feeder Frenzy, Home is Where the Forest Is, Home Sweet Home, Life in the Fast Lane, Migratory Mapping, Sunlight and Shades of Green, Tree Life Cycle, Who Was That Masked Bird?

Earth and Space Science
Structure of the earth system. Earth's history. Earth in the solar system.

Science and Technology
Abilities of technological design. Understandings about science and technology.

Science in Personal and Social Perspectives
Personal health. Populations, resources and environments. Natural hazards. Risks and benefits. Science and technology in society.
Activities: Home is Where the Forest Is, Life in the Fast Lane, Why Do We Study Soils?

History and Nature of Science
Science as a human endeavor. Nature of science. History of science.
Activities: Migratory Mapping

Source: National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

Elementary Activities

Over the past seven years we have presented many LTER related activities to SMILE teachers. Here we have included a representative sample of some of the activities presented, and classified them into the four main LTER themes of Growth, Mortality, Decomposition, and Cycles. Most activities fit into more than one category; some may be cross-listed here, others not. Some do not fit nicely into any and have been included in the "Other" category. You can find a simple outline of each activity in the following pages under the heading which it is listed.

Growth
Aqua Bodies (Mortality, Cycles)
Aquatic Organisms (Mortality, Cycles)
Soil Stories (Mortality)

Mortality
Life in the Fast Lane (All others)

Decomposition
Soil: The Great Decomposer
Why Do We Study Soils? (All others)

Cycles
Adopt a Tree
Air Plants
Migratory Mapping
Mud City
Resource-Go-Round
Signs of Fall
Soil and My Backyard
Sunlight and Shades of Green
The Incredible Journey
Tree Life Cycle

Other
Adaptation Artistry
Adventures in Density
Bird Beak Buffet
Bird Behavior Scavenger Hunt
Feeder Frenzy
Home Is Where the Forest Is
Home, Sweet Home
The Basis of Acid
Who Was That Masked Bird?

GROWTH

Activity: Aqua Bodies

Themes: Life systems and water; body water content.

Skills and Objectives: Students will conclude that water is the main ingredient of living organisms. They will organize information (estimating, calculating, categorizing), and analyze (comparing, identifying patterns).

Overview of Activity: Students trace their bodies and color portions to represent the amount of water their bodies contain. How does their water content compare to that of a cactus, lettuce, or whale?

Time: Prep: Part I ~15 minutes, Part II ~15 minutes, Part III ~10 minutes. Activity: Part I ~30 minutes, Part II ~30 minutes, Part III ~30 minutes.

Source: Project WET: Curriculum and Activity Guide, 1995.

STANDARDS

OREGON: (Grade 5) Life Science:
Organisms-Understand the characteristics, structure, and functions of organisms; Group or classify organisms based on a variety of characteristics; Describe basic plant and animal structures and their functions.
Diversity/Interdependence-Understand the relationships among living things and between living things and their environments; Describe the relationship between characteristics of specific habitats and the organisms that live there; Describe how adaptations help a species survive.

NATIONAL: Unifying Concepts and Processes: Change, constancy and measurement; Form and function.
Life Science: Characteristics of organisms; Organisms and environments.
Science in Personal and Social Perspectives: Personal health; Types of resources.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year. National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

GROWTH

Activity: Aquatic Organisms

Themes: Aquatic invertebrates; Organisms; Air and water temperature.

Skills and Objectives: Students will be able to identify three aquatic invertebrates, measure temperature of air and water, and draw an aquatic invertebrate.

Overview of Activity: After taking air and water temperatures, students collect aquatic invertebrates and use aquatic insect keys to identify four organisms. They draw one aquatic invertebrate.

Time: Preparation: ~ 15 minutes. Activity: ~ 50 minutes.

Source: Whole Ecosystems in Balance (WEB): A Natural Resources Curriculum. 1992. Blue Mountains Natural Resources Institute and Eastern Oregon State College. Developed by Donna Rainboth.

STANDARDS

OREGON: (Grade 5) Life Science:
Organisms-Understand the characteristics, structure, and functions of organisms; Group or classify organisms based on a variety or characteristics.
Diversity/Interdependence- Understand the relationships among living things and between living things and their environments; Describe the relationship between characteristics of specific habitats and the organisms that live there.

NATIONAL: (Grades K-4) Unifying Concepts and Processes: Systems, order, and organization; Change, constancy, and measurement.
Life Science: Characteristics of organisms; Life cycles of organisms; Organisms and environments.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year. National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

GROWTH

Activity: Soil Stories

Themes: Structure and scale of ecosystems are influenced by factors such as soil type, climate, availability of water and human activities.

Skills and Objectives: Students will identify components of soil and how these components determine its function, explain how different soil types determine the characteristics of ecosystems, and predict the influence of soils on water filtration and on human use of an area.

Overview of Activity: Students often wonder why certain plants grow in some places and not in others. Climatic factors such as temperature, moisture, and sunlight keep palm trees in Florida and fir trees in Oregon, but subtle differences in soil allow an oak to compete more successfully in one area and a maple in another. Students will explore differences in soil types and what they mean to us.

Time: Preparation: ~ 60 minutes. Activity: ~ Two 50 minute periods.

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

STANDARDS

OREGON: (Grade 5) Physical Science: Matter- Understand structure and properties of matter.
Earth and Space Science: The Dynamic Earth- Understand the properties and limited availability of the materials which make up the Earth.
Scientific Inquiry: Forming the Question/Hypothesis- Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations. **Designing the Investigation-**Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-**Conduct procedures to collect, organize, and display scientific data; Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions; Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Unifying concepts and processes: Systems, order and organization.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Physical Science: Properties of objects and materials.
Earth and Space Science: Properties of earth materials.
Science in Personal and Social Perspectives: Types of resources.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

MORTALITY

Activity: Life in the Fast Lane

Themes: Temporary wetlands.

Skills and Objectives: Students will describe physical and biological components of temporary wetlands, recognize the importance of temporary wetlands to larger ecosystems and explain how organisms in temporary wetlands race against time to obtain water, shelter, food and a mate.

Overview of Activity: Through a scavenger hunt and investigations of temporary wetlands in their neighborhood, students learn the benefits of and challenges to organisms living in temporary wetlands.

Time: Preparation: Part I ~50 minutes, Part II ~ 50 minutes. Activity: Part I ~One week to a month (for long-term investigation), Part II ~50 minutes.

Source: Project WET: Curriculum and Activity Guide, 1995.

STANDARDS

OREGON: (Grade 5) Life Science: Heredity-Describe the life cycle of an organism.
Diversity/Interdependence-Understand the relationships among living things and between living things and their environments; Describe the relationship between characteristics of specific habitats and the organisms that live there.
Scientific Inquiry: Forming the Question/Hypothesis- Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations. **Designing the Investigation-** Design a simple scientific investigation to answer questions or test hypotheses.
Collecting and Presenting Data-Conduct procedures to collect, organize, and display scientific data; Collect, organize, and summarize data from investigations.
Analyzing and Interpreting Results-Analyze scientific information to develop and present conclusion; Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Unifying concepts and processes: Change, constancy, and measurement.
Science as Inquiry-Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Life Science: Life cycles of organisms; Organisms and environments.
Science in Personal and Social Perspectives: Types of resources. Changes in environments. Science and technology in local challenges.
(Grades 5-8) Life Science: Populations and ecosystem; Diversity and adaptations of organisms.
Science in Personal and Social Perspectives: Populations, resources and environments.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

DECOMPOSITION

Activity: Soil-The Great Decomposer

Themes: To understand that soil, under different environmental conditions, changes its role in the decomposition of organic materials.

Skills and Objectives: Students will be able to identify soil conditions that promote the decomposition of organic matter in soils.

Overview of Activity: Students use "bottle" experiments to observe changes in the decomposition of vegetable scraps. Students vary temperature, moisture, and light conditions to determine the conditions that best facilitate the decomposition of organic material in soil.

Time: Preparation: ~ 30 minutes. Activity: ~ Three 50 minutes periods plus ongoing observations and recording of results.

Source: GLOBE 2005.

STANDARDS

OREGON: (Grade 5) Earth and Space Science: The Dynamic Earth-Understand the properties and limited availability of the materials which make up the Earth; Identify properties and uses of Earth materials; Identify causes of Earth surface changes. **Scientific Inquiry: Forming the Question/Hypothesis-**Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations. **Designing the Investigation-** Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-** Conduct procedures to collect, organize, and display scientific data; Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions; Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4)
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Earth and Space Science: Properties of earth materials.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

DECOMPOSITION

Activity: Why Do We Study Soils?

Themes: Introduces students to the importance of soil and why it needs to be studied.

Skills and Objectives: Students will understand the importance of soil science. They will be able to provide reasons for studying soil. They will understand how soil properties are determined by the five soil forming factors. Students will appreciate the relative amounts of usable soil that exist on Earth.

Overview of Activity: Students generate a list of why soils are important. Students describe the five factors that form a unique soil profile and explore these concepts. Students are shown a demonstration of how much soil there is on Earth that is available for human use.

Time: Preparation: ~ 50 minutes. Activity: ~ One or two 50 minute periods.

Source: GLOBE 2005.

STANDARDS

OREGON: (Grade 5) Physical Science: Matter- Understand structure and properties of matter.
Life Science: Organisms-Understand the characteristics, structure, and functions of organisms; Group or classify organisms based on a variety of characteristics.
Earth and Space Science: The Dynamic Earth- Understand the properties and limited availability of the materials which make up the Earth; Identify properties and uses of Earth materials.
Scientific Inquiry: Forming the Question/Hypothesis-Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations. **Designing the Investigation-** Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-** Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-** Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Physical Sciences: Properties of objects and materials.
Life Sciences: Organisms and environments.
Earth and Space Science: Properties of earth materials.
Science in Personal and Social Perspectives: Types of resources; Changes in environments; Science and technology in local challenges.
(Grades 5-8) Science in Personal and Social Perspectives: Populations, resources and environments.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: Adopt A Tree

Themes: Organisms are interdependent; Every living organism goes through a cycle of growth, maturity, decline, and death and its role in the ecosystem changes.

Skills and Objectives: Students will describe a chosen tree using personal observation and investigation, and organize information about the tree; identify relationships between their tree and other organisms; put together a book or portfolio about their tree.

Overview of Activity: This activity will encourage students' awareness of individual trees over time, as well as incorporate various other subjects. By adopting individual trees, students will gain greater awareness and appreciation of their local environments.

Time: Preparation: ~ 15 minutes. Activity: ~ 50 minutes (longer projects can be done throughout the year).

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

STANDARDS

OREGON: (Grade 5) Life Science: Heredity- Describe the life cycle of an organism; **Diversity/Interdependence-**Understand the relationships among living things and between living things and their environments; Describe the relationship between characteristics of specific habitats and the organisms that live there. **Scientific Inquiry: Forming the question/Hypothesis-**Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions based on those observations, which can be explored through scientific investigations. **Designing the Investigation-**Design safe and ethical scientific investigations to address questions or hypotheses. Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-** Conduct procedures to collect, organize, and display scientific data; Collect, organize and summarize data from investigations.

NATIONAL: (Grades K-4) Unifying Concepts and Processes: Change, constancy, and measurement
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Life Science: Characteristics of organisms; Life cycles of organisms; Organisms and environments.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: Air Plants

Themes: Altering the environment affects all life forms; Interdependence; Structure and scale of ecosystems are influenced by factors such as soil type, climate, availability of water and human activities.

Skills and Objectives: Students will demonstrate and describe the general process of photosynthesis and explore the relationship between the amount of oxygen produced by plants and the amount of oxygen used by humans.

Overview of Activity: Plants play a part in every breath we take. Use this activity to help your students understand how photosynthesis works and how humans depend on this process.

Time: Preparation: ~ 30 minutes. Activity: ~ Two 50-minute periods.

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

STANDARDS

OREGON: (Grade 5) Physical Science: Energy-Describe examples of energy transfer.
Life Science: Organisms-Describe basic plant and animal structures and their functions. **Diversity/Interdependence-** Understand the relationships among living things and between living things and their environments.

NATIONAL: (Grades K-4) Unifying Concepts and Processes: Form and function.
Life Science: Characteristics of organisms; Life cycles of organisms; Organisms and environments.
Science in Personal and Social Perspectives: Personal health.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November

CYCLES

Activity: Migratory Mapping

Themes: Follow that bird! Breeding ground, wintering ground, migration route, stopover point.

Skills and Objectives: Students will define the terms breeding ground, wintering ground, migration route, and stopover point; identify the breeding and wintering areas and migratory routes of the Wood Thrush and the Swainson's Thrush; describe hazards to migratory birds; and understand the uses of banding.

Overview of Activity: Students learn about the migration patterns of two Neotropical migratory birds-the Swainson's Thrush and the Wood Thrush-by compiling and mapping data from hypothetical band records.

Time: Preparation: ~15 minutes. Activity: ~ 45 minutes.

Source: Flying Wild: An Educator's Guide to Celebrating Birds, 2004.

STANDARDS

OREGON: (Grade 5) Life Science: Organisms- Understand the characteristics, structure, and functions of organisms.
Diversity/Interdependence- Understand the relationships among living things and between living things and their environments.
Scientific Inquiry: Forming the Question/Hypothesis-Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions; Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Life Science: Organisms and environments.
(Grades 5-8) Life Science: Regulation and behavior; Populations and ecosystems; Diversity and adaptations of organisms.
History and Nature of Science: Nature of Science.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: Mud City

Themes: Drought, erosion, ground cover, erosion control.

Skills and Objectives: The students will be able to physically mold their "property" to demonstrate erosion control methods such as terracing and contour planting; design a "reservoir" which will hold water; construct a simulated irrigation system; consult with a "representative" from the Soil Conservation Service (SCS) to determine what crops will grow on their soil; and communicate with other students about how and why they prevented different types of erosion.

Overview of Activity: In groups of 2-3, students design and construct a farmland model out of soil (mud) and crops (organic material-twigs, leaves, sticks), and try to prevent heavy rains (water) from eroding their land.

Time: Preparation: ~ 20 minutes. Activity: ~ 50 minutes.

Source: Whole Ecosystems in Balance (WEB): A Natural Resources Curriculum. 1992. Blue Mountains Natural Resources Institute and Eastern Oregon State College. Developed by Donna Rainboth.

STANDARDS

OREGON: (Grade 5) Organisms: Diversity/Interdependence-Understand the relationships among living things and between living things and their environment.
Earth and Space Science: The Dynamic Earth- Identify properties and uses of Earth materials; Identify causes of Earth surface changes.
Scientific Inquiry: Forming the Question/Hypothesis-Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions or form hypotheses based on those observations.
Designing the Investigation-Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-** Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-**Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Unifying Concepts and Processes: Evidence, models, and explanation.
Science as Inquiry: Abilities to do scientific inquiry; Understandings about scientific inquiry.
Life Science: Organisms and environments.
Earth and Space Science: Properties of earth material.
Science and Technology: Abilities of technological design; Understandings about science and technology.
Science in Personal and Social Perspectives: Types of resources; Changes in environments; Science and technology in local challenges.
(Grades 5-8) Life Science: Populations and ecosystem.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: Resource-Go-Round

Themes: Human societies and cultures affect natural systems. Consumers "drive" the market-place and these demands affect availability of natural resources and environmental quality. Industries often respond to consumer demand for recycled goods and environmentally friendly products.

Skills and Objectives: Students will identify the natural resources from which products are derived; trace the lifecycle of a product from natural resources, to the raw materials, to the finished product; and describe how energy is consumed in the manufacturing and transportation of products and how it might be conserved.

Overview of Activity: This activity gives students the opportunity to explore a variety of natural resources and products that people depend on every day. In addition, students will gain insight into the processes by which these natural resources are turned into products and the energy needed to make the products we use.

Time: Preparation: ~ 45 minutes. Activity: ~ Two 45-minute periods.

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

STANDARDS

OREGON: (Grade 5) Physical Science: Energy-Describe examples of energy transfer. **Earth and Space Science: The Dynamic Earth-**Understand the properties and limited availability of the materials which make up the Earth; Identify properties and uses of Earth materials. **Scientific Inquiry: Forming the Question/Hypothesis-**Formulate and express scientific questions or hypotheses to be investigated**. Designing the Investigation-** Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-**Conduct procedures to collect, organize, and display scientific data. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions.

NATIONAL: (Grades K-4) Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry. **Physical Science:** Properties of objects and materials. **Earth and Space Science:** Properties of earth materials. **Science and Technology:** Abilities of technological design; Understandings about science and technology; Abilities to distinguish between natural objects and objects made by humans. **Science in Personal and Social Perspectives:** Types of resources; Changes in environments; Science and technology in local challenges. **(Grades 5-8) Physical Science:** Properties and changes of properties in matter; Transfer of energy.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year. National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: Signs of Fall

Themes: Lifecycles, evolution, an organism's roles in the ecosystem at various stages of their lifecycle.

Skills and Objectives:
Students will describe some of the differences between deciduous and evergreen trees; identify patterns in the changing of seasons, and understand why leaves of deciduous trees change color in the fall.

Overview of Activity: In temperate regions, people can observe the annual change of seasons. In this activity, students will look for signs of autumn. They will also try an experiment to discover why leaves of deciduous trees change color in the fall.

Time: Preparation: ~ 20 minutes.
Activity: ~ Two 30-minutes periods.

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

STANDARDS

OREGON: (Grade 5) Life Science: Organisms- Group or classify organisms based on a variety of characteristics. **Heredity-**
Describe the life cycle of an organism.
Scientific Inquiry: Forming the Question/Hypothesis-Make observations; Ask questions or form hypotheses based on those observations. **Designing the Investigation-**Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-**Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions; Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Unifying concepts and processes: Change, constancy, and measurement; Form and function.
Science as Inquiry: Abilities necessary to do scientific inquiry. Understandings about scientific inquiry.
Life Science: Characteristics of organisms; Life cycles of organisms; Organisms and environments.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: Soil and My Backyard

Themes: Soil and soil properties.

Skills and Objectives: Students will be able to characterize soils. They will be able to differentiate soils based on their physical properties.

Overview of Activity: Students discover the variability of soils, derive relationships among soils and the soil forming factors and link it to their local environment. They use soil samples from their homes to identify properties that characterize their soils. They compare and contrast their soils to those of their classmates. As a class, students describe relationships between the properties of their soils and how and where they were sampled. Older students construct a soil classification scheme.

Time: Preparation: ~ 15 minutes. Activity: ~ Three 50 minute periods

Source: GLOBE 2005.

STANDARDS

OREGON: (Grade 5) Physical Science :Matter- Understand structure and properties of matter. **Earth and Space Science: The Dynamic Earth-** Understand the properties and limited availability of the materials which make up the Earth; Identify properties and uses of Earth materials. **Scientific Inquiry: Forming the Question/Hypothesis-**Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations. **Designing the Investigation-**Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-** Conduct procedures to collect, organize, and display scientific data; Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-**Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry. **Physical Science:** Properties of objects and materials. **Earth and Space Science-**Identify properties and uses of Earth materials; Identify causes of Earth surface changes. **Science in Personal and Social Perspectives:** Types of resources. Changes in environments. Science and technology in local challenges.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: Sunlight and Shades of Green

Themes: Photosynthesis, cycles, populations, adaptations, habitats.

Skills and Objectives: Students will test the effects of lack of sunlight on plant leaves and describe the process of photosynthesis and how it enables a plant to survive.

Overview of Activity: This activity introduces students to photosynthesis, the process that enables trees and other green plants to use sunlight to manufacture their own food.

Time: Preparation: ~ 20 minutes. Activity: ~ Two 45-minute periods over one week.

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

STANDARDS

OREGON: (Grade 5) Life Science: Organisms-Understand the characteristics, structure, and functions of organisms; Describe the function of organ systems; Describe basic plant and animal structures and their functions.
Diversity/Interdependence-Describe how adaptations help a species survive.
Scientific Inquiry: Forming the Question/Hypothesis- Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations. **Designing the Investigation-**Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-**Conduct procedures to collect, organize, and display scientific data; Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions. Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Unifying concepts and processes-Form and function.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Life Science: Characteristics of organisms; Life cycles of organisms; Organisms and environments.
History and Nature of Science: Science as a human endeavor.
(Grades 5-8) Life Science: Structure and function in living systems; Diversity and adaptations of organisms.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, *pp.109-111.*

CYCLES:

Activity: The Incredible Journey

Themes: The water cycle, condensation, evaporation, electromagnetic forces.

Skills and Objectives: Students will describe the movement of water within the water cycle, and identify the states of water as it moves through the water cycle.

Overview of Activity: With a roll of the die, students simulate the movement of water within the water cycle.

Time: Prep:~50 minutes. Activity: Part I ~50 minutes, Part II ~50 minutes.

Source: Project WET: Curriculum and Activity Guide, 1995.

STANDARDS

OREGON: (Grade 5) Physical Science: Matter- Understand structure and properties of matter; Understand chemical and physical changes; Identify substances as they exist in different states of matter; Describe the ability of matter to change state by heating and cooling.
Earth and Space Science: The Dynamic Earth- Understand the properties and limited availability of the materials which make up the Earth; Identify properties and uses of Earth materials; Describe patterns of seasonal weather.

NATIONAL: (Grades K-4) Unifying concepts and processes: Systems, order and organization; Change, constancy, and measurement**.**
Physical Science: Properties of objects and materials.
Earth and Space Science: Properties of earth materials.
Science in Personal and Social Perspectives: Types of resources.
(Grades 5-8) Physical Science: Properties and changes of properties in matter.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council,

CYCLES:

Activity: Tree Life Cycle

Themes: Patterns of change-Structure and systems change over various periods of time.

Skills and Objectives: Students will diagram the lifecycle of a tree, compare a tree lifecycle to a human lifecycle, and explain the role each stage of a tree's life plays in the forest (or other) ecosystem.

Overview of Activity: In this activity, students will discover that trees have a lifecycle that is similar to that of other living things. They will investigate a tree's role in the ecosystem at each stage of its life.

Time: Preparation: ~ 15 minutes. Activity: ~ 50 minutes.

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

STANDARDS

OREGON: (Grade 5) Life Science: Organisms-Understand the characteristics, structure, and functions of organisms; Describe basic plant and animal structures and their functions.

NATIONAL: (Grades K-4) Unifying concepts and processes: Systems, order and organization; Evidence, models, and explanation; Change, constancy, and measurement; Form and function.
Life Science: Characteristics of organisms; Life cycles of organisms. **(Grades 5-8) Life Science:** Structure and function in living systems.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year. National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

OTHER:

Activity: Adaptation Artistry

Themes: See how seemingly silly adaptations actually make perfect sense! Adaptation.

Skills and Objectives: Students will be able to identify and describe the advantages of bird adaptations, and discuss the importance of adaptations to birds.

Overview of Activity: Students design and create imaginary birds, then write descriptions of their birds' adaptations.

Time: Preparation: ~10 minutes. Activity: ~45 minutes.

Source: Flying Wild: An Educator's Guide to Celebrating Birds, 2004.

STANDARDS

OREGON: Life Science: Organisms-Understand the characteristics, structure, and functions of organisms; Group or classify organisms based on a variety of characteristics; Describe basic plant and animal structures and their functions.
Diversity/Interdependence-Understand the relationships among living things and between living things and their environments; Describe how adaptations help a species survive.

NATIONAL: (Grades K-4) Unifying Concepts and Processes: Evidence, models, and explanation; Form and function.
Life Science: Characteristics of Organisms; Organisms and environments.
(Grades 5-8) Life Science: Structure and function in living systems; Regulation and behavior; Diversity and adaptations of organisms.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

OTHER

Activity: Adventures in Density

Themes: Density.

Skills and Objectives: Students will demonstrate how heat and salinity affect the density of water; relate the compactness of water molecules to the density of water in different states; recognize that concepts of density can be found in literature and daily life.

Overview of Activity: Students conduct investigation to discover how the density of water is affected by heat and salinity, and relate their "discoveries" to literary adventures.

Time: Preparation: Part I ~ 50 minutes, Part II ~ 10 minutes. Activity: ~ Two 50-minute periods.

Source: Project WET: Curriculum and Activity Guide, 1995.

STANDARDS

OREGON: (Grade 5) Physical Science: Matter-Understand structure and properties of matter; Understand chemical and physical changes; Identify substances as they exist in different states of matter; Describe the ability of matter to change state by heating and cooling.

NATIONAL: (Grades K-4) Unifying concepts and processes: Change, constancy, and measurement.
Physical Science: Properties of objects and materials.
(Grades 5-8) Physical Science: Properties and changes of properties in matter.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year. National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

OTHER

Activity: Bird Beak Buffet

Themes: Resource partitioning; Adaptations, Structure and function; Math and how to graph data.

Skills and Objectives: Students will understand that different types of shorebirds can feed together in one area because each type is adapted to feed on different types of prey (resource partitioning). They will also understand that adaptations are features or behaviors that improve an organisms chance for survival. Students will use math and graph their results and recognize that scientists often use math when collecting data and that graphing helps us discover patterns and explain observations.

Overview of Activity: Students role-play species of birds with beaks of different shapes and sizes. They gather different food items with their "beaks," graph the results, and compare their feeding success.

Time: Preparation: ~ 30 minutes. Activity: Part I: ~ 30 minutes, Part II: ~ 50 minutes, Part III: ~ 15 minutes.

Source: MARE Ocean Immersion: Grade 3, Regents of the University of California, 2004.

STANDARDS

OREGON: (Grade 5) Life Science: Organisms- Understand the characteristics, structure, and functions of organisms; Group or classify organisms based on a variety of characteristics; Describe the function of organ systems; Describe basic plant and animal structures and their functions.
Diversity/Interdependesis-Understand the relationships among living things and between living things and their environments; Describe the relationship between characteristics of specific habitats and the organisms that live there; Describe how adaptations help a species survive.
Scientific Inquiry: Forming the Question/Hypothesis-Formulate and express scientific questions or hypotheses to be investigated; Make observations. **Collecting and Presenting Data-** Conduct procedures to collect, organize, and display scientific data; Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions; Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Unifying Concepts and Processes: Evidence, models, and explanation; Evolution and Equilibrium; Form and function.
Science as Inquiry: Abilities to do scientific inquiry; Understandings about scientific inquiry.
Life Science: Characteristics of organisms; Organisms and environments.
(Grades 5-8) Life Science: Structure and function in living systems; Regulation and behavior; Populations and ecosystems; Diversity and adaptations of organisms.
Science in Personal and Social Perspectives: Populations, resources and environments.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

OTHER

Activity: Bird Behavior Scavenger Hunt

Themes: Look at what that bird's doing! Bird behavior, flocking, roosting.

Skills and Objectives: Students will learn to identify different behavior patterns of birds and explain their function.

Overview of Activity: Following this bird-based version of a scavenger hunt, students observe various behaviors of birds.

Time: Preparation: ~15 minutes. Activity:~50 minutes.

Source: Flying Wild: An Educator's Guide to Celebrating Birds, 2004.

STANDARDS

OREGON: (Grade 5) Life Science: Organisms- Understand the characteristics, structure, and functions of organisms; Group or classify organisms based on a variety of characteristics; Describe the function of organ systems; Describe basic plant and animal structures and their functions. **Diversity/Interdependence-**Understand the relationships among living things and between living things and their environments; Describe the relationship between characteristics of specific habitats and the organisms that live there.

NATIONAL: (Grades K-4) Unifying Concepts and Processes: Form and function.
Life Science: Characteristics of organisms; Organisms and environments.
(Grades 5-8) Life Science: Regulation and behavior; Populations and ecosystems.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

OTHER

Activity: Feeder Frenzy

Themes: Do all birds eat the same thing? Scientific inquiry, problem-posing, problem-solving, persuasion.

Skills and Objectives: Students will identify common birds that are attracted to bird feeders, use scientific research methods, and conclude that different birds have different diets.

Overview of Activity: By proposing and conducting bird feeder experiments, students engage in scientific inquiry to learn about feeding preferences of birds.

Time: Preparation: ~ 20 minutes. Activity: Part I: ~ 45 minutes, Part II: On-going observations, Part III: Discussion ~ 20 minutes.

Source: Flying Wild: An Educator's Guide to Celebrating Birds, 2004.

STANDARDS

OREGON: (Grade 5) Life Science: Organisms- Understand the characteristics, structure and functions of organisms; Group or classify organisms based on a variety of characteristics. **Diversity/Interdependence-**Understand the relationships among living things and between living things and their environments; Describe how adaptations help a species survive.
Scientific Inquiry: Forming the Question/Hypothesis- Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations. **Designing the Investigation-**Design safe and ethical scientific investigations to address questions or hypotheses; Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-**Conduct procedures to collect, organize, and display scientific data; Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions; Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Unifying Concepts and Processes: Form and function.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Life Science: Characteristics about organisms. Regulation and behavior.
Science and Technology: Abilities of technological design.
(Grades 5-8) Life Science: Regulation and behavior; Diversity and adaptations of organisms.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

OTHER

Activity: Home Is Where the Forest Is

Themes: You have just become a bird living in the forest. What challenges await?

Skills and Objectives: Students will define the concepts of habitat and carrying capacity; describe the importance of forest habitat to bird species; and recognize some of the factors that influence or change bird populations.

Overview of Activity: By finding a bird's place in the "forest," students learn the importance of habitat in supporting a diversity of bird species. Role-playing shows that the number of birds an area can support depends on a variety of factors and influences.

Time: Preparation: ~30 minutes. Activity: ~50 minutes.

Source: Flying Wild: An Educator's Guide to Celebrating Birds, 2004.

STANDARDS

OREGON: (Grade 5) Life Science: Diversity/Interdependence-Understand the relationships among living things and between living things and their environments; Describe the relationship between characteristics of specific habitats and the organisms that live there; Describe how adaptations help a species survive.
Scientific Inquiry: Forming the Question/Hypothesis-Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations.

NATIONAL: (Grades K-4) Science as Inquiry: Abilities necessary to do scientific inquiry.
Life Science: Organisms and environments.
Science in Personal and Social Perspectives: Characteristics and changes in populations; Types of resources; Changes in environments.
(Grades 5-8) Life Science: Regulation and behavior; Populations and ecosystems.
Science in Personal and Social Perspectives: Populations, resources, and environments; Natural hazards; Risks and benefits.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

OTHER

Activity: Home, Sweet Home

Themes: What does it take to make a bird's "Home, Sweet Home"? Habitat, survey, evaluation, species.

Skills and Objectives: Students will demonstrate observation and data collection skills, evaluate whether a site is a suitable habitat for specific bird species, and recommend on-site actions to benefit birds.

Overview of Activity: Students conduct a habitat survey and evaluation.

Time: Preparation: ~ 15 minutes. Activity: Part I: ~ 40 minutes, Part II: ~ 40 minutes.

Source: Flying Wild: An Educator's Guide to Celebrating Birds, 2004.

STANDARDS

OREGON: (Grade 5) Life Science: Diversity/Interdependence-Understand the relationships among living things and between living things and their environments; Describe the realtionshi8p between characteristics of specific habitats and the organisms that live there.
Scientific Inquiry: Forming the Question/Hypothesis- Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations**. Collecting and Presenting Data-** Conduct procedures to collect, organize, and display scientific data; Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-** Analyze scientific information to develop and present conclusions; Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Life Science: Organisms and environment.
Science and Technology: Abilities of technological design.
(Grades 5-8) Life Science: Populations and ecosystems.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council,

OTHER

Activity: The Basis of Acids

Themes: What comes to mind with the word acid? Are any of the foods we eat acids? Which ones? How can we test whether something is an acid? What is the connection between acids and bases?

Skills and Objectives: Students will understand the difference between bases and acids and be able to organize common liquids along the spectrum of most acidic to most basic.

Overview of Activity: Students will test a variety of common items to see if they are acids by seeing if they cause a reaction with Baking Soda.

Time: Preparation: ~20 minutes. Activity: ~ 50 minutes.

Source: The SMILE Program, Ryan Collay, Oregon State University.

STANDARDS

OREGON: (Grade 5) Physical Science: Matter- Understand structure and properties of matter; Understand chemical and physical changes.
Earth and Space Science: The Dynamic Earth- Understand the properties and limited availability of the materials which make up the Earth.
Scientific Inquiry: Forming the Question/Hypothesis-Formulate and express scientific questions or hypotheses to be investigated; Make observations; Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations. **Designing the Investigation-** Design a simple scientific investigation to answer questions or test hypotheses. **Collecting and Presenting Data-**Conduct procedures to collect, organize, and display scientific data; Collect, organize, and summarize data from investigations. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions; Summarize, analyze, and interpret data from investigations.

NATIONAL: (Grades K-4) Unifying concepts and processes: Systems, order and organization; Change, constancy, and measurement.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Physical Science: Properties of objects and materials.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

OTHER

Activity: Who Was That Masked Bird?

Themes: Piece together clues to help Jay T. Birder identify the birds she saw on her day of birding in the great outdoors.

Skills and Objectives: In order to identify bird species, students will analyze descriptions of birds as well as the structure and contents of bird field guides. Students will explain reasons why people watch and identify birds.

Overview of Activity: Working with the field notes and audio recordings of a beginning birder, students can discover the fun and challenge of bird watching.

Time: Preparation: ~20 minutes. Activity: ~ 45 minutes.

Source: Flying Wild: An Educator's Guide to Celebrating Birds, 2004.

STANDARDS

OREGON: (Grade 5) Life Science: Organisms-Understand the characteristics, structure, and functions of organisms; Group or classify organisms based on a variety of characteristics; Describe basic plant and animal structures and their functions.

NATIONAL: (Grades K-4) Unifying concepts and processes: Systems, order and organization; Form and function.
Life Science: Characteristics of organisms; Organisms and environments.
History and Nature of Science: Science as a human endeavor.
(Grades 5-8) Life Science: Regulation and behavior; Populations and ecosystem; Diversity and adaptations of organisms.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year. National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

Oregon Benchmarks and National Science Standards

On the following pages we have provided a simple guide to the Oregon Science Benchmarks and National Science Standards by grade level. We have included a list of activities provided in this notebook that address each applicable Benchmark or Standard. In the *Activities* section of this notebook you will also find that we have included the relevant Benchmarks and Standards addressed in each activity. That way you may go to the *Benchmarks and Standards* sections and identify an activity which addresses the benchmarks and standards you wish, or, you may go to the *Activities* section and choose an activity for other reasons (time, prep, enjoyment, familiarity, etc.) and have a quick reference there about the Benchmarks and Standards you may address. We hope this cross referencing is helpful.

Oregon Benchmarks-Benchmark 3 (Grade 8)

PHYSICAL SCIENCE:

Matter
Understand structure and properties of matter.
Understand chemical and physical changes.
Compare properties of specific substances.
Compare physical and chemical changes.
Activities: Field, Forest and Stream, Forest Floor Exploration, Ice Cube Demonstration,

Force
Understand fundamental forces, their forms, and their effects on motion.
Explain interactions between force and matter and relationships among force, mass, and motion.
Recognize that every object exerts gravitational force on every other object.
Activities: Branching Out!,

Energy
Understand energy, its transformations, and interactions with matter.
Compare forms and behaviors of various types of energy.
Describe and explain various energy transfers and resulting transformations.
Activities: Field, Forest and Stream,

LIFE SCIENCE:

Organisms
Understand the characteristics, structure, and functions of organisms.
Describe and explain the relationship and interaction of organ systems.
Describe and explain the structure and functions of an organism in terms of cells, tissues, and organs.
Activities: Compost Columns, Eco Columns, Environmental Exchange Boxes, Every Tree For Itself, Tree Cookies,

Heredity
Understand the transmission of traits in living things.
Describe how the traits of an organism are passed from generation to generation.

Diversity/Interdependence
Understand the relationships among living things and between living things and their environments.
Identify and describe the factors that influence or change the balance of populations in their environment.
Describe and explain the theory of natural selection as a mechanism for evolution.
Activities: Eco Columns, Environmental Exchange Boxes, Every Tree For Itself, Field, Forest and Stream, Leaf Retention, School-yard Ecosystems, Tree Cookies,

EARTH AND SPACE SCIENCE:

The Dynamic Earth
Understand the properties and limited availability of the materials which make up the Earth.
Understand changes occurring within the lithosphere, hydrosphere, and atmosphere of the Earth.
Recognize that Earth materials are limited, and explore strategies for addressing this problem.
Explain the water cycle and its relationship to weather and climatic patterns.
Describe the Earth's structure and how it changes over time.
Activities: Branching Out!, Field, Forest and Stream, Ice Cube Demonstration, Schoolyard Habitat Cloud Experiment,

The Earth in Space
Understand the Earth's place in the solar system and the universe.
Explain the relationship of the Earth's motion to the day, season, year, phases of the moon, and eclipses.

The Universe
Describe natural objects, events, and processes outside the Earth, both past and present.

SCIENTIFIC INQUIRY:

Forming the Question/Hypothesis
Formulate and express scientific questions or hypotheses to be investigated.
Based on observations and scientific concepts, ask questions or form hypotheses that can be explored through scientific investigations.
Activities: Compost Columns, Eco Columns, Every Tree For Itself, Leaf Retention, Schoolyard Habitat Cloud Experiment, Forest Floor Explorations,

Designing the Investigation
Design safe and ethical scientific investigations to address questions or hypotheses.
Design a scientific investigation to answer questions or test a hypotheses.
Activities: Compost Columns, Eco Columns, Every Tree For Itself, Leaf Retention, Schoolyard Habitat Cloud Experiment, Transect and Grid Sampling,

Collecting and Presenting Data
Conduct procedures to collect, organize, and display scientific data.
Collect, organize, and display sufficient data to support analysis.
Activities: Eco Columns, Every Tree For Itself, Field, Forest and Stream, Lake Mendota "Ice-Out", School-yard Ecosystems, Schoolyard Habitat Cloud Experiment, Transect and Grid Sampling,

Analyzing and Interpreting Results
Analyze scientific information to develop and present conclusions.
Summarize and analyze data including possible sources of error. Explain results and offer reasonable and accurate interpretations and implications.
Activities: Eco Columns, *Every Tree For Itself, Field, Forest and Stream, Lake Mendota "Ice-Out", Schoolyard Habitat Cloud Experiment,*

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.

National Science Standards (Grades 5-8)

Unifying concepts and processes
Systems, order and organization. Evidence, models, and explanation. Change, constancy, and measurement. Evolution and equilibrium. Form and function.
Activities: Branching Out!, Compost Columns, Eco Columns, Every Tree For Itself, Field, Forest and Stream, Forest Floor Explorations, Lake Mendota "Ice-Out", Leaf Retention, School-yard Ecosystems, Transect and Grid Sampling, Tree Cookies,

Science as Inquiry
Abilities necessary to do scientific inquiry. Understandings about scientific inquiry.
Activities: Compost Columns, Eco Columns, Every Tree For Itself, Field, Forest and Stream, Forest Floor Exploration, Lake Mendota "Ice-Out", Leaf Retention, School-yard Ecosystems, Schoolyard Habitat Cloud Experiment, Transect and Grid Sampling,

Physical Science
Properties and changes of properties in matter. Motions and forces. Transfer of energy.
Activities: Compost Columns, Field, Forest and Stream, Ice Cube Demonstration,

Life Science
Structure and function in living systems. Reproduction and heredity. Regulation and behavior. Populations and ecosystem. Diversity and adaptations of organisms.
Activities: Compost Columns, Eco Columns, Environmental Exchange Boxes, Every Tree For Itself, Field, Forest and Stream, Leaf Retention, Tree Cookies,

Earth and Space Science
Structure of the earth system. Earth's history. Earth in the solar system.

Science and Technology
Abilities of technological design. Understandings about science and technology.

Science in Personal and Social Perspectives
Personal health. Populations, resources and environments. Natural hazards. Risks and benefits. Science and technology in society.
Activities: Environmental Exchange Boxes, Lake Mendota "Ice-Out",

History and Nature of Science
Science as a human endeavor. Nature of science. History of science.
Activities: Field, Forest and Stream, Forest Floor Explorations, Lake Mendota "Ice-Out", School-yard Ecosystems, Tree Cookies,

Source: National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

Middle School Activities

Over the past seven years we have presented many LTER related activities to SMILE teachers. We have included a representative sample of some of the activities presented and classified them into the four main LTER themes of Growth, Mortality, Decomposition, and Cycles. Most activities fit into more than one category; some may be noted here, some may not. Some do not fit nicely into any and have been included in the "Other" category. You can find a simple outline of each activity in the following pages under the heading which it is listed.

Growth
Field, Forest and Stream
Forest Floor Exploration (All)
Tree Cookies

Mortality
Every Tree For Itself (Growth, Cycles)

Decomposition
Compost Columns (Mortality, Cycles)
Leaf Retention (Cycles)

Cycles
Branching Out!
Ice Cube Demonstration
Lake Mendota "Ice-Out"
School-yard Ecosystems

Other
Eco Columns
Environmental Exchange Boxes
Transect and Grid Sampling

GROWTH

Activity: Field, Forest and Stream

Themes: Energy cycles, growth, decline, measurable indicators of environmental health.

Skills and Objectives: Students will investigate and measure components in three different ecosystems, describe similarities and differences they observe among three ecosystems, and identify ways that the abiotic components of an ecosystem affect the biotic components.

Overview of Activity: In this activity students will examine three different environments as they focus on sunlight, soil moisture, temperature, wind, plants, and animals, in each environment. By comparing different environments, students will begin to consider how nonliving elements influence living elements in an ecosystem.

Time: Preparation: ~ 60 minutes. Activity: ~ One or more 50 minute periods.

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

STANDARDS

OREGON: (Grade 8) Physical Science: Energy- Compare forms and behaviors of various types of energy; Describe and explain various energy transfers and resulting transformations.
Life Science: Diversity/Interdependence- Identify and describe the factors that influence or change the balance of populations in their environment.
Earth and Space Science: The Dynamic Earth- Explain the water cycle and its relationship to weather and climatic patterns.
Scientific Inquiry: Collecting and Presenting Data-Collect, organize, and display sufficient data to support analysis. **Analyzing and Interpreting Results-**Summarize and analyze data including possible sources of error. Explain results and offer reasonable and accurate interpretations and implications.

NATIONAL: (Grades 5-8) Unifying concepts and processes: Change, constancy and measurement.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Physical Science: Transfer of energy.
Life Science: Populations and ecosystem.
History and Nature of Science: Science as a human endeavor. Nature of science.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

GROWTH

Activity: Forest Floor Exploration

Themes: Keys-how to use, make; classification, soil tests, microscope use, graphing, technology, measurements, data collection and record keeping, etc.

Skills and Objectives: Students will use observation to explore forest floor materials from three different forest locations. They will identify questions they would like to know more about. They will develop research questions from these original wonderings and observations.

Overview of Activity: Students are given forest floor materials from 3 different forests and explore them for ~20 minutes. They then share observations and questions that arose and discuss how some of their questions can be turned into research questions.

Time: Preparation: ~1 hour . Activity: ~ One or two 50 minute periods.

Source: PEERS, NSF funded project, 1996-2000.

STANDARDS

OREGON: (Grade 8) Physical Science: Matter-Understand structure and properties of matter; Compare properties of specific substances.
Scientific Inquiry: Forming the Question/Hypothesis-Formulate and express scientific questions or hypotheses to be investigated; Based on observations and scientific concepts, ask questions or form hypotheses that can be explored through scientific investigations.

NATIONAL: (Grades 5-8) Unifying Concepts and Processes: Systems, order and organization; Change, constancy, and measurement.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
History and Nature of Science: Science as a human endeavor.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year. National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

GROWTH

Activity: Tree Cookies

Themes: Lifecycles, evolution.

Skills and Objectives: Students will identify heartwood, sapwood, and a tree's annual rings, infer from a tree's rings what damage or stress might have occurred in its life, and make a timeline of human history that coincides with a tree's rings.

Overview of Activity: One of the best ways to learn about a tree is to look at its annual rings. Tree rings show patterns of change in the tree's life as well as changes in the area where it grows. In this activity, students will trace environmental and historical changes using a cross section of a tree trunk, or "tree cookie".

Time: Preparation: ~ 15 minutes. Activity: ~ 50 minutes.

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

STANDARDS

OREGON: (Grade 8) Life Science: Organisms-Understand the characteristics, structure, and functions of organisms; Describe and explain the relationship and interaction of organ systems. **Diversity/Interdependence-** Understand the relationships among living things and between living things and their environments; Describe and explain the theory of natural selection as a mechanism for evolution.

NATIONAL: (Grades 5-8) Unifying Concepts and Processes: Evidence, models, and explanation; Change, constancy, and measurement; Evolution and equilibrium; Form and function.
Life Science: Structure and function in living systems.
History and Nature of Science: Science as a human endeavor. Nature of science. History of science.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year. National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

MORTALITY

Activity: Every Tree For Itself

Themes: Interdependence, regional variation, altering the environment affects all life forms.

Skills and Objectives: Students will simulate how trees compete for their essential needs, and describe how varying amounts of light, water, and nutrients affect a tree's growth.

Overview of Activity: Try this activity to give your students an idea of the conditions that trees need to live and grow, and to help your students understand that trees must often compete for their needs.

Time: Preparation: ~ 15 minutes. Activity: ~ 50 minutes.

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

STANDARDS

OREGON: (Grade 8) Life Science: Organisms-Understand the characteristics, structure, and functions of organisms. **Diversity/Interdependence-**Understand the relationships among living things and between living things and their environments; Identify and describe the factors that influence or change the balance of populations in their environment; Describe and explain the theory of natural selection as a mechanism for evolution.
Scientific Inquiry: Forming the Question/Hypothesis- Formulate and express scientific questions or hypotheses to be investigated; Based on observations and scientific concepts, ask questions or form hypotheses that can be explored through scientific investigations. **Designing the Investigation-**Design safe and ethical scientific investigations to address questions or hypotheses; Design a scientific investigation to answer questions or test a hypotheses. **Collecting and Presenting Data-**Conduct procedures to collect, organize, and display scientific data; Collect, organize, and display sufficient data to support analysis. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions; Summarize and analyze data including possible sources of error; Explain results and offer reasonable and accurate interpretations and implications.

NATIONAL: (Grades 5-8) Unifying Concepts and Processes: Change, constancy, and measurement; Form and function.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Life Science: Structure and function in living systems; Populations and ecosystem. Diversity and adaptations of organisms.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

DECOMPOSITION

Activity: Compost Columns

Themes: Where do things go when they die?

Skills and Objectives: Students will explore the process of decomposition. They will make observations and may also design experiments which explore the effects of variables on the decomposition column.

Overview of Activity: Students construct composting columns out of soda bottles and observe the process of biodegradation.

Time: Preparation: ~ 15 minutes. Activity: ~ 50 minutes and ongoing, long-term observations.

Source: Bottle Biology Project, Department of Plant Pathology, University of Wisconsin, 1991.

STANDARDS

OREGON: (Grade 8) Physical Science: Matter- Understand structure and properties of matter.
Life Science: Organisms-Understand the characteristics, structure, and functions of organisms.
Scientific Inquiry: Forming the Question/Hypothesis-Formulate and express scientific questions or hypotheses to be investigated; Based on observations and scientific concepts, ask questions or form hypotheses that can be explored through scientific investigations. **Designing the Investigation-**Design safe and ethical scientific investigations to address questions or hypotheses. Design a scientific investigation to answer questions or test a hypotheses.

NATIONAL: (Grades 5-8) Unifying Concepts and Processes: Change, constancy, and measurement.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Physical Science: Properties and changes of properties in matter.
Life Science: Structure and function in living systems.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

DECOMPOSITION

Activity: Leaf Retention in Streams

Themes: Percent outside (allochthonous) retention in streams, role of large woody debris and smaller debris, how this relates to macro-invertebrates in streams.

Skills and Objectives: Students will be able to recognize areas where outside (allochthonous) material is located in streams. They will be able to estimate percent retention of material in various locations.

Overview of Activity: Students dump pre-counted bags of leaves (yellow ginkgo recommended for visibility but any leaf variety acceptable), and watch where the leaves travel and remain in a stream segment. They suggest a connection between leaf retention and macro-invertebrate presence (they may test their hypothesis if stream depth allows-i.e. shallow enough to wade in and collect invertebrates).

Time: Preparation: ~ 20 minutes. Activity: ~ 50 minutes.

Source: The HJ Andrews LTER facility-Randy Wildman, 2003.

STANDARDS

OREGON: (Grade 8) Life Science: Diversity/Interdependence-Understand the relationships among living things and between living things and their environments; Identify and describe the factors that influence or change the balance of populations in their environment. **Scientific Inquiry: Forming the Question/Hypothesis-**Formulate and express scientific questions or hypotheses to be investigated; Based on observations and scientific concepts, ask questions or form hypotheses that can be explored through scientific investigations. **Designing the Investigation-**Design safe and ethical scientific investigations to address questions or hypotheses; Design a scientific investigation to answer questions or test a hypotheses.

NATIONAL: (Grades 5-8) Unifying Concepts and Processes: Evidence, models, and explanation; Change, constancy, and measurement.
Science as Inquiry: Abilities necessary to do scientific inquiry. Understandings about scientific inquiry.
Life Science: Populations and ecosystem.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year. National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: Branching Out!

Themes: Drainage basin, watershed, divide, tributary, runoff.

Skills and Objectives: Students will predict where water will flow in watersheds and describe drainage patterns in watersheds.

Overview of Activity: Students build a model landscape to investigate how water flows through and connects watersheds.

Time: Preparation: ~50 minutes. Activity: ~Two 50 minute periods.

Source: Project WET: Curriculum and Activity Guide, 1995.

STANDARDS

OREGON: (Grade 8) Physical Science: Force- Understand fundamental forces, their forms, and their effects on motion; Explain interactions between force and matter and relationships among force, mass, and motion; Recognize that every object exerts gravitational force on every other object. **Earth and Space Science: The Dynamic Earth-** Explain the water cycle and its relationship to weather and climatic patterns; Describe the Earth's structure and how it changes over time.

NATIONAL: (Grades 5-8) Unifying concepts and processes: Evidence, models, and explanation. **Physical Science:** Motions and forces.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: Ice Cubes Demonstration

Themes: Density, salinity, temperature, currents.

Skills and Objectives: This activity will give students a chance to observe and consider a phenomena that may be surprising to them (sometimes called a "discrepant event"); reinforce previous learning about the relationship of temperature, salinity, and density to the formation of ocean currents; and connect their learning to the density of water near Antarctica.

Overview of Activity: Temperature and salinity are combined to look at the interactions that create ocean currents. Students make predictions about whether ice cubes will melt faster in fresh water or salt water and explain their reasoning. They watch an experiment and hypothesize about the results.

Time: Preparation: ~30 minutes. Activity: ~ 50 minutes.

Source: GEMS Ocean Currents Book.

STANDARDS

OREGON: (Grade 8) Physical Science: Matter-Understand structure and properties of matter; Understand chemical and physical changes.
Earth and Space Science: The Dynamic Earth-Explain the water cycle and its relationship to weather and climatic patterns.

NATIONAL: (Grades 5-8) Unifying Concepts and Processes: Evidence, models, and explanation.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: Lake Mendota "Ice-Out"

Themes: Long term data, long term change, graphing, data manipulation.

Skills and Objectives: Students will develop an understanding of the importance of long-term data; learn to graph by hand or using Excel software; interpret graphs showing ice-out dates over a period of 150 years; learn about one method scientists use to measure global warming; and understand how data can be manipulated to support different points of view.

Overview of Activity: Working in small groups, students graph 10-year segments of a 150 year long data set. They then arrange the data to show the full 150 years and discuss what each 10 year segment shows versus what the entire 150 years shows.

Time: Preparation: ~ 10 minutes. Activity: ~ 50 minutes.

Source: Krasny, M, C Berger, and A Welman. 2001. Long Term Ecological Research Teacher's Manual. Cornell University,

STANDARDS

OREGON: (Grade 8) Scientific Inquiry: Collecting and Presenting Data-Conduct procedures to collect, organize, and display scientific data; Collect, organize, and display sufficient data to support analysis. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions; Summarize and analyze data including possible sources of error; Explain results and offer reasonable and accurate interpretations and implications.

NATIONAL: (Grades 5-8) Unifying Concepts and Processes: Systems, order and organization; Evidence, models, and explanation; Change, constancy, and measurement.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Science in Personal and Social Perspectives: Populations, resources and environments; Risks and benefits; Science and technology in society.
History and Nature of Science:
Science as a human endeavor; Nature of science; History of science.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

CYCLES

Activity: School-yard Ecosystems

Themes: Creating a school-yard or nearby wildlife habitat, habitats and interdependence.

Skills and Objectives: Students will understand what components are necessary to create habitat for various wildlife-birds, insects, small mammals, etc. They will include the necessary components to attract species to their habitat site and make observations about the wildlife that lives or visits there.

Overview of Activity: Working with the school administration, teachers set aside an area of the school-yard or a nearby property to create a wildlife habitat. Students research the various components needed to attract and maintain species in their habitat and include those items in the habitat space. They then make on-going observations of the wildlife.

Time: Preparation: ~Days. Activity: ~ On-going periods of 30-50 minutes, as often as you like.

Source: PEERS, NSF funded project, 1996-2000.

STANDARDS

OREGON: (Grade 8) Life Science: Diversity/Interdependence-Understand the relationships among living things and between living things and their environments; Identify and describe the factors that influence or change the balance of populations in their environment.
Scientific Inquiry: Collecting and Presenting Data-Conduct procedures to collect, organize, and display scientific data; Collect, organize, and display sufficient data to support analysis.

NATIONAL: (Grades 5-8)
Unifying Concepts and Processes: Change, constancy, and measurement.
History and Nature of Science: Science as a human endeavor; Nature of science.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

OTHER

Activity: Eco Columns

Themes: Ecology, population dynamics, water chemistry.

Skills and Objectives: Students will construct and observer aquatic and terrestrial micro-environments with habitats and niches for insect, spiders and small vertebrates. Students will design their own research questions and record observations to answer their questions.

Overview of Activity: Students create miniature systems in soda bottles that can be interconnected to explore natural systems.

Time: Preparation: ~ 30 minutes. Activity: ~ One or more 50-minute periods as well as long term observations.

Source: Bottle Biology Project, Department of Plant Pathology, University of Wisconsin, 1991.

STANDARDS

OREGON: (Grade 8) Life Science: Organisms- Understand the characteristics, structure, and functions of organisms. **Diversity/Interdependence-**Understand the relationships among living things and between living things and their environments; Identify and describe the factors that influence or change the balance of populations in their environment.
Scientific Inquiry: Forming the Question/Hypothesis- Formulate and express scientific questions or hypotheses to be investigated; Based on observations and scientific concepts, ask questions or form hypotheses that can be explored through scientific investigations. **Designing the Investigation-**Design safe and ethical scientific investigations to address questions or hypotheses; Design a scientific investigation to answer questions or test a hypotheses. **Collecting and Presenting Data-**Conduct procedures to collect, organize, and display scientific data; Collect, organize, and display sufficient data to support analysis. **Analyzing and Interpreting Results-**Analyze scientific information to develop and present conclusions; Summarize and analyze data including possible sources of error; Explain results and offer reasonable and accurate interpretations and implications.

NATIONAL: (Grades 5-8) Unifying Concepts and Processes: Systems, order and organization; Evidence, models, and explanation; Change, constancy, and measurement.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.
Life Science: Structure and function in living systems; Populations and ecosystem.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.
National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

OTHER

Activity: Environmental Exchange Box

Themes: Biological diversity, habitats, culture and society influence our beliefs toward the use of resources and environmental protection.

Skills and Objectives: Students will discover some of the resources, products, and other characteristics of their region and ways that people in their region are trying to improve the environment, and describe similarities and differences between their region and another region with respect to these characteristics.

Overview of Activity: Preparing an environmental exchange box will give your students a chance to learn more about their own region and the things that are special about it. Then, when they receive an exchange box from another region, they can compare environments, people, and much more.

STANDARDS

OREGON: (Grade 8) Life Science:
Organisms-Understand the characteristics, structure, and functions of organisms.
Diversity/Interdependence-Understand the relationships among living things and between living things and their environments.

NATIONAL: (Grades 5-8) Life Science:
Structure and function in living systems; Populations and ecosystem; Diversity and adaptations of organisms.
Science in Personal and Social Perspectives: Populations, resources and environments.

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

Time: Preparation: ~ One hour. Activity: ~ Two 50-minute periods.

Source: Project Learning Tree: Environmental Education Activity Guide, 2001.

OTHER

Activity: Transect and Grid Sampling

Themes: Random sampling methods, transitions, observation, comparing, changes over time.

Skills and Objectives: Students will be able to set up a transect and use sampling grids. They will be able to collect and record observations verbally and visually (drawing or sketching). They will be able to compare and contrast findings along a transitional area.

Overview of Activity: Students set up a transect along a transition area and randomly sample along the transect line with a sampling grid.

Time: Preparation: ~ 10 minutes. Activity: ~ 45 minutes,

Source: The SMILE Program, Oregon State University, Bree Benton and Ryan Collay, 2006.

STANDARDS

OREGON: (Grade 8) Scientific Inquiry: Designing the Investigation-Design safe and ethical scientific investigations to address questions or hypotheses; Design a scientific investigation to answer questions or test a hypotheses. **Collecting and Presenting Data-**Conduct procedures to collect, organize, and display scientific data; Collect, organize, and display sufficient data to support analysis.

NATIONAL: (Grades 5-8) Unifying Concepts and Processes: Systems, order and organization; Change, constancy, and measurement.
Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry**.**

Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

Oregon Benchmarks and National Science Standards

On the following pages we have provided a simple guide to the Oregon Science Benchmarks and National Science Standards for High School. So far we haven't provided any LTER related activities to the High School SMILE clubs, thus we haven't included any here. In the future we hope to carry the LTER learning and concepts through to the High School level and will add activities to this section as they are made available to SMILE High School clubs.

Oregon Benchmarks-CIM/CAM High School Science

PHYSICAL SCIENCE:

Matter
Describe properties of elements and their relationship to the periodic table.
Analyze the effects of various factors on physical changes and chemical reactions.

Force
Describe and explain the effects of multiple forces acting on an object.
Recognize that gravity is a universal force.

Energy
Describe differences and similarities between kinds of waves, including sound, seismic, and electromagnetic, as a means of transmitting energy.
Describe and analyze examples of conservation of energy.

LIFE SCIENCE:

Organisms
Describe, explain and compare the structure and functions of cells in organisms.

Heredity
Explain laws of heredity and their relationship to the structure and function of DNA.

Diversity/Interdependence
Describe and analyze the effect of species, including humans, on an ecosystem.
Analyze how living things have changed over geological time, using fossils and other scientific evidence.

EARTH AND SPACE SCIENCE:

The Dynamic Earth
Describe how the importance and use of resources has changed over time with changes in economic and technological systems.
Analyze the relationship between global energy transfer and climate.
Analyze evidence of ongoing evolution of the Earth system.

The Earth in Space
Explain how mass and distance affect the interaction between Earth and other objects in space.

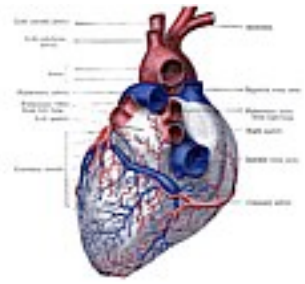
SCIENTIFIC INQUIRY:

Forming the Question/Hypothesis
Based on observations and scientific concepts, ask questions or form hypotheses that can be answered or tested through scientific investigations.

Designing the Investigation
Design a scientific investigation that provides sufficient data to answer a question or test a hypotheses.

Collecting and Presenting Data
Collect, organize, and display sufficient data to facilitate scientific analysis and interpretation.

Analyzing and Interpreting Results
Summarize and analyze data, evaluating sources of error or bias. Propose explanations that are supported by data and knowledge of scientific terminology.



Sources: Oregon Standards newsletter, Oregon Department of Education, 2005-2006 School Year.

National Science Standards (Grades 9-12)

Unifying concepts and processes
Systems, order and organization. Evidence, models, and explanation. Change, constancy, and measurement. Evolution and equilibrium. Form and function.

Science as Inquiry
Abilities necessary to do scientific inquiry. Understandings about scientific inquiry.

Physical Science
Structure of atoms. Structure and properties of matter. Chemical reactions. Motions and forces. Conservation of energy and increase in disorder. Interactions of energy and matter.

Life Science
The cell. Molecular basis of heredity. Biological evolution. Interdependence of organisms. Matter, energy, and living systems.

Earth and Space Science
Energy in the earth system. Geochemical cycles. Origin and evolution of the earth system. Origin and evolution of the universe.

Science and Technology
Abilities of technological design. Understandings about science and technology.

Science in Personal and Social Perspectives
Personal health and community health. Population growth. Natural resources. Environmental quality. Natural and human induced hazards. Science and technology in local, national, and global challenges.

History and Nature of Science
Science as a human endeavor. Nature of scientific knowledge. Historical perspectives.

Source: National Science Education Standards, National Research Council, Seventh Printing November 1999, pp.109-111.

Long-Term Studies

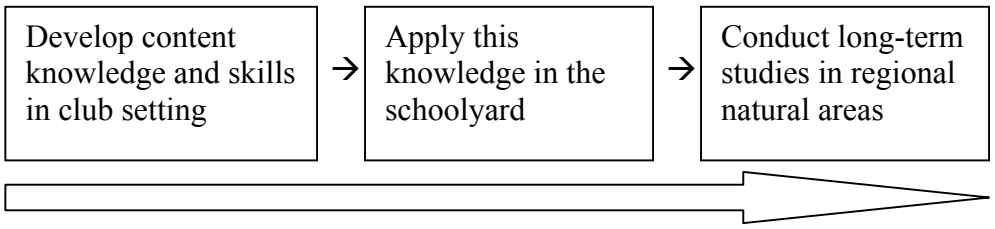
Supporting SMILE club Long Term Ecological Research

The goal of our program is for students to develop skills they can apply in the study of natural areas over the long-term. Programming works like this:

Skills and content knowledge are developed in the club and classroom settings. We provide activities that highlight key concepts, such as decomposition, and also the methods used to conduct a variety of experiments. Students also learn various "tools of the trade" of scientific research such as how to use thermometers or read a meter stick. They also learn the importance of empirical design and creating protocols.

These skills are then practiced in the schoolyard, by creating a transect or using a random sampling method as a study skill. They also establish model long-term studies. They learn a variety of strategies for how they might develop an understanding of processes like decomposition, or long-term cycles.

They then use these skills in nearby natural or wilder areas. The work in these area leads to other opportunities such as inquiry, service learning, and creating educational materials and displays. The completed linkages are a great opportunity to truly develop and apply skills in the context of long-term understandings.



Inquiry

One of the goals of science programming is to support students in conducting their own studies. Using content they understand, and skills they can apply, we guide them through the scientific process. Inquiry is the idea that students learn science within the context of understanding why and how scientists define problems, explore the methodology for finding answers, and then engage in research. Many of our projects build the skills and knowledge for students to engage in inquiry. In inquiry most open-ended form, students define their question, learn the necessary skills, and apply these skills to a question. We seed this process by developing short-term projects where students learn skills and content within the overarching context of learning how scientists develop an understanding for the natural world. This leads to long-term projects that are more student-centered.

Barriers and Opportunities to Schoolyard Long Term studies

Many schools are resistant to students using the school grounds for study areas if this includes changing site management plans. For example, if the club wants to create a set-aside area, they must work with district personal to change the landscape management plan. While observing succession makes sense to us, the maintenance staff may see this as simply a weedy area or even a safety hazard. Other barriers include vandalism, spraying of herbicides in planting areas, and other issues that may be beyond the scope of

a teacher or a club to solve. The best procedure is to start slow, build alliances and educate the staff.
The opportunities for using the schoolyard as a study are many as well. Students see the schoolyard as part of a learning community. If they have a garden of native plants, a set-aside area where they study pioneer species of plants and animals, they become more involved in their school. Students also appreciate the longer-term commitment to a project as well as the establishment of a legacy of data for others to use.
Overcoming these barriers and enhancing the opportunities requires a solid plan. Each school site will have differing issues and opportunities.

Ideas for long-term studies
There are many ideas and opportunities for building the content and skills that can be applied in long term studies. We have listed a few that we have used, singularly and in combination, to enhance the students' application of the scientific process.
Set-Aside areas—these are areas where minimal intrusion and maintenance allow the natural succession of plants and animals to "take over" an area. These can be a small fenced-off area in a schoolyard where the maintenance department agrees to not mow. The process can also be seeded through planting regional native vegetation. A common study is to see what insects colonize these areas.
Photo Points—a simple method to study long term changes and cycles is to establish a set of photo points, a place where students take picture from the same point, at the same time of day, 3-6 times per year and create a database of pictures. A common idea is to pick a newly planted tree, it could be either coniferous or deciduous, and take a picture seasonally. Over many years the tree will cycle through the seasons, grow and change. The concept is that we don't notice these changes, particularly growth, unless we collect data. If the project continues for multiple years students will be able to see otherwise subtle changes in their tree.
Bird Feeders—creating bird feeders and watching birds that visit these feeders is a simple way to study migration, habitat, and learn bird species by feed type. There are many feeders that students can make, and even take home, as they collect the club's life list. A great idea is to create a poster over time listing all the birds seen. You can include pictures of the birds, notes on behavior, time of day they visit the feeder, what they eat, etc.... This is a very rich source of long-term data and can actively involve local groups such as Audubon.
Decomposition bags—the study of slow changes takes time to establish. Net bags that can be filled with organic materials that slowly decompose show some of these changes. A club could establish a sequence of bags they observe over many years. Short-term decomposition could be shown with leaves or produce from the store. Long term decomposition could be shown with woody shavings such as animal bedding or pieces of lumber. Changes to observe would be the moisture content through weight, the presence of fungi or invertebrates. Something to think about with these studies is to make sure to place enough materials in the net bags so that some material can remain in the bag and some can be removed for study.
Daffodil study—the study of the growth of daffodils offers a chance to explore the life cycle and reproduction of perennial plants. One feature of plant growth is its cyclic nature. A question for students to investigate would be, "What controls the timing of

flowering in daffodils?" A key to this study is the establishment of a set protocol for the experiment and the data collection. Different clubs could perform this study and see if there are regional differences. To do this without creating confounding differences requires that each club perform the experiment the same way so they can rule out factors and generate a hypothesis they could then test.

Weather Watchers—simply noting and recording observations over long periods is a great method to build connections between variables. Cloud types and air pressure are two simple observations where patterns emerge over long periods. Other variables to include are wind speed and wind direction. One study looked at the regional images from satellites as compared to local data on cloud types. The concept of local versus regional is interesting, particularly if you have a weather service station nearby with which you can compare. Many factors can be very localized such as rainfall.

Service Learning and Education

Service as well as education are important components of many projects, particularly at the upper levels. Studying and then connecting to a community helps to build students' understanding of their commitment. Many areas have opportunities for students to work at a reserve or natural area; even a city park could be a great project site. One idea is returning an area to native plants along with signage for each species. Another component could be education. A site becomes an educational opportunity for other students as well as the public. This area is very rich in opportunities although they will be different for each teacher and club.

Integration

Long-term studies offer a great opportunity for teachers to integrate a variety of content areas. The literature and science connection is one option for integration, another is science and math. Long-term studies also offer opportunities for students to use their skills in a project-based way. Skills are taught in a classroom or club setting, practiced in the schoolyard or neighboring field and then can be applied to a more natural setting. This links what we teach in a more formal setting to what scientists do as they work to understand an ecological community.

Modeling Connected Communities Through LTER

SMILE Community and Program
- Local schools and clubs
- Local resources, partnerships, possible locations
- Long-term ecological community studies
- Activities and materials

Program support
- Our model for forming transformative relationships
- Role models and mentors
- Involving other partners and programs

LTER Partnerships
- Serving the partner's needs
- Sharing research with SMILE students
- Engaging in LTER
- Dissemination of teaching materials

Level Specific Club activities
- Activities in clubs
- Schoolyard skills-building
- Field trips to study site
- Service to community
- Developing community and professional connections to community resources

Creating/partnering for a long-term study site
- Using this as a study area
- Developing longer-term connections
- Leading field trips
- Community Open Houses

Aquatics
- Biology and Habitats
- Ecology
- Mapping and watersheds
- Nutrients
- Hydrology
- Geology

Multi—Level Contributions
- Field trips
- Project WEB
- Tours

Elementary School
- Connection to EOSA, living and non-living years
- Aquatic communities
- Biological understanding

Middle School
- Geology and Earth Science
- Watersheds, mapping
- Space science
- Biology

High School
- Hydrology, physics
- Chemistry
- Ecology
- Genetics
- Service

A Nature Study Area Facilitates Learning About Life's Diversity

Life's diversity: Terrestrial and Aquatic
Plant types, primary production
Worms, soils, invertebrate's role in soil formation
Spiders, carnivore insects, hunting techniques
Many aquatic insect types
Fish, foods sources, protection, spawning, migration
Frogs and amphibians, migrations, return to aquatic environments to reproduce
Reptiles, predator/prey relations, return to terrestrial environments to reproduce
Birds, migration, diversity, indicators of community health
Mammals, prey and predator species, herbivores and productivity

Plant life cycles: Simple plants, mosses and ferns, spores, vascular and non-vascular
Flowering Annual/biannual, reproduction strategies, pollination,
Perennial, herbaceous with a resting stage
Deciduous shrubs and trees, adaptations to winter, dry cycles
Evergreen shrubs and trees

Animal life cycles: Metamorphosis by insects and amphibians, aquatic life cycles
Nesting and parental care by birds and squirrels

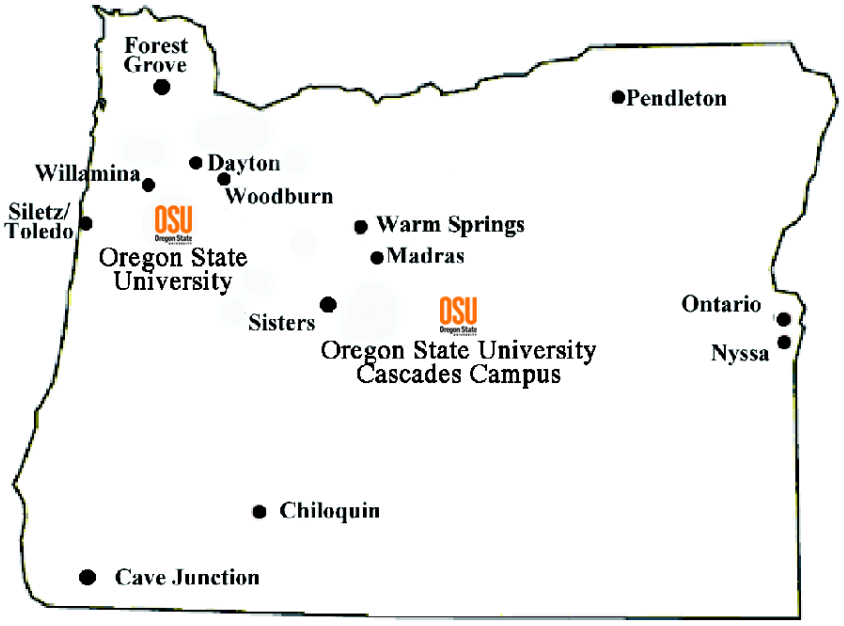
Specific adaptations of plants and animals: Drought tolerance
Shade or sun adaptations
Specific pollinators: adaptations of both plant and its pollinator-Wind, moths, butterflies, hummingbirds, bees
Bird beaks for different food types
Visual systems of prey and predators
Hibernation
Plant seed dispersal: animals vs. wind

Needs of wildlife: Food
Water
Nest sites
Cover from predators and weather

Stewardship of natural resources: Respect for other forms of life as unique and interesting entities and as valuable agents in the ecological balance
Garbage composting
Nutrient cycles
Soil requirements
Ecological role of decomposers and earthworms
Recycling materials to generate money for the area

SMILE Schools

Where SMILE clubs can be found …



(and in Rhode Island too!)

Source:
http://smile.oregohttp://smile.oregonstate.edu/SMILEcommunities_index.htmnstate.edu/SMILEcommunities_index.htm

Resource Links

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The HJ Andrews LTER site, http://www.lternet.edu/, http://www.lternet.edu/sites/and, http://www.fsl.orst.edu/lterhome.html/, and http://www.fsl.orst.edu/lter/edu/schoolyard/smile.cfm?topnav=125

The SMILE Program, Oregon State University, http://smile.oregonstate.edu/SMILEcommunities_index.htm, and http://smile.oregonstate.edu/aboutUs_index.htm

Whole Ecosystems in Balance (WEB): A Natural Resources Curriculum. 1992. Blue Mountains Natural Resources Institute and Eastern Oregon State College. Developed by Donna Rainboth.