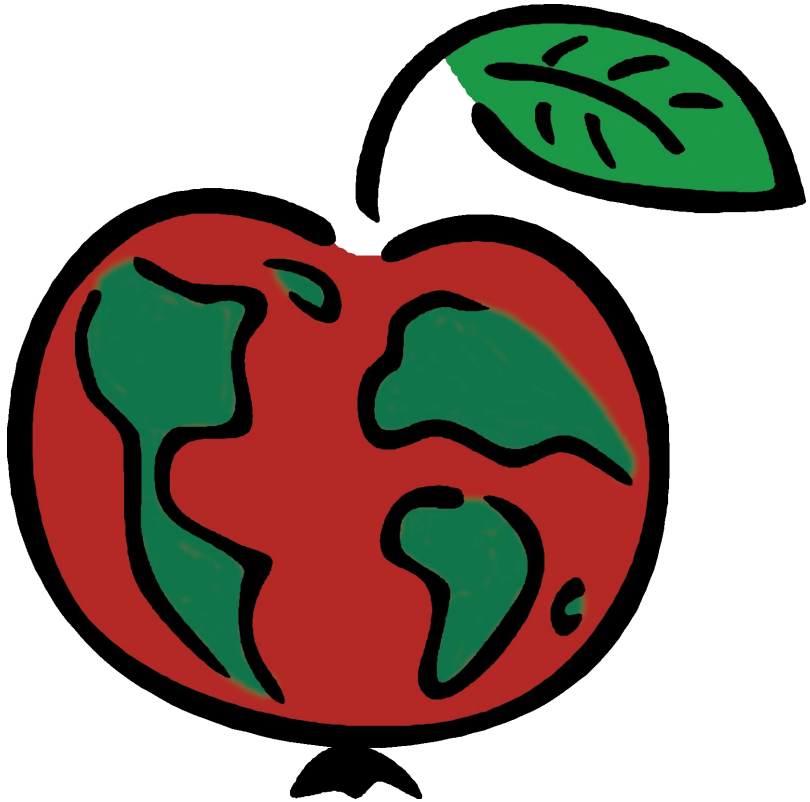
# Wisconsin Environmental Science Digital Resource Library

This digital resource library contains materials that can be used to teach the topics, concepts, and subconcepts in the *Environmental Science Course Framework.* Resources include activities; assessment strategies; labs; web sites; and video, field trip, and guest speaker suggestions.

**Wisconsin Environmental Science Course Framework** outlines an ideal year-long high school environmental science course. Topics in the framework are prioritized to help in planning courses of varied length. The framework is not intended to serve as a curriculum but to provide a consistent foundation upon which environmental science courses in Wisconsin can be developed. The framework should be modified to meet each individual teacher's needs. The Framework can be downloaded from the WCEE website.

## LIBRARY TOPICS





| Introduction | |
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| Quality of life/Quality of environment<br>Ecological footprint<br>Maslow's needs hierarchy<br>Population<br>Tragedy of the commons<br>Environmental problems and issues<br>Timeline of environmental history<br>Environmental leaders<br>Environmental careers | |

| Introduction | | | |
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| **The Cartoon Guide to the Environment**<br>Using the fate of Easter Island as a metaphor for Island Earth, this book covers forests and water, chemical cycles, communities of life on land and in water, food and energy webs, populations, agriculture, commercial hunting, extractive energy processes, urbanization, pollution, environmental action, and appropriate technologies. HarperCollins, 200+ pages. Students enjoy the cartoon images to as a way to increase understanding and add humor to the content. | Book | Book<br><br>Borrow from WCEE EE Resource Library | Authors, Larry Conick and Alice Outwater |
| **Earth Observatory**<br>You can accompany NASA scientists as they explore our world and unravel the mysteries of our climate and environmental changes. Through the use of satellite and research pictures, surface mapping, etc., you can access current information in areas of atmosphere, oceans, land, energy, and life. Images and stories covered may change as this website is updated often. | Website | Website | NASA |
| **Ecological Terms Writing Assignment**<br>At the beginning of the year, give the students 15 commonly used ecology terms. Students think they know the definition of some words but often their definition is incorrect. Have students write a short story using the terms in the correct context. The story is difficult for some to write, but they never forget the words. | Activity (MS Word) | Download Activity | Greg Rose, Clintonville High School |
| **Environmental E-Quiz**<br>Test your environmental knowledge with the easy, medium, or difficult quiz. Each quiz has ten questions and gives an immediate response of answers with additional information about the questions. | Website | Website | EEinWisconsin.org |
| **Environmental Knowledge Quiz**<br>This is a simple 12 question quiz designed to test the average person's knowledge of the environment and environmental protection. | Website | Website | National Environmental Education Foundation |
| **Environmental Quiz**<br>In 1991 a short environmental quiz was developed at the University of Minnesota and has been updated and administered annually to students since that time. The quiz is useful in stimulating discussion about forest and environmental trends. Focusing on topics from population to raw material consumption trends, the quiz stimulates comparison of answers and interaction among participants after the quiz is completed. It provides a great segue to further discussion. | Activity | Website | University of Minnesota |

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| **Quality of life/Quality of environment** | | | |
| **Defining Happiness**<br>Students individually decide what types of things positively contribute to their quality of life. They compare their ideas about quality of life to national statistics related to how Americans spend their time, and determine how Americans could restructure their time to improve quality of life. Students also evaluate their own progress toward "the good life" and how their personal consumption habits impact their progress. | Activity<br>(Lesson 7) | Website | Facing the Future |
| **Defining Needs**<br>One step to improving personal well-being is to think about what we need and how we want to spend our time and money to meet these needs. If each of us focused on meeting our basic needs, might quality of life improve for everyone? This easy-to-read article provides a good summary for students. | Article<br>(PDF) | Download Article | Facing the Future |
| **Quality of Life**<br>Ask students to list the things in life that are essential to their lives and the things that are non-essential and bring the list to class the next day for discussion. As the discussion takes place, students begin to realize that many of the things they consider essential are not as necessary as they thought. They also get a feel for resource consumption. | Activity | | Joyce Johnson, Reedsburg School District |
| **The Lorax**<br>After reading the Lorax or watching the video, students participate in a role-play activity and answer critical questions about the story. The role-play asks students to become a character from the story and defend their position. The questions have students analyze the content of the story. | Book, Video, Activity<br>(MS Word) | Download Activity<br><br>Book \| DVD<br><br>Borrow from WCEE EE Resource Library | Harv Hayden, Wisconsin Rapids School District |
| **Ecological footprint** | | | |
| **The Ecological Footprint: Accounting for a Small Planet**<br>Dr. Mathis Wackernagel introduces the Ecological Footprint, a resource accounting tool that measures human demand on the Earth. In just thirty minutes, the film paints a picture of our current global situation: for the first time, humanity is in "ecological overshoot" with annual demand on resources exceeding what Earth can regenerate each year. | DVD | DVD | Global Footprint Network and Bullfrog Films |
| **Ecological Footprint Calculator**<br>A 27 question quiz that allows users to estimate the amount of land and ocean required to sustain their consumptive and waste generating lifestyle. | Online Tool | Website | Redefining Progress |
| **Ecological Footprint Calculator**<br>This Canadian footprint calculator provides background on the concept of ecological footprint and compares the calculated print to that of other nation's averages. | Online Tool | Website | Royal Saskatchewan Museum |
| **Ecological Impact & Food**<br>This webquest asks students to consider their ecological impact by first understanding ecological footprints and then considering a specific example based on food selection. | Activity<br>(MS Word) | Download Activity | Anita Sundstrom, Oregon School District |
| **Global Footprint Network**<br>This website explains the science behind global footprint accounting | Background | Website | Global Footprint Network |

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| **Labor Day Dinner**<br>This activity is designed to illustrate the concept of Ecological Footprint. The students are divided into groups to analyze the impact on the environment of the Labor Day dinner of the family they have chosen. They then make a presentation in front of the class in which they explain the impacts that their particular family would have on the environment. The activity can be modified for the particular community in which your school is based. | Activity<br>(MS Word) | Download Activity | Charlie Frisk, Luxemburg-Casco School District |
| **Mapping the Impact**<br>Students create a web diagram to illustrate environmental, social, and economic impacts associated with everyday items. This activity expands the concept of "ecological footprint" to consider impacts of a given lifestyle on people and societies. Students develop ideas to reduce the ecological footprint and associated impacts related to an everyday item. | Activity<br>(Lesson 2) | Website | Facing the Future |
| **Maslow's needs hierarchy** | | | |
| **Abraham Maslow**<br>Information about Abraham Maslow and the hierarchy of needs theory he proposed in the 1943 paper A Theory of Human Motivation can be found by doing an Internet search. | Background | Website | Wikipedia |
| **Population** | | | |
| **6 Billion Human Beings**<br>This European website provides an overview of human population numbers, trends, and issues. The worksheet helps students explore the site. | Website<br><br>Activity (PDF) | Website<br><br>Download Activity | Harv Hayden, Wisconsin Rapids School District |
| **Food for Thought**<br>In this activity students are grouped to simulate the distribution of people into five world regions and then compare resource use, growth rate, birth rates, death rates. The teacher distributes items to each region to represent energy consumption, food, wealth, etc. | Activity | Website | Population Connection |
| **Human Population**<br>This website is a population clock providing a second by second mathematical update of the current human population. It also gives viewers the opportunity to look at future population numbers. It can be used to spark some interesting discussion about current and future populations. | Website | Website | Galen Huntington, UC Berkley PhD Candidate |
| **The People Bomb**<br>The People Bomb is a set of 10-15 minute CNN news reports about several dimensions of global demographic explosion in 13 (mostly third world) countries. Although from 1998, this video provides vivid information about population growth and control. It is an excellent resource to present when covering population and development issues. There are several broadcasts that apply to the impact of population growth on our environment and quality of life in our habitats. This is particularly effective and eye opening for students in focused on a materialistic world. | Video | VHS<br><br>Borrow from WCEE EE Resource Library | CNN |
| **Populating the Planet**<br>Without the pressure of population growth, perhaps none of the issues facing humanity today would be large enough to qualify as global. Explore historic and modern population trends in this concise and easy-to-read article. | Background | Download Article | Facing the Future |
| **Population Pyramids**<br>The purpose of this brief lesson is to help students understand population distribution worldwide and compare different areas of the world. Also, discussion allows students to begin to understand how this | Activity<br>(MS Word and PDF) | Download:<br>Adapted Instructions | Anita Sundstrom, Oregon School District and Population Connection |

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| information might help one analyze current and future needs based on growth. Students create their own population pyramids. | | Student Sheet<br><br>Original Activity | |
| **World Population**<br>This short (~7 minute) video provides a great visual of the human population explosion that is currently occurring. The video displays a world map and time ticks away in years on the bottom of the screen. When 1 million people are in an area a dot will appear. You can see how slowly the human population grew at first and how war and disease affect population (historical references are noted on the bottom) and how an explosion of dots appear in recent years. | Video | DVD<br><br>Borrow from WCEE EE Resource Library | Population Connection |
| **Tragedy of the commons** | | | |
| **The Tragedy of the Commons**<br>This student activity illustrates the Tragedy of the Commons through a fishing simulation using Gold Fish Crackers. | Activity (MS Word) | Download Activity | Chad Janowski, Shawano School District |
| **Truffula Tree Company**<br>Have students read The Lorax by Dr. Seuss in class, then have them read the story of Easter Island. Talk about the Tragedy of the Commons, similarities between the fictional story and the real one, and have students fill out the worksheet as they go. As a fun way to end the lesson, show the students the Lorax video. The Lorax can be purchased online or checked out from public library. The story of Easter Island can be found using a Google search. | Activity (MS Word) | Download Activity | Becca Bestul, Eau Claire Area School District |
| **Environmental problems and issues** | | | |
| **The 11th Hour**<br>Narrated by actor Leonardo DeCaprio, this powerful documentary shocks viewers by showing the unfortunate current state of our planet and how it came to be this way. It then shifts to persuade viewers to take action and make the changes necessary since we are at the "11th Hour" or final moment available to make a change. Viewpoints from many renowned scientists and leaders are presented. Official website also includes links with various facts, tips, and suggestions of how to take action. 2008. Running time: 124 minutes. | Video | DVD | Warner Home Video |
| **Badger Poll**<br>The spring 2008 Badger Poll asked Wisconsin residents about a variety of environmental issues. The major results and analysis are summarized. E.g., 66% of Wisconsinites rate the natural environment of the state as excellent or good. | Survey Data (PDF) | Download Document | University of Wisconsin Survey Center |
| **Environmental Issue Investigation**<br>Students identify an environmental issue and then develop an action project to increase awareness and knowledge of the issue within the school, the community, and hopefully beyond. | Activity (MS Word) | Download Activity | Ron Weber, Weyerhaeuser School District |
| **Timeline of environmental history** | | | |
| **Environmental History Timeline**<br>Timeline of environmental history from BC to the future. Includes many links, suggested readings, and biographies of environmental leaders. | Website | Website | Originally printed in Mass Media and Environmental Conflict by M. Neuzil and W. Kovarik |

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| **History of the Environmental Movement**<br>A visual timeline of the Environmental Movement in the United States including the First Peoples of North America (25,000 years ago), Exploitation Years (1620 - 1900), Conservation Years (1900 - 1948), and the Environmental Era (1948-???). | PowerPoint | Download Presentation | Pat Arndt, Berlin Area School District |
| **An Iroquois Perspective**<br>Short article which states the Iroquois Perspective (representative of many Native tribes) toward the environment. Presented during the Timeline of Environmental History as a take home reading assignment for students with class discussion the following day. | Article<br>(Chapter 10 in American Indian Environments: Ecological Issues in Native American History. Syracuse University Press. 1994.) | Available from Barnes & Noble online | Written by Oren Lyons |
| **Environmental leaders** | | | |
| **Environmental Prophets**<br>Presentation about John Muir, Aldo Leopold, and Rachel Carson. | PowerPoint | Download Presentation | Harv Hayden, Wisconsin Rapids School District |
| **Aldo Leopold: Learning from the Land**<br>This 51-minute DVD recounts the biography of Wisconsin's premier environmentalist, Aldo Leopold, and the story of how he and his family learned from the land and each other at their weekend retreat, the "Shack." Featuring first-hand accounts by his daughter, Nina Leopold Bradley, and historic family photos, the film also includes dramatic readings shot on location at the Shack from Leopold's famous book, A Sand County Almanac. | Video | DVD<br><br>Borrow from WCEE EE Resource Library | |
| **Aldo Leopold Shack and Farm**<br>Wisconsin was home to one of the most well-known environmental leaders, Aldo Leopold. The Shack, a re-built chicken coop along the Wisconsin River where Aldo Leopold and his family stayed during weekend retreats, inspired many of the essays in the conservation classic, A Sand County Almanac. The Leopold Center is an educational and interpretive facility near the Leopold Shack, located on the very land where Aldo Leopold died in 1948 fighting a brush fire. The Legacy Center embodies the philosophy of Leopold with features like solar power, geothermal, and sustainable building materials - making this one of the "greenest" buildings in the world. Both self and naturalist guided tours are available. | Field Trip | Website | Location: Baraboo, WI |
| **Environmental careers** | | | |
| **Green Careers**<br>Find descriptions of 20 environmental jobs including education requirements and links for more information. This page is part of supporting material for Miller's Environmental Science textbook. | Website<br>(click on green careers in left box) | Website | Brooks/Cole CENGAGE Learning |
| **Careers in Forestry & Natural Resources**<br>This site contains a wealth of information on natural resource careers including profiles of actual people, education needed, and places to seek further education. | Website | Website | National Science Foundation project |

## Ecological Principles

1. Commoner's laws of ecology
   a. "Everything is connected to everything else"
   b. "Everything must go somewhere"
   c. "Nature knows best"
   d. "There is no such thing as a free lunch"
2. Energy primer
   a. Definition
   b. Laws of energy
   c. Types of energy
3. Evolution
   a. Natural selection
   b. Environmental adaptations and ecological niche
   c. Speciation, biodiversity, co-evolution, extinction
   d. Rates of evolution - gradualism vs. punctuated equilibrium
4. Organismal ecology
   a. Unit of natural selection – survival and reproduction
   b. Kingdoms of life and requirements for life
   c. Habitat, environmental adaptations, and ecological niche
   d. Homeostasis and feedback regulation – thermoregulation, osmoregulation, gas exchange, energetics
   e. Cellular metabolism – photosynthesis, cellular respiration, chemosynthesis
5. Population ecology
   a. Population dynamics – exponential vs. logistic growth
   b. Carrying capacity and limiting factors
   c. Population structure – age, gender, survivorship
   d. Population genetics and genetic diversity
6. Community ecology
   a. Species interactions – resource competition, predation, symbiosis
   b. Competitive exclusion principle
   c. Niche partitioning and keystone species
   d. Species biodiversity
   e. Ecological succession – primary vs. secondary
   f. Disturbance
7. Ecosystem ecology
   a. Matter/Biogeochemical cycles (biotic/abiotic) – water, carbon, nitrogen, phosphorous, sulfur
   b. Energy flow – trophic levels, food pyramids, food webs
   c. Thermodynamics – 1st law (conservation of energy) and 2nd law (entropy)
   d. Biomes – environmental factors influencing distribution
   e. Value of ecosystem services
8. Biosphere ecology
   a. Global energy flow – solar input, ocean currents, air mass circulation
   b. Global matter cycling – global biogeochemical cycles
   c. Global biodiversity – species distribution and abundance
   d. Plate tectonics – theory of continental drift
   e. Global environmental issues – extinction crisis, climate change, etc.

## Ecological Principles

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| **Basic Ecology Concepts Review**<br>This two page worksheet helps students review a variety of ecology concepts. | Worksheet (MS Word) | Download | David Bendlin, Milton School District |
| **Ecology Fundamentals**<br>ECB VideoLink offers high-quality digital media for students and educators. This series of images illustrating biotic components, habitats, producers, etc. | Images | Website | Educational Communications Board |
| **Leopold Education Project** | Activities | Website | Leopold Education |

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| The Leopold Education Project (LEP) deals with Part I of The Sand County Almanac, which records observations and events throughout the seasons. Although the over-riding purpose of the lessons is to promote responsible decision making regarding our impact on ecosystems, the developers do not advocate particular positions on value-sensitive issues such as hunting, using wetlands, applying pesticides and herbicides, or any others. The LEP's underlying theory about these controversial topics is that given a supportive classroom climate to study a variety of positions and viewpoints, students will develop responsible environmental values on their own. | | | Project |
| **Sustainable Tomorrow: A Teachers' Guidebook for Applying Systems Thinking to Environmental Education Curricula for Grades 9-12**<br>This is a guidebook for incorporating systems thinking into instruction. Systems thinking looks at the whole of a system rather than individual parts to better understand complex phenomena. The guide includes background information on systems concepts, tools, and skills. There are also examples of how to apply a systems perspective to existing lessons. | Curriculum (PDF) | Download | Pacific Education Institute |
| **1. Commoner's laws of ecology** | | | |
| **Barry Commoner**<br>Find out who Barry Commoner is. | Background | Website | Wikipedia |
| **Overview of Commoner's Laws of Ecology**<br>This reading describes Commoner's four Laws of Ecology. Includes diagrams. These four laws form the basis for studying and understanding the relationships and interdependencies found in communities and ecosystems. They further explain that humankind is only one member of the biotic community and people are shaped and nurtured by characteristics of the land. | Background (PDF) | Download | University of Maine Cooperative Extension |
| **a. "Everything is connected to everything else"** | | | |
| **Brother Eagle, Sister Sky**<br>This book presents an adapted version of the speech given by Chief Seattle in the 1850s. Although there is controversy over the wording of the original speech and even the identity of the actual speaker, this book presents powerful quotes related to the idea of the interconnections in the web of life. It works well as an introduction activity or students can take quotes from the book and rewrite them in their own words. | Children's book | Book<br><br>Borrow from WCEE EE Resource Library | Susan Jeffers, author |
| **b. "Everything must go somewhere"** | | | |
| **c. "Nature knows best"** | | | |
| **d. "There is no such thing as a free lunch"** | | | |
| **2. Energy primer** | | | |
| **a. Definition** | | | |
| **Energy Basics**<br>This site provides a basic definition of energy. | Webpage | Website | US Energy Information Administration |
| **What is the Definition of Energy?**<br>This site provides a discussion on energy topics in a conversational and fun way. | Website | Website | FT Exploring Science and Technology |

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| **b. Laws of energy** | | | |
| **c. Types of energy** | | | |
| **3. Evolution** | | | |
| **Evidence for Evolution**<br>This is a group activity that requires students to find, research, discuss, and present their findings about the fossil evidence, structural evidence and genetic evidence for evolution. | Webquest | Website Activity (MS Word) | PBS and DeForest Science Teacher |
| **a. Natural selection** | | | |
| **Bird Beak Buffet**<br>Students learn about natural selection by becoming birds foraging for food on an island (area of the schoolyard or classroom). The prey (beans) vary in their coloration and birds vary in the type of beak they have. Each season, surviving predators and prey reproduce. Over several generations, the bird and bean populations shift. In this way, students model natural selection and get a good idea of how it works. | Activity | Website | My Science Box |
| **b. Environmental adaptations and ecological niche** | | | |
| **c. Speciation, biodiversity, co-evolution, extinction** | | | |
| **d. Rates of evolution - gradualism vs. punctuated equilibrium** | | | |
| **4. Organismal ecology** | | | |
| **Bugguide.net**<br>Online "bug" identification web site. Identification available by drawing, photo, or you submit a photo for ID. | Website | Website | Iowa State University Entomology |
| **a. Unit of natural selection – survival and reproduction** | | | |
| **Toothpick Fish**<br>This population genetics simulation designed for middle school students but can be modified. It is a good review of basic genetic concepts with a focus on the environment and natural selection. Using a made-up fish population students discover how the environment can affect the gene pool. | Activity (PDF) | Download | The GENETICS Project, University of Washington |
| **b. Kingdoms of life and requirements for life** | | | |
| **c. Habitat, environmental adaptations, and ecological niche** | | | |
| **Hook**<br>"Hook" is a 1940 short story about the life cycle of a hawk. It follows an abandoned fledgling to maturity and its eventual death after an incident with a poor farmer. | Short story | Download (fee) | Walter Van Tilburg Clark, author |
| **d. Homeostasis and feedback regulation – thermoregulation, osmoregulation, gas exchange, energetics** | | | |
| **e. Cellular metabolism – photosynthesis, cellular respiration, chemosynthesis** | | | |
| **5. Population ecology** | | | |

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| **Calculating Populations**<br>This handout and activity help students understand how to determine population growth and carrying capacity. The first page lists the different population equations. The activity consists of practice problems that the students solve. | Activity<br>(MS Word) | Download | Greg Rose, Clintonville School District |
| **Estimating Populations**<br>Students perform a capture and recapture activity to estimate the number of items in a known quantity to observe the accuracy of this technique. Follow up questions guide students to brainstorm other population estimating methods. This is a sample activity from Catalyst Learning Curricula. | Activity<br>(PDF) | Activity - pages 3-8 | Catalyst Learning Curricula |
| **Estimating Populations**<br>Students estimate grasshopper population size and conduct a mark and recapture survey to determine the actual population. | Activity<br>(MS Word) | Download | Joyce Johnson, Reedsburg School District |
| **a. Population dynamics – exponential vs. logistic growth** | | | |
| **b. Carrying capacity and limiting factors** | | | |
| **c. Population structure – age, gender, survivorship** | | | |
| **Population Pyramid Internet Assignment**<br>Simple internet activity derived from the census bureau data where students can investigate the population dynamics of growing, stable, and declining countries of their choosing or the instructors. | Activity<br>(MS Word) | Download | Teacher, Palmyra-Eagle School District |
| **Age Structure**<br>Students learn about population age structure and complete a diagram to determine the population growth of different groups. | Activity<br>(PDF) | Download | ESA21 |
| **d. Population genetics and genetic diversity** | | | |
| **6. Community ecology** | | | |
| **a. Species interactions - resource competition, predation, symbiosis** | | | |
| **Never Cry Wolf**<br>A true story by Farley Mowat that was made into a Disney movie in 1983. Mowat is a wildlife biologist who was sent to investigate the decline in caribou in northern Canada and whether it was related to wolves. Mowat learns much about the wolves, the Inuit natives, and human's place in nature. The study guide was created to accompany the movie. | Book/DVD and Study Guide<br>(MS Word) | Study Guide<br><br>DVD \| Book<br><br>Borrow from WCEE EE Resource Library | Harv Hayden, Wisconsin Rapids School District |
| **Predators**<br>This video (narrated by Edward Norton) shows how important the "big bad wolf" and other predators are to ecosystems. It is episode three of the Strange Days on Planet Earth video series. Follow the video with an essay assignment where the students write about "Why are predators important?" They must use examples from the video on what can go wrong without predators and suggest ideas of what we can do to try and fix the problems we have. | Video and Worksheet<br>(MS Word) | DVD<br><br>Borrow from WCEE EE Resource Library | National Geographic and Tanya Monet-Bakken |

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| | | Worksheet<br><br>Website | |
| **b. Competitive exclusion principle** | | | |
| **c. Niche partitioning and keystone species** | | | |
| **d. Species biodiversity** | | | |
| **Ecology in Your Backyard**<br>Students learn how to calculate the Shannon diversity index and species richness using cars in a parking lot. These types of inter-community comparisons are done by ecologists attempting to assess the impacts of human development or pollution. | Activity (PDF) | Download | Unknown |
| **e. Ecological succession – primary vs. secondary** | | | |
| **f. Disturbance** | | | |
| **7. Ecosystem Ecology** | | | |
| **Bottle Biology Energy Systems**<br>This is a great activity to do in conjunction with bottle biology because it gets students critically thinking about how the bottle system allows species to stay alive. Students take several photos of their bottle and diagram and label the various systems present | Activity (MS Word), Website, Book | Activity<br><br>Website<br><br>Book | Greg Rose, Clintonville High School |
| **Ecosystem Excursions**<br>This lesson was developed as a result of a teacher exchange trip to South Africa. In this lesson, Wisconsin students make a video field trip visiting 3 Wisconsin ecosystems. Students research the ecosystems, construct a script, film, edit their video, and mail it to a high school in South Africa. This lesson could be adapted for use by any high school class as an exchange with another school or simply a class project. | Activity (MS Word) | Download | Karla Lockman, Stevens Point Area Senior High |
| **a. Matter/Biogeochemical cycles (biotic/abiotic) – water, carbon, nitrogen, phosphorous, sulfur** | | | |
| **Carbon Adventures**<br>Students learn what carbon is, the difference between organic and inorganic carbon, the different carbon pools, different forms carbon takes when it cycles, and how humans influence the carbon cycle. The game is played in groups of four using a game board, dice, and cards for various carbon pools. Requires some prep time by the teacher the first use but can be reused for several years. | Game and Worksheet (MS Word) | Website<br><br>Download Worksheet | Arizona State University GK-12 Down to Earth Science website and Margie Winter, Fond du Lac School District |
| **The Water Cycle**<br>This comprehensive website is about the water cycle and features a diagram of the cycle and an in-depth discussion of each of the 15 topics on the diagram. The diagram is available in 36 languages. | Website | Website | US Geological Survey |
| **Investigating the Carbon Cycle in Field Systems**<br>Following carbon from the atmosphere to plants to the roots to the soil and back to the atmosphere involves a complex series of interactions. The set of activities helps students break down components of the carbon cycle to model and measure carbon as it moves through | Labs and Activities | Website (search page to locate activities) | Great Lakes Bioenergy Research Center |

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| different parts of this system.<br><br>**Field Investigation: Biomass Yield and Root Growth In Crops**<br>Field investigations to strengthen student understanding of the ability of plants to sequester carbon above and below ground. Students measure above ground biomass by harvesting small samples, and root growth using ingrown root-cores. These activities are adaptable to school-yard plots, existing agricultural plots or natural areas.<br><br>**Root Depth Model**<br>In this activity, raffia ribbon is used to create a visual representation of the differing root depths in biofuel crops and prairie plants. The wall hanging can be used to promote discussion about plants' ability to sequester carbon and contribute to soil carbon.<br><br>**Measuring Soil Microbial Activity**<br>This activity examines how soil microbes, such as bacteria and fungi, are involved in carbon cycling. Students design experiments to explore the relationship between microbial respiration rates and soil variables such as temperature, habitat, soil type, and agricultural management choices. Three methods for measuring CO2 released from soil are provided, one in the field (CO2 probe), and two in the lab (CO2 probe and acid-base titration). | | | |
| **b. Energy flow – trophic levels, food pyramids, food webs** | | | |
| **Food Web for Northern Wisconsin Forest & Lake**<br>In groups of four, students identify food web trophic levels and create a large food web diagram based on a northern Wisconsin forest & lake ecosystem species. This is a challenging activity where the complexity of food webs becomes evident. Includes instruction sheet and 11 pages of species card information. Each group needs a set of sheets that are cut into fourths to make the card sets. | Activity (MS Word) | Download | Margie Winter, Fond du Lac School District |
| **c. Thermodynamics – 1st law (conservation of energy) and 2nd law (entropy)** | | | |
| **d. Biomes – environmental factors influencing distribution** | | | |
| **Biomes of the World**<br>This site provides a wealth of background information on biomes of the world in a student-friendly manner. | Website | Website | Missouri Botanical Garden |
| **Coral Reef Ecosystems**<br>This is a collection of science objects, journal articles, archived webinars, and online learning experiences related to coral reef ecosystems. | Web collection | Website (Register for free to log in to the site) | National Science Teachers Association (NSTA) |
| **e. Value of ecosystem services** | | | |
| **8. Biosphere ecology** | | | |
| **Earthweek - A Diary of the Planet**<br>World map showing natural events (earthquakes, volcanoes, tropical storms, pest invasions) that affect the environment. Updated every Friday. Click items for information and photos about the events. | Interactive Map | Website | Andrews McMeel Universal and Steve Newman, Meterologist |

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| **a. Global energy flow – solar input, ocean currents, air mass circulation** | | | |
| **b. Global matter cycling – global biogeochemical cycles** | | | |
| **c. Global biodiversity – species distribution and abundance** | | | |
| **d. Plate tectonics – theory of continental drift** | | | |
| **Plate Tectonics Story**<br>In this activity, students use the Dynamic Earth website to research plate tectonics and write a story describing the theory. The website is divided into 8 chapters containing sub topics and diagrams relevant to the main topic. | Activity (MS Word) & Website | Download<br>Website | Matt Tiller, Verona Area High School and US Geological Survey |
| **This Dynamic Earth: The Story of Plate Tectonics**<br>Online version of a 1996 book by J. Kious and R. Tilling. Gives a brief introduction to the concept of plate tectonics and highlights some of the people and discoveries that advanced the development of the theory and traces its progress since its proposal. Although the general idea of plate tectonics is now widely accepted, many aspects still continue to confound and challenge scientists. | Website | Website<br>PDF of website | US Geological Survey |
| **e. Global environmental issues – extinction crisis, climate change, etc.** | | | |

## Human Systems

1. Human well-being and environmental quality
   a. Interdependence
   b. Sustainability
2. Consumption and natural resources
   a. Population - world population, exponential growth, birth/death rate, age structure, migration, historical patterns
3. Effects of natural resource consumption
   a. Social development - affluence, health, culture, economic growth
   b. Resource distribution - food/water distribution, nourishment, wealth gap
   c. Waste - reduce, reuse, recycle, refuse; toxic waste; pollution
   d. Cultural diversity threats
   e. Variability - socioeconomic status, race, culture, ethnicity, etc.
4. Addressing effects
   a. Education - empowerment of women, needs hierarchy
   b. Political action - laws, lobbying, environmental justice
   c. Ecomanagement - trail building, recycling, ecosystem restoration
   d. Legal action - lawsuits, law enforcement
   e. Lifestyle choices - ecological footprint, consumer choices
   f. Community involvement - service learning, ecomunicipalities

## Human Systems

### 1. Human well-being and environmental quality

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| | **EarthTrends: Population, Health and Human Well-being**<br>Click on the link for Population, Health and Human Well-being to find a searchable database of statistics, maps, and country profiles of environmental, social, and economic trends that shape our world. Example information includes life expectancy, literacy rates, water and sanitation, and population density | Website | Website | World Resources Institute |
| | **Emerging and Re-Emerging Infectious Diseases**<br>This website provides background information and lessons related to many aspects of infectious disease. Good images, videos, simulations, and interactives. It includes five modules that can be followed as written or adapted for individual/class needs. | Activities | Website | National Institutes of Health |
| | **Mercury Poisoning Reading and Questions**<br>Mercury is one of the most significant metal toxins and pollutants in the world. This reading involves a young college student who works in the chemical storeroom at school. He mysteriously and unwittingly becomes a victim of mercury poisoning, which eludes detection by supervisors and faculty, his parents and even his doctors. Readers are introduced to mercury's properties, its many uses in our world, and the environmental consequences of improper disposal and exposure. The | Activity (PDF) | Download Chapter 10<br><br>Student Questions | Sleuth At Work, by Lester Levin |

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| book, Sleuth At Work, features many other stories related to environmental and occupational health. | | Book | |
| **a. Interdependence** | | | |
| **b. Sustainability** | | | |
| **Drilling Down to Sustainability**<br>Students define and discuss sustainability and its three key components: the economy, the environment, and society. In a warm-up activity, they evaluate two seemingly identical apples through the lens of sustainability. Students then discuss and debate the sustainability of various resource extraction methods. Finally, they determine if alternatives would be more sustainable. | Activity | Download | Facing the Future |
| **Education for Sustainability**<br>The Cloud Institute equips school systems K-12 and their communities with the core content, competencies, and habits of mind that characterize education for a sustainable future. Their website provides an overview of sustainability education and framework of core standards. | Website | Website | The Cloud Institute for Sustainability Education |
| **Education for Sustainability (EfS) Starter Kit**<br>This is a tool schools can use to start the process of becoming a Sustainable School. The Kit includes what schools need to start using sustainability as an integrating theme, and to catalyze school change with efficient use of existing resources and without regard to geographic limitations. Download professional development modules, an EfS framework, and activities. | Background | Website | Sustainable Schools Project, Shelburne Farms |
| **Sustainability Overview**<br>Explanation of sustainability and The Natural Step principles for sustainability. | Background (PDF) | Download Document | Compiled by Jeremy Solin, Wisconsin Center for Environmental Education |
| **2. Consumption and natural resources** | | | |
| **Buy, Use, Toss?**<br>Buy, Use, Toss? A Closer Look at the Things We Buy is an interdisciplinary unit that includes ten fully-planned lessons. This unit is correlated with national science and social studies standards and will lead your students through an exploration of the system of producing and consuming goods that is called the materials economy. Students will learn about the five major steps of the materials economy; extraction, production, distribution, consumption, and disposal. They will also be asked to analyze the sustainability of these steps, determining how consumption can benefit people, economies, and environments. | Activity Guide | Website | Facing the Future |
| **CIA World Factbook**<br>Statistics about every country in the world including population, environmental issues, economy, life expectancy, transportation, communication, and more. | Website | Website | Central Intelligence Agency |
| **Material World: A Global Family Portrait**<br>A fascinating look at the material possessions of families throughout the world. "Average" families from around the world agreed to have photographers move the contents of their houses outside in order to create visible representations of their relative standards of living. The dirt house and few possessions of Mali residents contrast with the 4 cars, 45-foot long sofa, and 12+ oriental carpets | Book | Book<br><br>Borrow from WCEE EE Resource | Sierra Club Books |

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| | lined up outside a luxury home in Kuwait. Students can create comparison charts and graphs to illustrate resource use information to bring awareness to the availability and use of natural resources. | | Library | |
| | **The Story of Stuff**<br>From its extraction through sale, use and disposal, all the stuff in our lives affects communities at home and abroad, yet most of this is hidden from view. The Story of Stuff is a 20-minute, fast-paced, fact-filled look at the underside of our production and consumption patterns. The Story of Stuff exposes the connections between a huge number of environmental and social issues, and calls us together to create a more sustainable and just world. It'll teach you something, it'll make you laugh, and it just may change the way you look at the stuff in your life forever. | Video | Website | Annie Leonard |
| | **The Story of Stuff - Analyzing the Message**<br>Students critically analyze The Story of Stuff by identifying the overall message of the film, persuasive techniques used, and bias. In an extension activity, students further examine data presented in the film, cross-checking references to analyze the accuracy and reliability of the film. | Activity | Website | Facing the Future |
| | **Why Buy?**<br>Students begin by considering the purpose of advertising. Each student critically analyzes an advertisement that appeals to him or her, weighing advertised information against their needs as consumers. Students discuss whether additional information should be included in product advertisements and how advertising connects to consumption choices. | Activity | Website | Facing the Future |
| | **a. Population - world population, exponential growth, birth/death rate, age structure, migration, historical patterns** | | | |
| | **6 Billion Human Beings**<br>This European website provides an overview of human population numbers, trends, and issues. The worksheet helps students explore the site. | Website<br><br>Activity (PDF) | Website<br><br>Download Activity | Harv Hayden, Wisconsin Rapids School District |
| | **Cemetery Population Study**<br>Obtain tombstone data from a local cemetery or visit with a class. Have teams of students record information as follows at each marker: male or female, decade of birth, decade at death, age at death. Student teams should obtain enough data from 40-50 markers to be able to make inferences about historical patterns of life and death. | Activity | Website | Environmental Science Teacher |
| | **Cultural and Economic Influences on Population Structure**<br>Students use data from the US Census Bureau web site to answer questions about their age cohort and compare it to other nations. When doing this activity, students should have a basic understanding of world population and growth issues. | Activity | Website<br><br>Download Handout | Doug Bailey, Badger School District and US Census Bureau |
| | **Food for Thought**<br>In this activity students are grouped to simulate the distribution of people into five world regions and then compare resource use, growth rate, birth rates, death rates. The teacher distributes items to each region to represent energy consumption, food, wealth, etc. | Activity | Website | Population Connection |
| | **Human Population**<br>This website is a population clock providing a second by second mathematical update of the current human population. It also gives viewers the opportunity to look at future population numbers. It can be used to spark some interesting discussion about current and future | Website | Website | Galen Huntington, UC Berkley PhD Candidate |

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| | populations. | | | |
| | **Human Population Growth Over Time**<br>A summary of information from the Population Reference Bureau in an easy to read document that includes review questions. The reading and questions are useful to introduce basic vocabulary around human population growth. Topics include: growth and distribution, future growth, patterns of change, and world urbanization. | Activity<br>(MS Word) | Website<br><br>Download Handout | Matt Tiller, Verona Area High School and Population Reference Bureau |
| | **Measuring Duckweed Growth**<br>This website provides an abundance of information about duckweed. Details on how to grow duckweed are given. The "Measuring Growth" section of the site describes the exponential growth of duckweed and provides instructions on how to measure growth. | Lab | Website - go to Labs and Projects for Teachers and Students | John W. Cross, author of The Charms of Duckweed |
| | **The People Bomb**<br>The People Bomb is a set of 10-15 minute CNN news reports about several dimensions of global demographic explosion in 13 (mostly third world) countries. Although from 1998, this video provides vivid information about population growth and control. It is an excellent resource to present when covering population and development issues. There are several broadcasts that apply to the impact of population growth on our environment and quality of life in our habitats. This is particularly effective and eye opening for students in focused on a materialistic world. | Video | VHS<br><br>Borrow from WCEE EE Resource Library | CNN |
| | **Populating the Planet**<br>Without the pressure of population growth, perhaps none of the issues facing humanity today would be large enough to qualify as global. Explore historic and modern population trends in this concise and easy-to-read article. | Background | Download Article | Facing the Future |
| | **Population Pyramids**<br>The purpose of this brief lesson is to help students understand population distribution worldwide and compare different areas of the world. Also, discussion allows students to begin to understand how this information might help one analyze current and future needs based on growth. Students create their own population pyramids. | Activity<br>(MS Word and PDF) | Download:<br>Adapted Instructions<br><br>Student Sheet<br><br>Original Activity | Anita Sundstrom, Oregon School District and Population Connection |
| | **World Population**<br>This short (~7 minute) video provides a great visual of the human population explosion that is currently occurring. The video displays a world map and time ticks away in years on the bottom of the screen. When 1 million people are in an area a dot will appear. You can see how slowly the human population grew at first and how war and disease affect population (historical references are noted on the bottom) and how an explosion of dots appear in recent years. | Video | DVD<br><br>Borrow from WCEE EE Resource Library | Population Connection |
| **3.** | **Effects of natural resource consumption** | | | |
| | **Natural Resources Extraction**<br>This lesson encourages students to think about where the natural resources we use come from and the processes by which these resources are extracted. Students also consider the environmental, cultural, and human rights issues that are frequently associated with the extraction of natural | Activity | Website | National Geographic Xpeditions |

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| resources. They conduct Internet research on specific resources and create presentations to showcase what they have learned. | | | |
| **Life Cycle Diagrams**<br>Students pick ANY product they use in everyday life. It's easier if they keep it simple (e.g., instead of choosing a computer they choose the mouse or a flash drive). Encourage variety in the class. After choosing a product, students analyze and explain the environmental impact of the production of that item while drawing a "life cycle" diagram of it, then develop a re-engineering plan to reduce pollution costs without sacrificing commercial appeal. | Activity<br>(MS Word) | Download Activity | Becca Bestul, Eau Claire Area School District |
| **a. Social development - affluence, health, culture, economic growth** | | | |
| **EcoHealth**<br>EcoHealth provides the in-depth analysis and context behind today's headline news. This website is geared to middle-school students and their teachers but can be adapted easily. It delivers scientific information in a kid-friendly, engaging, and visually-vibrant manner. | Website | Website | Johns Hopkins Bloomberg School of Public Health |
| **Things Aren't Always What They Seem**<br>This activity from Project Learning Tree has students identify their perception of the relative degree of risk associated with technologies, environmental hazards, and everyday activities. It challenges students to think critically when making choices about risks they are willing to take for personal decisions. Students will learn how to evaluate risks and weigh costs and balances. | Activity<br>(In Focus on Risk Guide) | Website<br><br>Borrow from WCEE EE Resource Library | Project Learning Tree; Exploring Environmental Issues: Focus On Risk |
| **b. Resource distribution - food/water distribution, nourishment, wealth gap** | | | |
| **Hungry Planet**<br>A photographic study of families from around the world, revealing what people eat during the course of one week. Each family's profile includes a detailed description of their weekly food purchases; photographs of the family at home, at market, and in their community; and a portrait of the entire family surrounded by a week's worth of groceries. The book illustrates how diet is determined by largely uncontrollable forces like poverty, conflict, and globalization, which can bring change with startling speed. | Book | Book<br><br>Borrow from WCEE EE Resource Library | Written by Peter Menzel and Faith D'Aluisio |
| **Food, Inc.**<br>*Video*: Food, Inc. lifts the veil on our nation's food industry, exposing how our nation's food supply is now controlled by a handful of corporations that often put profit ahead of consumer health, the livelihood of the American farmer, the safety of workers and our own environment.<br>*Discussion Guide*: The 102-page guide provides questions and activities about the film's themes, including health, sustainability, animal welfare, and workers' rights. It is designed to help high school students make more thoughtful choices about food and participate in a meaningful dialogue about food and food systems. | Video and Discussion Guide | Video Website<br><br>Discussion Guide Website | Documentary by Robert Kenner<br><br>Discussion Guide by Center for Ecoliteracy |
| **Nourish**<br>The purpose of Nourish is to open a broad public conversation about our food system that encourages citizen engagement, particularly among young people and families. To inform and inspire, Nourish combines television programming, short films, web content, and learning tools. Several two minute videos are available on topics such as local food, health, hidden costs, and more. | Video | Website | WorldLink |
| **Our Dwindling Food Variety** | Diagram | Website | National Geographic |

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| | This diagram shows how thousands of heirloom varieties have disappeared as we've come to depend on a handful of commercial varieties of fruits and vegetables. | | | |
| | **Shop Till You Drop?**<br>In this simulation, students experience how resources are distributed and used by different people based on access to wealth. Students discuss and work toward personal and structural solutions to address the environmental impacts of resource consumption, and to help alleviate poverty. Facing the Future is full of great resources that help bring cultural, political, and economical issues into environmental topics. | Activity | Book<br><br>Borrow from WCEE EE Resource Library | Facing the Future; Engaging Students Through Global Issues: Activities-Based Lessons and Action Projects |
| **c.** | **Waste - reduce, reuse, recycle, refuse; toxic waste; pollution** | | | |
| | **Container Recycling Institute**<br>The Container Recycling Institute is a non-profit organization that studies and promotes policies and programs that increase recovery and recycling of beverage containers. They focus on programs that shift the social and environmental costs associated with manufacturing, recycling, and disposal of container and packaging waste from government and taxpayers to producers and consumers. Their website has a wealth of information on the recycling of plastic, glass, and aluminum beverage containers. | Website | Website | Container Recycling Institute |
| | **Garbology**<br>Students first analyze typical contents of a North American trash can in order to define "luxury" and "necessity" for themselves. They read a short article about trash typically found in a modern dump in North America. Using information from this reading, students will draw conclusions about how these artifacts reflect the lifestyle of those who used and disposed of the items. | Activity | Download | Facing the Future |
| | **It's A Dirty Job**<br>Students take on perspectives of different stakeholder groups involved in determining how to deal with a community's growing trash. Stakeholder groups are encouraged to form alliances in order to reach consensus on the plan that will be best for the community. | Activity | Download | Facing the Future |
| | **Mercury Poisoning Reading and Questions**<br>Mercury is one of the most significant metal toxins and pollutants in the world. This reading involves a young college student who works in the chemical storeroom at school. He mysteriously and unwittingly becomes a victim of mercury poisoning, which eludes detection by supervisors and faculty, his parents and even his doctors. Readers are introduced to mercury's properties, its many uses in our world, and the environmental consequences of improper disposal and exposure. The book, Sleuth At Work, features many other stories related to environmental and occupational health. | Activity (PDF) | Download Chapter 10<br><br>Student Questions<br><br>Book | Sleuth At Work by Lester Levin |
| | **Timberline Trail Landfill Trip**<br>Contact Trevor Wilson (715-868-7000) for a landfill tour. The presentation begins in the conference center then participants tour the landfill and the gas-to-energy plant which produces enough electricity to run 4,660 homes. The natural byproduct of the residential waste landfills, methane gas, is the fuel used to generate the renewable energy. | Field Trip | Website for background information | Location: Bruce, WI |
| | **Waste Audit**<br>Students carry around a garbage bag for an entire week (must be on their person at all feasible times). Every bit of waste they produce goes in the bag. This has also been adapted to include a second bag for recyclables (bottles, cans, etc.). If they don't carry the second bag, they have | Activity (MS Word) | Introduction<br>Teacher Alert<br>Sign in Sheet<br>Worksheet | Pamela Hansen, Whitehall School District |

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| to separate recyclables at end of week. Follow with a questionnaire and discussion. See introduction, information for other teachers, and final questionnaire above. | | | |
| **Waste, Recycling, Landfill Resources and Lessons**<br>The Waste Management website features many resources for teaching about waste. Find diagrams, videos, and handouts on topics such as anatomy of a landfill, groundwater wells, bioremediation, converting landfill gas to energy, recycling. | Website | Website | Waste Management |
| **d. Cultural diversity threats** | | | |
| **Medicine Man**<br>Medicine Man is a PG-13 movie about a scientist living in the Amazon rain forest who is involved in a search for a cancer cure. The movie presents more to the students than the need for a cancer cure. It presents the economics behind the search, how the search impacts the indigenous population, as well as the intrinsic, aesthetic, and spiritual importance of the rain forest. | Video | DVD | Walt Disney Video |
| **e. Variability - socioeconomic status, race, culture, ethnicity, etc.** | | | |
| **4. Addressing effects** | | | |
| **a. Education - empowerment of women, needs hierarchy** | | | |
| **Abraham Maslow**<br>Information about Abraham Maslow and the hierarchy of needs theory he proposed in the 1943 paper A Theory of Human Motivation can be found by doing an Internet search. | Background | Website | Wikipedia |
| **Woman in a Material World**<br>A follow-up to coauthor Peter Menzel's lauded Material World: A Global Family Portrait, Women in the Material World illuminates the human family with the focus on women. The result is a collection of photographs, interviews, and anecdotes documenting the day-to-day lives and thoughts of women from 20 different countries. This is a great way to connect environmental issues with issues women face worldwide. | Book | Book<br><br>Borrow from WCEE EE Resource Library | Authors: Faith D'Aluisio and Peter Menzel |
| **b. Political action - laws, lobbying, environmental justice** | | | |
| **Champions of the Public Trust**<br>This 28 minute video from the Wisconsin DNR uses historical photos, video, and interviews to explain the Public Trust Doctrine and a history of water use in Wisconsin. Learn how Wisconsin anglers and other citizens have fought to ensure that Wisconsin lakes and rivers belong to all state residents, and to secure the public's right to clean waters, good fishing, scenic beauty, and other benefits in those waters. | Video | Website (free download) | Wisconsin Department of Natural Resources |
| **Going to Green**<br>Going to Green is a five disk series that deals with the restoration of America's urban landscape through the creation of sustainable neighborhood ecosystems. Each chapter is devoted to a specific section and is accompanied by a lesson with service learning extensions. Disk Five: Public Policy and Green Collar Opportunities features a 25 minute public policy and community action segment that explains how model ordinances can be put into place to assist municipalities in becoming more sustainable, and the role that students, teachers, and citizen activists can play in that process. | Video | DVD<br><br>Borrow from WCEE EE Resource Library | PBS |

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| | **Who are My Legislators?**<br>This page is a good resource when addressing political action at the state level. Students can search to find out who their legislators are, what committees they serve on, information on service agencies, various Wisconsin laws, lobbyists, writing to their legislator, or better yet inviting them into your classroom. | Website | Website | Wisconsin State Legislature |
| | **Wisconsin League of Conservation Voters**<br>Wisconsin League of Conservation Voters is a nonprofit, nonpartisan organization dedicated to electing conservation leaders, holding decision makers accountable and encouraging lawmakers to champion conservation policies that effectively protect Wisconsin's public health and natural resources. Their website tracks the way elected officials vote on environmental issues. | Website | Website | Wisconsin League of Conservation Voters |
| **c.** | **Ecomanagement - trail building, recycling, ecosystem restoration** | | | |
| | **American Trails**<br>This website provides comprehensive information related to trails. There are articles on topics ranging from accessibility to wildlife and resources on surfaces, design, and construction. | Website | Website | American Trails |
| | **Container Recycling Institute**<br>The Container Recycling Institute is a non-profit organization that studies and promotes policies and programs that increase recovery and recycling of beverage containers. They focus on programs that shift the social and environmental costs associated with manufacturing, recycling, and disposal of container and packaging waste from government and taxpayers to producers and consumers. Their website has a wealth of information on the recycling of plastic, glass, and aluminum beverage containers. | Website | Website | Container Recycling Institute |
| | **Handbook for Trail Design, Construction and Maintenance**<br>Topics in this handbook include trail history, layout, structures, signs, maintenance, working with landowners, and more. | Handbook | Website | National Park Service |
| | **Landscaping with Native Plants of Wisconsin**<br>This book is an excellent resource for someone who wants to do a habitat restoration at their school. The book includes prairie restoration, woodland restoration, butterfly and rain gardens, and much more. This an good for both teachers and students to reference. | Book | Book | Lynn M. Steiner, Author |
| | **National Tree Benefit Calculator**<br>The Tree Benefit Calculator allows anyone to make a simple estimation of the benefits individual street-side trees provide. With inputs of location, species, and tree size, users will get an understanding of the environmental and economic value trees provide on an annual basis. This tool should be considered a starting point for understanding trees' value in the community, rather than a scientific accounting of precise values | Online Tool | Website | Casey Trees and Davey Tree Expert Co. |
| | **Signs, Trails, and Wayside Exhibits**<br>This book is a comprehensive, visual guide to planning, designing, and fabricating effective interpretive panels and trails. The book contains essential information for any site that has or is planning outdoor media or trails. | Book | Book | Schmeeckle Reserve |
| | **Volunteer Trail Building**<br>The Ice Age Trail Alliance website lists volunteer opportunities for trail building in many Wisconsin communities. Check out your local chapter's calendar for upcoming events. | Service Learning Idea | Website | Ice Age Trail Alliance |

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| **d. Legal action - lawsuits, law enforcement** | | | |
| **A Civil Action**<br>In this story, the families of children who died sue two companies for dumping toxic waste. The novel and movie provide a look at the legal and ethical issues associated with Superfund. The concepts of groundwater, contamination, and plume are reinforced in some of the movie frames, which can be used in short clips for class discussions. The activity can be used to assess your students' understanding of the steps needed to determine if a water source is contaminated and how it got that way, and to suggest possible methods of cleanup or remediation. | Book, Video, Lessons | DVD<br>Book<br>Lessons | Jonathan Harr, Author and Learn Inc. (lessons) |
| **e. Lifestyle choices - ecological footprint, consumer choices** | | | |
| **The Ecological Footprint: Accounting for a Small Planet**<br>Dr. Mathis Wackernagel introduces the Ecological Footprint, a resource accounting tool that measures human demand on the Earth. In just thirty minutes, the film paints a picture of our current global situation: for the first time, humanity is in "ecological overshoot" with annual demand on resources exceeding what Earth can regenerate each year. | Video | DVD | Global Footprint Network and Bullfrog Films |
| **Ecological Footprint Calculator**<br>A 27 question quiz that allows users to estimate the amount of land and ocean required to sustain their consumptive and waste generating lifestyle. | Online Tool | Website | Redefining Progress |
| **Ecological Footprint Calculator**<br>This Canadian footprint calculator provides background on the concept of ecological footprint and compares the calculated print to that of other nation's averages. | Online Tool | Website | Royal Saskatchewan Museum |
| **Ecological Impact & Food**<br>This webquest asks students to consider their ecological impact by first understanding ecological footprints and then considering a specific example based on food selection. | Activity (MS Word) | Download Activity | Anita Sundstrom, Oregon School District |
| **Food, Farming & Community**<br>This site provides a reader's theater and a six-part curriculum that builds understanding and engages students in dialogue about local food and the importance of sustainable practices. | Activities | Website | Michigan State University Museum |
| **Food for a Healthy Planet**<br>This is a good site for ideas on teaching about food choices. It was created for elementary students in the UK but the basic concepts can be transferred and activities adapted. Topics include: where food comes from, what others eat, how far food travels, and local/organic options. | Website | Website | Practical Action |
| **Glatfelter Interactive (Paper) Mill Tour**<br>This is an excellent overview of the complete papermaking process from forest to finished product. Includes information on forest certification programs, use of biofuels, and environmental considerations. Good for generating discussion on the use of natural resources, environmental impacts/considerations, and product awareness. | Interactive Video | Website | Glatfelter |
| **Global Footprint Network**<br>This website explains the science behind global footprint accounting | Background | Website | Global Footprint Network |
| **Labor Day Dinner**<br>This activity is designed to illustrate the concept of Ecological Footprint. The students are divided into groups to analyze the impact on the environment of the Labor Day dinner of the | Activity (MS Word) | Download Activity | Charlie Frisk, Luxemburg-Casco School District |

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| | family they have chosen. They then make a presentation in front of the class in which they explain the impacts that their particular family would have on the environment. The activity can be modified for the particular community in which your school is based. | | | |
| | **Mapping the Impact**<br>Students create a web diagram to illustrate environmental, social, and economic impacts associated with everyday items. This activity expands the concept of "ecological footprint" to consider impacts of a given lifestyle on people and societies. Students develop ideas to reduce the ecological footprint and associated impacts related to an everyday item. | Activity | Website | Facing the Future |
| | **Nourish**<br>The purpose of Nourish is to open a broad public conversation about our food system that encourages citizen engagement, particularly among young people and families. To inform and inspire, Nourish combines television programming, short films, web content, and learning tools. Several two minute videos are available on topics such as local food, health, hidden costs, and more. | Video | Website | WorldLink |
| | **The Story of Stuff**<br>The Story of Stuff is a 20-minute video that takes viewers on a provocative and eye-opening tour of the real costs of our consumer driven culture—from resource extraction to iPod incineration. Leonard examines the real costs of extraction, production, distribution, consumption and disposal. The Story of Stuff examines how economic policies of the post-World War II era ushered in notions of "planned obsolescence" and "perceived obsolescence" —and how these notions are still driving much of the U.S. and global economies today. Done in cartoon style, this video catches students' attention. | Video | Website | Annie Leonard |
| | **The Story of Stuff – Analyzing the Message**<br>Students critically analyze The Story of Stuff by identifying the overall message of the film, persuasive techniques used, and bias. In an extension activity, students further examine data presented in the film, cross-checking references to analyze the accuracy and reliability of the film. | Activity | Website<br>(Lesson 10) | Facing the Future |
| | **Stuff**<br>This book walks through the environmental consequences of everyday items. Chapters include coffee, cola, French fries, T-shirt, computer, car/bike, and more. Each chapter focuses on one item and what it takes to make, package, and ship the product. Suggestion: have students read a chapter, get in small groups to answer discussion questions, report to the class. This way students aren't overwhelmed by the depressing realization of the products we are so addicted to. | Book | Book | The Futurist |
| **f.** | **Community involvement - service learning, ecomunicipalities** | | | |
| | **K-12 Service Learning Project Planning Toolkit**<br>This is an easy to follow step-by-step guide for any service learning project. There are ready to use worksheets, forms, and outlines. | Booklet<br>(PDF) | Download Guide | Learn and Serve Clearinghouse |
| | **Designing Sustainable Urban Areas**<br>This lesson begins on page 11 of the PDF linked above. Students use legos to design cities that maximize various features to find the most functional and sustainable arrangement. They research cities that have implemented improvements to increase sustainability and quality of life. The group discussion focuses on the pros and cons of city living while minimizing negative | Activity<br>(PDF) | Activity | Catalyst Learning |

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| | effects. | | | |
| | **Earth Day Activities**<br>Reedsburg Area High School mobilizes all students to participate in community based environmental activities on the Friday closest to Earth Day. Teachers work in groups of 2-3 (sometimes more) to organize activities such as storm drain stenciling, work at the International Crane Foundation, clean up at the school forest, river clean up, bike trail clean-up, lawn raking for the elderly etc. Students are transported or walk to their activities. This is part of the community service requirement for graduation. | Activity | | Joyce Johnson: Reedsburg School District |
| | **Going to Green**<br>Going to Green is a five disk series that deals with the restoration of America's urban landscape through the creation of sustainable neighborhood ecosystems. Each chapter is devoted to a specific section and is accompanied by a lesson with service learning extensions. Disk Five: Public Policy and Green Collar Opportunities features a 25 minute public policy and community action segment that explains how model ordinances can be put into place to assist municipalities in becoming more sustainable, and the role that students, teachers, and citizen activists can play in that process. | Video | DVD<br><br>Borrow from WCEE EE Resource Library | PBS |
| | **The Natural Step for Communities: How Cities and Towns can Change to Sustainable Practices**<br>This book clarifies the concept of sustainability and provides inspiring examples of communities that have made dramatic changes toward sustainability and explains how others can emulate their success. Many examples explained are from Sweden, the place the Natural Step was born. The book also includes many US examples. Throughout Wisconsin, many of the eco-municipalities that are establishing are based off principles taken from this book. | Book | Borrow from WCEE EE Resource Library | Written by Sarah James and Torbjorn Lahti |

## Energy Resources

1. Renewable/nonrenewable sources
    e. Examples – coal, oil, natural gas, nuclear, solar, wind, geothermal, hydro, biomass, tidal
    f. Benefits and limitations
    g. Projected reserves/availability
2. Human Use
    d. Historical use
    e. Community sectors – transportation, agricultural, industrial, municipal, commercial, residential
    f. Demands and consumption
3. Effects
    e. Environmental – pollution, climate change, mining issues, waste management, habitat destruction
    f. Human health
    g. Economic
    h. Political – war, legislation, border issues
4. Solutions
    f. Technology
    g. Projected reserves/availability
    h. Demands an consumption
    i. Lifestyle changes

## Energy Resources

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| **EarthTrends: Energy and Resources**<br>Click on the link for Energy and Resources to find a searchable database of statistics, maps, and country profiles of environmental, social, and economic trends that shape our world. Example information includes energy consumption by source, fossil fuels, transportation, and trade in energy. | Website | Website | World Resources Institute |
| **Energy**<br>This energy education unit that includes all background information and handouts needed to introduce students to different sources of energy including solar, wind, tidal, hydroelectric, nuclear, geothermal, biomass/biofuels, coal, oil, and natural gas. Students use Google Earth to explore locations of different power plants. They use My World GIS to investigate the best places to locate new power plants and to analyze data. | Unit | Website | Environmental Literacy and Inquiry Working Group at Lehigh University |
| **Energy Bingo**<br>Play Energy Bingo with your students as an introductory or concluding activity. Includes 31 questions about renewable and nonrenewable energy. Answers and a classroom set of cards provided. | Activity (PDF) | Questions<br>Answers<br>Bingo Cards | KEEP – Wisconsin K-12 Energy Education Program |
| **Energy Education Activity Guide**<br>The KEEP Activity Guide contains 44 hands-on, interdisciplinary lessons that are aligned with Wisconsin's academic standards and make energy relevant to students' lives. The guide is organized around the four | Course, website, activity guide | Website | KEEP – Wisconsin K-12 Energy Education Program |

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| themes: We Need Energy, Developing Energy Resources, Effects of Energy Resources Development, and Managing Energy Resource Use. The guide is obtained by taking a KEEP 730 Energy Education in the Classroom Course. | | | |
| **Energy in Brief**<br>Energy in Briefs explain important energy topics in plain language. Each Brief answers a question relevant to the public and recommends resources for further reading. Explore topics such as biofuels, renewable energy, foreign oil dependence, and natural gas. Resources include statistics and carts/graphs. Check out the renewable energy section for a slide show with audio. | Online Articles | Website | US Energy Information Administration |
| **1. Renewable/nonrenewable sources** | | | |
| **Energy Efficiency and Renewable Energy**<br>Find lesson plans on many energy efficiency and renewable energy topics. You may search by subject or grade. The site also includes science project ideas, alternative fuel and vehicle technologies, energy related careers, scholarships, training, workshops, etc. | Lesson Plans | Website | US Department of Energy |
| **Energy Letter to Representative**<br>This assignment can be used in place of a test for an energy unit. Students write a letter to their representative summarizing the current state of fossil fuel consumption, why it is a problem, and suggest alternative energy sources. Students are given time to research and write the letter in class but they should use things they have learned in class. Extra credit can be given if they actually send the letter. | Activity<br>(MS Word) | Download Activity | Becca Bestul, Eau Claire Area School District |
| **Renewable Energy Overview**<br>This online narrated slide show provides an overview of the types of renewable energy used in the US along with statistics and comparisons to other countries. | Online Presentation | Website | Energy Information Administration |
| **Renewable Energy Timeline**<br>Historical outline of renewable energy resources including biofuel, water, solar, and wind. Images, quotes, and comments accompany each section. | Website | Website | Bill Kovarik, PhD |
| **Renewable Energy Education Online**<br>Gain fundamental knowledge of renewable energy and investigate renewable energy practices you can incorporate into your life. This online course is open to the public, however, at certain times of the year it can be taken for one graduate credit through the University of Wisconsin-Stevens Point. | Online Course | Website | KEEP – Wisconsin K-12 Energy Education Program |
| **a. Examples – coal, oil, natural gas, nuclear, solar, wind, geothermal, hydro, biomass, tidal** | | | |
| **100 People: A World Portrait**<br>The SunPower Foundation has created 100 People Under the Sun, a program that provides classroom lesson plans and online videos to help students identify the ways they use energy and investigate the use of solar energy in their communities. Also find facts such as “if the world were 100 people, 24 would have no access to electricity.” | Website | Website | Sunpower Foundation |
| **ACE Ethanol Plant**<br>ACE Ethanol, LLC in Stanley, Wisconsin produces four million gallons of ethanol per year using area corn. The field trip gives an overview of the plant and a walkthrough tour showing the production facilities. Contact person Bob Sather 715-579-8063 | Field Trip or Guest Speaker | Website | David Post, Greenwood School District |
| **Biodiesel**<br>Students learn to make biodiesel from both new and waste oil from the cafeteria (very easy!). they must come up with a home brew design for batches of 40 gallons at a time, a cost benefit | Lab<br>(MS Word) | Biodiesel from new oil | Jeanne Kaidy, McQuaid Jesuit High School, NY. Modified from a lab from |

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| | analysis comparing petrol diesel to biodiesel, and a written component. | | Biodiesel from waste oil<br><br>Biodiesel Project | Matt Steimann, Dickinson College, PA |
| | **BioFutures**<br>Web links and downloadable activity guide related to biomass energy. | Activity Guide & Website | Website | KEEP – Wisconsin K-12 Energy Education Program |
| | **Community Solar Projects**<br>This website provides an overview of several buildings around the state using solar panels to produce electricity. Each location has a description of the unit used to produce the energy and also output details on a 24 hour basis. It is relatively easy to find a location near you and monitor the kilowatt hour produced during any day. In Wisconsin, we see great contrasts depending on weather conditions. The site also includes some good information on GreenMax homes. | Website | Website | WPPI Energy |
| | **Exploring Wind Energy**<br>Hands-on activities that provide a comprehensive understanding of the scientific, economic, environmental, technological, and societal aspects of wind energy to secondary students. | Activities (PDF) | Teacher Guide<br>Student Guide | National Energy Education and Development Project |
| | **Extreme Oil: Exploring the History of Oil**<br>Students examine the role oil has played throughout human history, how that role has changed over time, and the repercussions of oil use on society and the environment. Students use an online timeline to explore how oil's role has changed throughout history. Then, utilizing another online interactive, students complete an in-depth analysis of oil's current and historic applications in the home, in industry, in medicine, and in transportation. Finally, through the use of the PBS series Extreme Oil, students examine the environmental impact of the oil industry, and decide whether or not they support an expansion of oil drilling operations into the Arctic National Wildlife Refuge. | Lesson with associated video | Website with lessons<br><br>Borrow from WCEE EE Resource Library | PBS |
| | **Great Lakes Bioenergy Research Center Educational Materials Page**<br>K-16 inquiry activities and readings on biofuels, primarily cellulosic ethanol. | Activities & Background Information | Website | Great Lakes Bioenergy Research Center |
| | **Nuclear Energy**<br>Students read about nuclear energy and basic reactor design. An online simulation allows students to study the intricacies of running a nuclear power plant. | Activity (PDF) | Download Activity | ESA21 |
| | **Our Insatiable Appetite for Coal**<br>Article discussing the increases in CO2 emission in Wisconsin and the use of coal as an energy source. | Article | Website | Milwaukee Journal Sentinel |
| | **Point Beach Nuclear Power Plant and Energy Center**<br>This is a good field trip when studying energy resources and alternative sources of electricity generation. The staff at the center provide a great program on nuclear power generation and nuclear reactions. Staff will also lead power trivia game. Students love the nuclear reaction demonstration and the video of the jet crashing into a container building. The center also has a hands-on museum on the history and generation of electricity. For city kids it is a great day in the country with spectacular views of Lake Michigan. When they return to school students | Field Trip | Call Toll Free: 800-880-8463 For reservations. | 6400 Nuclear Rd., Two Rivers, WI |

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| | make a PowerPoint presentation on the pros and cons of nuclear power. | | | |
| | **Production of Biodiesel**<br>Basic instructions for creating biodiesel from methanol, lye, and cooking oil. This can be used to generate good discussion with students. | Lab<br>(MS Word) | Download Lab | Candice Olson, Badger High School |
| | **Progress through Petroleum**<br>This online learning tool explores the many ways in which oil, natural gas, and petroleum-derived products – plastics, pharmaceuticals and more – have improved our quality of life in the past 150 years. Using an easy-to-navigate grid, you can track petroleum-aided innovations in the home, the workplace, medicine and transportation. | Online Interactive | Website | American Petroleum Institute |
| | **Solar Cells**<br>PowerPoint presentation outlining how a PV cell works to collect solar energy and convert it to useable energy. Use in conjunction with a hands-on exploration of solar cells. | Activity and PowerPoint | Download PowerPoint | Kristi Hawk, Port Edwards School District. |
| | **Solar Energy Principles and Applications**<br>Students track the apparent path of the sun across the sky to discover how solar energy can best be captured and used. Images can be collected and used to introduce the concepts of active and passive solar collection. | Activity<br>(PDF) | Download Activity (see pages 9-12) | Catalyst Learning Curricula |
| | **The Evolution of a Valuable Resource**<br>Timeline of oil's history. | Website | Website | PBS |
| | **Wind**<br>Basic information on wind and how turbines create energy. Supporting wind maps of WI and US. | Background | Website | KEEP – Wisconsin K-12 Energy Education Program |
| | **Wind Energy**<br>Resources to teach about wind energy including background information, lesson plans, and numerous ideas for building an educational wind turbine. | Lessons and Background | Website | KidWind |
| | **Wind Power Introduction**<br>Students read an article and complete a worksheet as an introduction to wind power. This activates students' preconceptions and briefly introduces them to the economics of wind power. It is best used near the beginning of an energy discussion. The student guide is designed to help students improve reading skills and based on suggestions provided in Doug Buehl's "Classroom Strategies for Interactive Learning" book. | Background Article and Activity<br>(MS Word) | Download Article<br><br>Download Activity | Anita Sundstrom, Oregon School District. |
| | **Yeast Fermentation**<br>Prior to the lb, students are asked, "Why do we use corn to make ethanol?" Students look at how yeast fermentation and biomass are used to produce ethanol. The students have six things they can ferment including: sugar, corn syrup, molasses, honey, condensed milk, and Splenda. The sugar is the control. They record and graph the $CO_2$ production, which is an indication of yeast activity and fermentation, then complete a lab report. All results are recorded on the front chalk board so they can graph the results. | Lab<br>(MS Word) | Download teacher instructions, student instructions, worksheet | Adapted from, "Fermentation, Respiration, and Enzyme Specificity: A Simple Device and Key Experiments wit Yeast", by L. Reinking, J. Reinking, and K. Miller, The American Biology Teacher, Vol 56, March 1994, pp. 166-168. |

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| **b. Benefits and limitations** | | | |
| **Biofuels Sustainability: Assessing Energy and Carbon Balance**<br>This high school/introductory college-level activity considers the sustainability of different transportation fuels. Students are introduced to the concept of a life cycle assessment, focusing on energy and carbon cycling for corn and cellulosic ethanol and gasoline production systems. | Activity | Website (scroll down webpage for supporting materials) | Great Lakes Bioenergy Research Center |
| **Electric Power from Sun and Wind**<br>This quantitative module describes the electric energy generated by wind turbines and photovoltaic arrays. The efficiency and cost of these technologies are compared and their abilities to reduce carbon dioxide emissions are estimated. Pages 4-14 of the Special Focus: Energy and Climate Change materials. | Activity (PDF) | Download Activity | AP Central – The College Board |
| **c. Projected reserves/availability** | | | |
| **A Crude Awakening: The Oil Crash**<br>Good video to show when discussing topics such as "Peak Oil" or availability of fossil fuels. The 90 minute documentary explains how our civilization's addiction to oil puts it on a collision course with geology. Compelling and entertaining, the film visits with the world's top experts and comes to a startling, but logical conclusion – our industrial society, built on cheap and readily available oil, must be completely re-imagined and overhauled. | Video | Website<br>DVD: $24.99 at Amazon.com | |
| **Global Energy Flows**<br>Students analyze data detailing global energy sources (wind, solar, etc) and sinks (uses) and construct a diagram to show the relative scale and the connections between them. Discussions of scale, historical, socio-environmental and geographic variation in this data and implications for future energy use are included | Activity | Website (scroll down webpage for supporting materials) | Great Lakes Bioenergy Research Center |
| **2. Human Use** | | | |
| **Wisconsin Energy Statistics**<br>Every year Wisconsin publishes energy data including consumption, generation, renewable energy, prices, and expenditures in Wisconsin. The Wisconsin Office of Energy Independence (OEI) publishes this book as the foundation for evaluating energy activities and trends in Wisconsin. Students can use the charts and graphs to study and compare the data. The worksheet can be updated each year to reflect the latest data. | Web based publication and Worksheet (MS Word) | Website<br>Worksheet | Wisconsin Office of Energy Independence and Quan Banh, Prentice School District |
| **Xcel Energy Guest Speaker**<br>Tina Ball works with the Education Outreach Program at Xcel Energy. She will visit schools within Xcel's service territory (everything west of Marathon City to the WI/MN border, south to LaCrosse and north to Lake Superior. Tina is located in Eau Claire) and present on energy resources and ho Xcel Energy is working to promote energy efficiency across its service area. | Guest Speaker | 800-328-8226 | Xcel Energy |
| **a. Historical use** | | | |
| **Renewable Energy Timeline**<br>Renewable Energy has been used throughout the world throughout time because of its convenience and availability. This timeline shows events and product discoveries relating to renewable energy. An activity follows that you are able to do with your students called Over | Website | Website | KEEP – Wisconsin K-12 Energy Education Program |

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| the Years. | | | |
| **b. Community sectors – transportation, agricultural, industrial, municipal, commercial, residential** | | | |
| **Energy and Transportation**<br>Information, activity suggestions, and resources related to energy and transportation. | Website | Website | KEEP – Wisconsin K-12 Energy Education Program |
| **Global Energy Flows**<br>This activity focuses on global energy that is related to human activities. It steps through where this energy comes from (sources); how it is used; how it flows from these sources to uses; and what the corresponding losses are. An emphasis is placed on student development of questions in regards to these energy flows. Further detail on global bioenergy is provided. | Activity | Website (scroll down webpage for supporting materials) | Great Lakes Bioenergy Research Center |
| **Greenercars.org**<br>This website rates the "greenness" (or not) of currently produced automobiles. Also find green driving tips. | Website | Website | American Council for an Energy-Efficient Economy |
| **c. Demands and consumption** | | | |
| **Watt Meter**<br>Watt Meters (sometimes called Line Loggers) are a tool that can be used to measure the electric usage of appliances. By plugging an appliance into the meter and ten into a socket, you can measure the actual electric use of a particular appliance. | Hands-on Equipment (PDF) | Borrow from WCEE EE Resource Library | Check out available from many public libraries. For purchase (Internet search) - ranging from a basic Kill-A-Watt meter ($25) to a Watt's Up meter that calculates costs ($125). |
| **World Oil Consumption**<br>Search for "world oil consumption." You must download Google Earth to your computer. This is a quick and powerful visual showing different levels of oil consumption of countries around the world. The relative level of oil consumption by each country is projected three dimensionally into space to create dramatic comparison. | Google Earth Map | Website | Google Earth |
| **3. Effects** | | | |
| **Wisconsin Land Use Megatrends: Energy**<br>This publication investigates the connections between energy (renewable and nonrenewable) and land use. A map scenario illustrating how Wisconsin might achieve its goal of producing 25% of its energy from renewable sources by 2025 is presented. Also included are building, transportation, and community design approaches to reduce energy use. | Background Information/ Publication (PDF) | Download Document | Center for Land Use Education and UW Extension |
| **a. Environmental – pollution, climate change, mining issues, waste management, habitat destruction** | | | |
| **Operation Oil Spill Clean Up**<br>Students select various materials and use them to determine their effectiveness at cleaning up a model oil spill. After designing an experiment to test their theory the students evaluate how well their plan worked. | Lab (PDF) | Download Lab | Holt Environmental Science |
| **Effects – Environmental – Climate Change**<br>Visit the Air Resources – Climate Change section for climate change resources. | | | |

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| **b. Human health** | | | |
| **c. Economic** | | | |
| **The Big Energy Gamble**<br>In this 2009 video, students learn about the economic pro's and con's of California's AB-32 (Assembly Bill 32). The goal of this bill is to combat global warming by slashing California's carbon dioxide emissions 30 percent by 2020 and 80 percent by 2050 by promoting the technology and use of renewable energy. Students learn how this aggressive policy may potentially affect both businesses and residents of California and potentially the rest of the US | Video, Activity (MS Word), Website | Activity<br><br>Website<br>DVD: $24.99 from PBS | PBS Nova and Ruth O'Donnell, Brown Deer School District |
| **d. Political – war, legislation, border issues** | | | |
| **4. Solutions** | | | |
| **a. Technology** | | | |
| **Community Solar Projects**<br>This website provides an overview of several buildings around the state using solar panels to produce electricity. Each location has a description of the unity used to produce the energy and also output details on a 24 hour basis. It is relatively easy to find a location near you and monitor the kilowatt hour produced during any day. In Wisconsin, we see some great contrasts depending on weather conditions. The site also includes some good information on GreenMax homes. | Website | Website | WPPI Energy |
| **b. Projected reserves/availability** | | | |
| **c. Demands and consumption** | | | |
| **Watt Meter**<br>Watt Meters (sometimes called Line Loggers) are a tool that can be used to measure the electric usage of appliances. By plugging an appliance into the meter and ten into a socket, you can measure the actual electric use of a particular appliance. | Hands-on Equipment (PDF) | Borrow from WCEE EE Resource Library | Check out available from many public libraries. For purchase (Internet search) - ranging from a basic Kill-A-Watt meter ($25) to a Watt's Up meter that calculates costs ($125). |
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| **d. Lifestyle changes** | | | |
| **Green Home Design**<br>Students design a home and implement energy saving features. They submit a drawing and written description. The activity was adapted from the lesson titled "Green Home Design" on p.114 in the KEEP Doable Renewables guide. The Doable Renewables guide can be obtained by taking a KEEP course. | Activity (MS Word) | Activity | Becca Bestul, Eau Claire Area School District |

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| | **Your Carbon Diet – Home Energy**<br>This is a simple interactive that shows how various household appliances can become more efficient. Click on an appliance to learn kWh, CO2 produced, and oil used. | Online Interactive | Website | PBS NOVA |

## Air Resources

1. Atmospheric science
   - h. Atmospheric composition and structure
   - i. Weather and climate – relationship between sun, wind, and ocean currents; difference between weather and climate; historical patterns
2. Human use
   - g. Biological
   - h. Combustion
   - i. Work – transportation, wind energy generation
   - j. Waste disposal
3. Pollution
   - i. Types of pollutants – primary, secondary, synergistic
   - j. Source of pollutants – natural and anthropogenic
   - k. Impacts of pollutants – ozone depletion, smog, acid precipitation, heat islands, inversions, health issues
   - l. Solutions or reductions
4. Climate change
   - j. Natural greenhouse effect
   - k. Greenhouse gas
   - l. Keeling Curve
   - m. Impacts/consequences
   - n. Data interpretation and computer modeling
   - o. Solutions

| Air Resources | | | |
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| **Air Unit Review**<br>This two page worksheet helps students review typical concepts covered in a unit on air, the atmosphere, and air pollution. | Worksheet (MS Word) | Download Worksheet | David Bendlin, Milton School District |
| **1. Atmospheric Science** | | | |
| **a. Atmospheric composition and structure** | | | |
| **Making and Using Schoenbein Paper**<br>Christian Friedrich Schoenbein discovered ozone and used its reactivity to measure its presence and demonstrate that it is a naturally occurring component of the atmosphere. He developed a way to measure ozone in the troposphere using a mixture of starch, potassium iodide, and water spread on filter paper. The paper, called Schoenbein paper, changes color when ozone is present. In this activity, students create Schoenbein paper and measure the presence of ozone. | Activity | Website | Project Learn, University Corporation for Atmospheric Research |

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| **b. Weather and climate** – relationship between sun, wind, and ocean currents; difference between weather and climate; historical patterns | | | |
| **DataStreme Atmosphere**<br>Find real-time data about current weather conditions anywhere in the United States. You'll find daily summaries, major weather news, radar, satellite, and surface maps. The information can be used as is but is enhanced by a course that teaches the technical aspects of the information. The site contains information about how the 3 credit course can be taken at little to no cost. | Website | Website | American Meteorological Society |
| **2. Human Use** | | | |
| **a. Biological** | | | |
| **b. Combustion** | | | |
| **c. Work** – transportation, wind energy generation | | | |
| **d. Waste Disposal** | | | |
| **3. Pollution** | | | |
| **a. Types of Pollutants** – primary, secondary, synergistic | | | |
| **Air Pollution**<br>This activity introduces several types of air pollutants. Students read about a single air pollutant, work in a group to answer questions, and prepare a presentation to share their information with the entire class. | Activity (MS Word) | Teacher Directions<br>Picture & Outline Guide<br>Presentation Guide<br>Acid Rain Reading<br>Acid Rain Guide<br>Indoor Air Quality Reading<br>Indoor Air Quality Guide<br>Improving Indoor Air Quality Reading<br>Improving Indoor Air Quality Guide<br>Smog Reading<br>Smog Guide<br>Ozone Reading<br>Ozone Guide<br>Radon Reading<br>Radon Guide<br>VOC Reading<br>VOC Guide<br>Air Pollution Intro Reading<br>Air Pollution Intro Guide | Anita Sundstrom, Oregon School District |

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| **b. Source of Pollutants** – Natural and Anthropogenic | | | | |
| **c. Impacts of Pollutants** – Ozone Depletion, Smog, Acid Precipitation, Heat Islands, Inversions, Health Issues | | | | |
| | **Milkweed Monitoring to Detect Ozone Pollution**<br>This website explains how students can observe and monitor the leaves of milkweed plants in early fall to determine the levels of ground level ozone in their area. Click on the link to print the 16 page Teacher's Guide "Milkweed Monitoring: Keeping a Finter on Nature's Pulse" for instructions and background. Links to other resources, pictures of ozone damage on milkweed leaves, and a directory of participating schools is also available through the site. | Activity / Student Action Project | Website | Wisconsin Department of Natural Resources |
| | **Wisconsin's Air Quality Index**<br>This interactive map provides real-time data from stations monitoring Wisconsin's ambient air to determine the air quality index. The network focuses on EPA's list of the most serious health –related air pollutants: ozone, particle pollution, sulfur dioxide, nitrogen dioxide, and carbon monoxide. | Website | Website | Wisconsin Department of Natural Resources |
| | **Stratospheric Ozone**<br>Students learn about the effect of UV radiation on stratospheric ozone and then do an activity to study the relationship between the two using data from the South Pole. | Activity (PDF) | Download Activity | ESA21 |
| | **Smog**<br>Students examine ground-level ozone (smog) through reading and NPR stories. They then conduct an online simulation called Smog City that demonstrates the relationship between weather conditions and different types of smog-forming pollutants. They will also learn how transportation choices make a difference in air pollution levels. | Activity (PDF) | Download Activity | ESA21 |
| | **Acid Deposition**<br>In this lab, students examine the effects of acid rain on an ecosystem. Lab modified from Earth Matters, an interdisciplinary teaching resource that explores some of the most pressing environmental social and economic issues of our time. The original lab is in Unit III "Air Pollution" and is called "The Acid Tests." | Lab (MS Word) | Download Lab | Hary Hayden, Wisconsin Rapids School District and Population Connection |
| | **Acid Rain**<br>This is a very simplified acid rain lab to illustrate how some lakes buffer acid rain much better than others. It is very simple, so not recommended for upper level students. The questions in the analysis have students relate what they saw in class to some real lakes. | Lab (MS Word) | Download Lab | Becca Bestul, Eau Claire Area School District |
| **d. Solutions or Reductions** | | | | |
| **4. Climate Change** | | | | |
| | **An Inconvenient Truth**<br>Al Gore's award winning documentary about global climate change | DVD, book, website | Website<br>Download Curriculum | |
| | **Climate Change Debate**<br>Climate Debate Daily is intended to deepen understanding of disputes over climate change and the human contribution to it. The sit links to scientific articles, news stories, economic studies, editorials, and more. The column on the left includes arguments in support of the IPCC position on the reality of anthropogenic global warming. The right column includes material skeptical of the | Website | Website | Douglas Campbell and Denis Dutton |

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| IPCC position and the notion that anthropogenic global warming represents a threat to humanity. As a matter of editorial policy, Climate Debate Daily maintains neutrality to allow readers to form their own judgments. | | | |
| **Climate Change: A Wisconsin Activity Guide**<br>Activities that help students develop the knowledge and skills needed to become informed and active participants in society's climate change discussions. It touches on both the scientific aspects of climate change and social issues. | Activities | Website<br>download | Wisconsin Department of Natural Resources |
| **Climate Change: Connections and Solutions**<br>An interdisciplinary, self-contained two-week unit aligned with national education standards that lays the foundation for understanding some of the forces behind climate change and its connections to numerous social, economic, and environmental factors. | Lessons | Website<br>download | Facing the Future |
| **Frequently Asked Questions**<br>Summaries of key points of the IPCC 2007 report. Examples: What factors determine Earth's climate? What is the relationship between climate change and weather? What is the greenhouse effect? How do human activities contribute to climate change? | Background info/publication (PDF) | Download<br>Document | Intergovernmental Panel on Climate Change |
| **The Most Terrifying Video You'll Ever See 2**<br>This video is from a high school science teacher presenting an argument on why we should act on climate change from a risk assessment stand point. His creative style keeps viewers interested as he presents this topic from a different perspective. | Video | Website | HS science teacher post on YouTube |
| **Wisconsin Climate Change**<br>Wisconsin-based climate change information including background, trends, impacts, adaptations, and government initiatives. | Website | Website | Wisconsin Department of Natural Resources |
| **a. Natural Greenhouse Effect** | | | |
| **Greenhouse Gas Investigations**<br>Through this experiment, students explore Earth's greenhouse effect. Students graph results of three scenarios to draw conclusions about how greenhouse gases affect air temperature. | Lab<br>(PDF) | Download Lab | Facing the Future |
| **b. Greenhouse Gas** | | | |
| **Cape Grim Greenhouse Gas Data**<br>This animated map show the change in greenhouse gas levels from 1977 to the present from one of the cleanest air sources in the world, Cape Grim on Tasmania's west cost. The site also provides the history of the data collection and information about various gases such as carbon dioxide, methane, and nitrous oxide. | Background information | Website | Commonwealth Scientific and Industrial Research Organization (CSIRO) |
| **Energy Balance as a Basis for the Greenhouse Effect and Global Warming**<br>This article provides an analytically detailed description of the greenhouse effect from a physical science perspective. Questions are provided to assess comprehension. Pages 20-34 of the Special Focus: Energy and Climate Change materials | Article and Questions (PDF) | Download<br>Activity | AP Central – The College Board |
| **Global Climate Change**<br>In this problem-based learning activity, students predict the effects of increased atmospheric concentrations of carbon dioxide on the yield of hard red winter wheat in Kansas. The website provides guidelines for student research and the background information needed to complete the activity. | Activity | Website | Exploring the Environment |
| **Greenhouse Gs Equivalency Calculator** | Website | Website | Environmental Protection |

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| | Did you ever wonder what reducing carbon dioxide emissions by 1 million metric tons means in everyday terms? The EPA has a tool for translating phrases like "metric ton of carbon dioxide" into more everyday terms, such as "the carbon dioxide emissions of a passenger car over two months." Simply enter the amount of emissions in one measure, and the calculator ten lists a selection of equivalent measures | | | Agency (EPA) |
| | **Greenhouse Gases: Yesterday, Today and Tomorrow**<br>A data analysis activity that looks at Mauna Loa carbon dioxide levels and the Vostoc ice core data to draw conclusions. This activity was modified from an article in EE News and originally created by Al Stenstrup. | Activity (MS Word) | Download Activity | Hary Hayden, Wisconsin Rapids School District |
| | **An Historical Record of CO2**<br>In this activity, students examine two different carbon dioxide sources: recent measurements from air samples collected at the Mauna Loa Observatory in Hawaii and older concentrations from an ice core drilled in 1975 at the Law Ice Dome in Antarctica. Analysis of both types of values allow students to recreate concentrations of CO2 since 1010, determine the rate at which CO2 concentrations have changed since the 18th Century, and estimate future concentrations | Activity | Website download | Center for Remote Sensing of Ice Sheets |
| **c. Keeling Curve** | | | | |
| | **Keeling Curve Lessons**<br>Charles David Keeling directed a program to measure the concentrations of CO2 in the atmosphere that continued without interruption from the late 1950s through the present. This program, operated out of Scripps Institution of Oceanography, is responsible for the Mauna Loa record, which is the best-known icon illustrating the impact of humanity on the planet as a whole. This site provides an overview of the data collection and summary of what can be learned from it. | Background | Website | Scripps CO2 Program |
| | **Revisiting the Keeling Curve**<br>In the late 1950s, scientist Charles David Keeling began research that would prove to be a key signpost of climate change. In this archived story, hosts Madeleine Brand and Alex Chadwick talked with Keeling's widow and other scientists about the impact of Keeling's work. | Audio cast | Website Download | NPR |
| | **Trends in Atmospheric Carbon Dioxide**<br>A graph showing recent monthly mean carbon dioxide measured at Mauna Loa Observatory, Hawaii. The carbon dioxide data on Mauna Loa constitute the longest record of direct measurements of CO2 in the atmosphere. They were started by C. David Keeling of the Scripps Institution of Oceanography in March of 1958. | Data | Website | NOAA, Earth System Research Laboratory |
| **d. Impacts/Consequences** | | | | |
| | **Climate Change Projection, A Look at the Water Budget**<br>Students use an online water budget modeling program to create water budget diagrams. By comparing water balance diagrams of present-day and IPCC based future climate change scenarios students can evaluate the type of changes Kansas (and other areas) could experience due to temperature related precipitation changes. | Activity | Download Lesson<br><br>Water-Budget Interactive<br><br>Modeling Program | Center for Remote Sensing of Ice Sheets |

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| | **Ecological Impacts of Climate Change**<br>This 28-page booklet is based on *Ecological Impacts of Climate Change* (2009), a report by an independent panel of experts convened by the National Research Council. It explains general themes about the ecological consequences of climate change and identifies examples of ecological changes across the United States. Climate change is affecting ecosystems right in your own backyard. In addition, PowerPoint presentation modules are available to assist educators in sharing this information. | Booklet and PowerPoints | Website | National Academy of Sciences |
| | **The Day After Tomorrow**<br>This Dennis Quaid movie is a great way to culminate a climate change unit. A climatologist tries to figure out a way to save the world from abrupt global warming. He must get to his young son in New York, which is being taken over by a new ice age. | Movie | Approx. $7 from Amazon or rent it from a local video store. | 20th Century Fox |
| | **Global Climate Change: Earth's Atmosphere Heats Up**<br>This Bill Nye video investigates the effects of fossil fuels, how carbon dioxide impacts the atmosphere, and the process measuring climate change. | DVD | Approx: $30 at Disney, or Borrow from WCEE EE Resource Library | Bill Nye, Disney Educational Productions |
| | **The Human Toll of Climate Change**<br>This map provides scientific information on climate change threats such as natural disasters, including hurricanes, floods, droughts, and wildfires; the spread of infectious disease such as the West Nile virus; rising sea levels that could wipe out coastal cities and towns; and declines in crop production and fish catches. Clicking a category will display icons on the map in locations where scientific research indicates there may be problems along with the corresponding data. | Website | Website | Center for American Progress |
| | **Ice Research**<br>UW Limnology researchers give us a snapshot of Wisconsin's environmental future, frozen in time. What can the ice covered lakes of the frozen tundra reveal? Data on seven lakes in Vilas County reach back to the early 1980s. Information for Lake Mendota in Madison has been kept for more than 150 years. Art Hackett reports on drastic shifts in the length of time ice covers Wisconsin lakes. A good connection to local climate change issues. 7 minutes | Video | Website | In Wisconsin, Wisconsin Public Television |
| | **Mother Nature's Tea Party – Talking about Climate Change**<br>Each student plays the role of a real person that has been affected by climate change. As they chat with the other people in the room, students discover that climate change has a very human face and that it affects people (and the earth) in a great variety of ways. They also learn a little geography, too. | Activity (MS Word) | Download Activity | Dana Lex, West De Pere High School |
| | **Polar Visions**<br>This film by Dr. Ryan Vachon is about the causes and effects of climate change in the polar regions. The movie is divided into seven segments for ease of integration with classroom instruction. Polar Visions is aligned with the National Science Education Standards ad is suitable for middle level to undergraduate students. | Video | View online | Cooperative Institute for Research in Environmental Science. |
| | **Waterworld**<br>This Kevin Costner movie is great for culminating a climate change unit. In a future where the | Movie | Approx. $15 at Amazon, or | Universal Studios |

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| | polar ice caps have melted and most of Earth is underwater, a mutated mariner fights starvation and outlaw "smokers," and reluctantly helps a woman and a young girl find dry land. | | rent it from a local video store | |
| **e.** | **Data Interpretation and Computer Modeling** | | | |
| | **The Breathing Earth**<br>This real-time simulation displays the CO2 emissions of every country in the world, as well as their birth and death rates. | Computer Simulation | Website | David Bleja |
| | **EarthTrends: Climate and Atmosphere**<br>Click on the link for Climate and Atmosphere to find a searchable database of statistics, maps, and country profiles of environmental, social, and economic trends that shape our world. Example information includes CO2 emissions, global gas concentrations, non-CO2 greenhouse gas emissions, and global carbon storage. | Website | Website | World Resources Institute |
| | **Global Temperatures**<br>In this problem-based learning scenario, students analyze and summarize temperature data for a report detailing what global mean temperatures indicate about the overall picture of climate change. | Website | Website | Exploring the Environment |
| | **The Vulcan Project**<br>The Vulcan Project has created maps and analysis of CO2 emissions for the continental U.S. from power plants, industrial sources, roads and highways, and residential sources. Each projection shows the location and magnitude of emissions. Students can compare the who, what, and where of CO2 emissions. Ask students to analyze the plots and decide which regions' sources are the greatest contributors to CO2 in the atmosphere. They can then make comparisons and formulate questions and hypotheses. This is a great use of real/current data in class that helps students answer the question "how do they know this stuff?" The Vulcan (Roman God of fire) site also includes a video showing diurnal cycles of carbon emissions and a Google Earth application. | Activity and Website | Website | Purdue University |
| | **Watch 131 years of Global Warming in 26 Seconds**<br>This 26-second video depicts how temperatures around the globe have warmed since 1880. The data comes from NASA's Goddard Institute for Space Studies in New York, which monitors global surface temperatures. | Video | Website | Climate Central and NASA |
| **f.** | **Solutions** | | | |

## Land Resources

1. Soil science
    j. Formation
    k. Rock cycle
    l. Layers
    m. Composition
    n. Soil chemistry
    o. Soil mapping
    p. Soil community
    q. Glaciation
2. Terrestrial ecosystems
    k. Forests
    l. Prairie/grassland
    m. Desert
    n. Tundra
3. Land use
    m. Minerals/mining
    n. Agriculture
    o. Forestry
    p. Rangeland
    q. Wilderness
    r. Public lands
    s. Private land
    t. Urbanization
    u. Solid waste

4. Effects of human use
    a. Desertification
    b. Salinization
    c. Alkalinization
    d. Erosion
    e. Fragmentation
    f. Habitat loss

5. Planning and management
    a) Historical – exploitation, conservation, preservation
    b) Managing land use – mitigation, reclamation, multiple use, green space/open space, comprehensive planning/smart growth

## Land Resources

### 1. Soil Science

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| **Measuring Soil CO2**<br>This lab measures CO2 production in soil as a factor in soil productivity (the more CO2 produced, he less organic matter that is retained). You can build a simple gas outflux trap by cutting off the bottom of a 5 gallon pail and drilling a 1 1/8" hole in the lid. Push the pail a few inches into the soil and plug the hole with a #6 rubber stopper. You can measure the gas directly with a CO2 probe (like Vernier) or use soda lime and titration. It takes a little time, but students love it and it's a great intro to biological processes that create soil. | Lab<br>(MS Word) | Download Lab | Craig Kohn, Waterford Union High School |

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| **Soil Testing Products**<br>Supplies and information related to soil testing. | Lab Supplies | Website | LaMotte Company |
| **Web Soil Survey**<br>Provides soil data produced by the National Cooperative Soil Survey. The survey includes air photo and solid descriptions as well as GIS style maps that you can select to create layers and analyze your site of choice. The web soil survey could be used to analyze the various habitats found in your district school forest. Have students research the type of soils found at a site, the soil characteristics, and then sample the site to see how close our profiles match the soil survey. | Website | Website | USDA Natural Resources Conservation Service |
| **a. Formation** | | | |
| **b. Rock Cycle** | | | |
| **c. Layers** | | | |
| **d. Composition** | | | |
| **Soil Infiltration**<br>This outdoor lab investigating infiltration rates of soils. The lab can be completed in small groups around your school site or in a natural area. Hints…you will need some sort of container. Large cans from the food service department work well. If students place a small 2x4 over the top edge of the can before pounding into the ground it will help preserve the integrity of the can. The lab has the most impact if students can measure the infiltration from more than one site. | Outdoor Lab (MS Word) | Download Lab | Matt Tiller, Verona Area High School |
| **e. Soil Chemistry** | | | |
| **LaMotte Soil Handbook**<br>The LaMotte Soil Handbook offers instruction for testing soils and applying the information learned. | Book | Website<br>Approx. $40 at Amazon | LaMotte Company |
| **f. Soil Mapping** | | | |
| **Soil Map of Wisconsin**<br>Found in the Wisconsin DNR's publication, Ecological Landscapes of WI, this is a first step in locating country specific maps and information for the study of local soils. | Map | Website | Wisconsin Department of Natural Resources |
| **g. Soil Community** | | | |
| **h. Glaciation** | | | |
| **2. Terrestrial Ecosystems** | | | |
| **Biome Book**<br>Have students write a book about their biome. All students have to include the same information but it comes out differently in each biome. For example, a frog in a deciduous forest is much different than a rain forest frog. You may want to add a seasonal variation requirement. Students cover these required elements: Description of Biome, Movement of water through the biome, The cycles – Carbon, Oxygen, Nitrogen, Plants & their Adaptations, Decomposers & their Adaptations, | Activity (MS Word) | Download Activity | Environmental Science Teacher |

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| Patterns in this Biome, Food Chains, Food Webs, Energy Pyramid, Environmental Effects on Biome. | | | |
| **Biome Gallery Walk**<br>Assign a different biome to each group of students in the class. Each group researches their biome and presents required information on a posterboard. Display the posters around the classroom, gallery style, after they are checked for correctness. Have groups tour the gallery and collect information in a booklet about biomes they did not research prior to the test. | Activity<br>(MS Word) | Download Activity | Letizia Judd, Orchard Lake, MI |
| **Biome Speech**<br>Have students write a speech (riddle style) about their biome. | Activity<br>(MS Word) | Download Student Instructions | Environmental Science Teacher |
| **Biome Travel Agents**<br>Cover each biome using PowerPoints, projects, video clips, and case studies. As a closure activity students become travel agents. They are assigned a city and have to figure out what biome it is in and create a travel ad PowerPoint and a brochure that includes sights, how to get there, and prices. After the students have completed their sales pitch to the class the students vote on where they would go based on the presentations. | Activity<br>(MS Word) | Download Project instructions<br>Partner Feedback<br>Presentation Rubric<br>Peer Eval<br>Final Grade Sheet<br>Vote | Environmental Science Teacher |
| **Biomes of the World Mini-Atlas**<br>Students create an atlas of eight world biomes based on a template and Internet research. Instructions and grading rubrics are included. | Project<br>(MS Word and PDF) | Download Activity<br>Biome Template | Sandra Naas, Ashland School District |
| **EarthTrends: Forests, Grasslands, and Drylands**<br>Click on the link for Forests, Grasslands, and Drylands to find a searchable database of statistics, maps, and country profiles of environmental, social, and economic trends that shape our world. Example information includes dryland extent, ecosystem areas, forest cover, and grassland habitat types. | Website | Website | World Resources Institute |
| **a. Forests** | | | |
| **LEAF**<br>The mission of the Wisconsin K-12 Forestry Education Program is to initiate and facilitate the development, dissemination, implementation, and evaluation of forestry education within Wisconsin Schools. From the homepage, educators can access curriculum, resources, and support for teaching about forestry in Wisconsin. | K-12 Education Program | Website | Wisconsin K-12 Forestry Education Program (LEAF) |
| **Making a Tree Scale Stick**<br>Instructions for making tree scale sticks to measure tree diameter and height. | Instructions<br>(PDF) | Download Instructions | Mississippi State University Extension Service |
| **National Tree Benefit Calculator**<br>The Tree Benefit Calculator allows anyone to make a simple estimation of the benefits individual street-side trees provide. With inputs of location, species, and tree size, users will get an understanding of the environmental and economic value trees provide on an annual | Web Tool | Website | Casey Trees and Davey Tree Expert Co. |

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| basis. This tool should be considered a starting point for understanding trees' value in the community, rather than a scientific accounting of precise values. | | | |
| **Tree ID**<br>The LEAF tree ID materials are helpful in teaching basic ID skills using a dichotomous key. There is a paper key and set of full-color ID cards that can be used to set up a tree ID lab outdoors as well as an online tree ID key that can be used with samples brought to the classroom or the sample "mystery" trees provided | Activity and/or Lab | Online Dichotomous Tree Key, Tree ID Cards, Dichotomous Tree Key | Wisconsin K-12 Forestry Education Program |
| **Wisconsin Forests at the Millennium**<br>A comprehensive description of Wisconsin's forests: past, present, and future. | Publication | Website | Wisconsin Department of Natural Resources |
| **Wisconsin High School Forestry Education Kits**<br>The Forestry Kit contains equipment and tools to facilitate teaching tree identification and management, plot investigations, and navigation using compasses. Supporting lessons are available on the LEAF website. | Kits | Information about how to access kits | Wisconsin K-12 Forestry Education Program |
| **b. Prairie/Grassland** | | | |
| **Prairie Resources**<br>A Webliography of prairie-related resources. | Website | Website | Camp Silos |
| **c. Desert** | | | |
| **Deserts**<br>This website provides information on deserts worldwide and some of the plants and animals found there. It is written with student-friendly language. | Website | Website | Missouri Botanical Garden |
| **d. Tundra** | | | |
| **Tundra**<br>This website provides information on tundra worldwide and some of the plants and animals found there. It is written with student-friendly language. | Website | Website | Missouri Botanical Garden |
| **3. Land Use** | | | |
| **Changing Land Use and the Impacts on the Environment**<br>This activity begins with the teacher creating a set of maps for students to work from. Each map shows a distribution of various land uses. Students compare maps from two different time periods and make predictions about how changes in land use affect the natural resources. | Activity (PDF) | Instructions | Roger Boettcher, Fennimore Area School District |
| **a. Minerals/mining** | | | |
| **b. Agriculture** | | | |
| **EarthTrends: Agriculture and Food**<br>Click on the link for Agriculture and Food to find a searchable database of statistics, maps, and country profiles of environmental, social, and economic trends that shape our world. Example information includes agricultural production, land use, livestock, and agricultural trade. | Website | Website | World Resources Institute |
| **Food, Farming & Community**<br>This site provides a reader's theater and a six-part curriculum that builds understanding and engages students in dialogue about local food and the importance of sustainable practices. | Activities | Website | Michigan State University Museum |
| **The Meat of the Matter** | Article | Download | E Magazine |

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| | This article catalogs the environmental effects of raising large numbers of livestock for meat from the potential impact on climate to the displacement of wildlife and incredible quantity of animal waste produced. The meat industry is responsible for more greenhouse gas emissions than worldwide transportation, uses 26 percent of the Earth's land for grazing, and releases toxins into our water supplies. | (PDF) | Article | |
| | **Sustainable Agriculture**<br>This website has many links to information and resources on sustainable agriculture. It is a good place to introduce a variety of issues from rainforest deforestation to organic farming to the use of pesticides to capturing rainwater for irrigation and more. The site has links to agricultural news, soil development, and games and quizzes. Use this site to have students choose their own area of interest (among those presented) and have them report their findings back to the class. | Website | Website | National Geographic |
| | **Toward a Sustainable Agriculture**<br>This curriculum consists of six modules related to sustainable agriculture: introduction, field crops, animals, horticulture, organics, and natural resource management. Overarching themes include: social, environmental, and economic impacts; food system and agroecosystem analysis; sustainable agriculture is defined and driven by goals; and real world examples provide the best opportunities for understanding the potential and challenges of sustainable agriculture. | Online Curriculum | Website | Center for Integrated Agricultural Systems |
| **c. Forestry** | | | | |
| | **EarthTrends: Forests, Grasslands, and Drylands**<br>Click on the link for Forests, Grasslands, and Drylands to find a searchable database of statistics, maps, and country profiles of environmental, social, and economic trends that shape our world. Example information includes forest production, forest certification, trade in forest products, and plantation area. | Website | Website | World Resources Institute |
| | **Ecology LEAF Project**<br>Students collect, press, and mount leaves in a variety of designs (forest, landscape, golf course, etc). Students then identify leaves by common and scientific names and give justifications for why they included each leaf in their design based on growth habits, uses, etc. It ends up being a cross between a leaf collection and an art project. | Activity (MS Word) | Download Activity | Ron Weber, Weyerhaeuser School District |
| | **Vegetation Analysis: Quadrant Lab Sampling**<br>This lab has students sample quadrants to obtain quantitative information about the structure and composition of terrestrial plant communities. When used in a forest students calculate basal parameters such as density and importance values. The technique can be used on all major types of plant communities. | Lab (PDF) | Download Lab | David Post, Greenwood School District |
| | **Winter Trees and Shrubs**<br>This site provides images of 200 species of woody plants. Each page features a description of the tree and close-up photos of twigs, branches, bark, etc. with identifying features pointed out. Developed in Canada but applicable in Wisconsin. | Website | Website | Portrait of the Earth |
| **d. Rangeland** | | | | |
| **e. Wilderness** | | | | |

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| **f. Public Lands** | | | |
| **g. Private Land** | | | |
| **Land Trust Stories – An In Wisconsin Special**<br>This video, put out by Wisconsin Public Television, does a good job of showing the importance of land trusts as a way of conserving our wild places, especially those on private lands. It is especially good at showing that land in a trust is still working lad, not only in nature's terms but also as managed forests, a natural classroom, etc. 30 minutes. | DVD | $16.95 from Wisconsin Public Television | Wisconsin Public Television |
| **h. Urbanization** | | | |
| **Community of Choices**<br>This video focuses on the economic, social and environmental benefits of preserving community character. It addresses the role that historic preservation, urban design, trees and landscaping, open space preservation and other issues play in shaping our sense of place. | DVD, Lessons | $25 from the DUNN Foundation. Lessons, video clips available on DUNN website | The DUNN Foundation |
| **i. Solid Waste** | | | |
| **Exploring Environmental Issues: Municipal Solid Waste**<br>Through this module, students begin understanding waste management issues and options. The module uses hands-on experiences to show the interrelationships among waste generation, natural resource use, and disposal. The activities guide students through waste management strategies and solutions while providing the necessary tools to make informed decisions and choices on waste management issues. Guide acquired by taking a workshop in your area or is available for check out from the WCEE EE Resource Library. | Activity Guide | Website | Project Learning Tree |
| **4. Effects of Human Use** | | | |
| **Earthshots: Satellite Images of Environmental Change**<br>This USGS site features many current and archived images. The viewer clicks on areas that are experiencing or have experienced various types of environmental impact. Some change is natural and some is human made. Mot images include a thorough description of the area and the impact of the change on vegetation, water, atmosphere, etc. | Website | Website | US Geological Survey |
| **Land Degradation**<br>An overview of the primary causes of land degradation including erosion, desertification, salinization and nutrient loss. | Website | Website | University of Michigan |
| **Soil: Key to Solving the Food Crisis?**<br>Soil has caused civilizations to rise and fall, depending on its health. In light of today's suffering soils and rising food security concerns, how can we prevent another civilization catastrophe? The Why Files examines solutions to many soil degradation issues such as erosion, drought, urban encroachment, salinization. | Background Information | Website | The Why Files |
| **a. Desertification** | | | |
| **Desertification**<br>Information about desertification including causes, global monitoring, ad local remedies. | Background Information | Website | USGS |

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| **Life in the Sahara**<br>Students research the Sahara region of Africa including weather, agriculture, and lifestyles then discuss the causes of desertification and how it impacts the people , plants, and animals | Activity | Website | PBS |
| **b. Salinization** | | | |
| **Salinization**<br>Overview of salinization including causes, indicators, effects, and management. | Background Information (PDF) | Download Document | USDA Natural Resources Conservation Service |
| **Salinization**<br>In this investigation, students design an experiment to investigate the effect of salt on seed germination. After graphing their data they prepare a report on their findings. | Lab (PDF) | Download Document | AP College Board |
| **c. Alkalinization** | | | |
| **d. Erosion** | | | |
| **Erosion in a Bottle**<br>In this activity, students study erosion and its effect on the environment. Groups build a model that demonstrates runoff and erosion, which can occur in both urban and agricultural settings. After the students complete the lab and look at other groups' results, you can discuss erosion control practices. This can be adapted for an agriculture education course by looking at the Natural Resource Conservation Service (NRCS) requirements for residue as it relates to soil loss and farming practices. Students receive a soil, they determine texture by feel, and their group selects a crop residue to apply to the soil. Groups choose 0%, 10%, 30%, and 60%. The NRCS has visuals the students can use as a reference. The students then look at the amount of water run-off with each residue. | Lab (PDF) | Download Lab | Water Action Volunteers |
| **Soil Erosion**<br>Overview of soil erosion signs, causes, how it is measured, and how it can be avoided | Background Information (PDF) | Download Document | USDA Natural Resources Conservation Service |
| **e. Fragmentation** | | | |
| **Habitat Fragmentation due to Transportation Infrastructure**<br>This report provides an overview of the scale and significance of the problem of fragmentation of natural habitats by roads, railways, and waterways in Europe and examines the solutions that are currently applied. | Background Information (PDF) | Download Document | European Co-Operation in the field of Scientific and Technical Research (COST) |
| **Subdivide and Conquer: A Modern Western**<br>An excellent documentary on urban sprawl, its history, what drives it, and real examples of strategies to limit sprawl. | Video | $250 at Bullfrog Films –reduced price rental available for teachers; on Documentary Channel occasionally. | Bullfrog Films |
| **f. Habitat Loss** | | | |

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| **Finding Solutions to Habitat Loss**<br>Statistics about wildlife habitat loss due to human impacts. | Background Information (PDF) | Download Document | Fish and Wildlife Service |
| **Habitat Loss**<br>An overview of how habitat loss from habitat destruction, fragmentation, and degradation affects wildlife survival. | Background Information | Website | National Wildlife Federation |
| **5. Planning and Management** | | | |
| **Center for Land Use Education**<br>The webpage for the CLUE at UWSP is the place to go to begin integrating land use planning into your curriculum. Information and resources abound. | Website | Website | Center for Land Use Education |
| **Deer Management**<br>This activity is based on the problems that many urban areas are facing with the burgeoning urban deer herds. The students are divided into groups and each group represents a real group that has vested interest in how the deer overpopulation problem will be solved. The groups range from PETA to the Safari Club. The student groups develop a management solution for the deer overpopulation problem and present their solution at a mock city council hearing. | Activity (MS Word) | Download Activity | Charlie Frisk, Luxemburg-Casco School District |
| **a. Historical – Exploitation, Conservation, Preservation** | | | |
| **b. Managing Land Use – Mitigation, Reclamation, Multiple Use, Green Space/Open Space, Comprehensive Planning/Smart Growth** | | | |
| **"Green – Based" urban Growth: Next Wave of Environmentalism**<br>This article describes how some communities are able to better plan for future land use with "smart growth" plans. Rather than zoning codes and maps dictating land use with the left over being set aside for green space, the reverse is occurring in some eco-municipalities. | Article | Website | National Geographic |
| **Demands on the Land**<br>Today, most American wild horses and burros are located in portions of the West on public lands managed by the Bureau of Land Management (BLM). Public lands also provide habitat for wildlife. In addition, BLM issues permits to ranchers to allow them to graze their livestock on public lands. Land managers strive to balance the various uses of the land while protecting the health of the rangelands. This "balancing act" can be quite challenging. To get a feel for the difficulties involved in making land-use decisions, conduct this role-playing activity. Students will research and debate the viewpoints of different interest groups regarding the removal of horses from a wild horse and burro Herd Management Area (HMA). | Activity | Website | Bureau of Land Management |
| **Functional Urban Areas**<br>Students design cities using legos to maximize various aspects including personal space, green space, and sustainability. They then research and discuss modern cities designed to improve quality of life for all residents. | Lab (PDF) | Download Lab - pages 13-21 | Catalyst Learning Curricula |
| **Whose Nature Trail is this Anyway?**<br>Students are divided into conflicting user groups of a nature trail. Groups create a presentation to defend their position and then debate the best use. Issues such as environmental impact, cost, laws, and most people benefited are discussed. | Activity (MS Wor) | Download Activity | Cal Geiger, Mayville School District |

## Water Resources

1. Characteristics of water on Earth
    r. Properties of water
    s. Physical, chemical, biological aspects (adaptations)
    t. Distribution
    u. Watersheds
2. Surface water
    o. Fresh – lakes, streams and rivers, wetlands
    p. Estuaries
    q. Salt - oceans
3. Groundwater
    v. Models
    w. Aquifer
    x. Artesian well
    y. Water table
    z. Zones – cone of depression, recharge, saltwater intrusion
4. Human use
    a. Historical Use
    b. Use sectors – agriculture, residential, commercial (including fisheries), municipal, industrial
    c. Demands and consumption
5. Impacts of water use
    a. Shortages
    b. Salinization
    c. Pollution/contamination – point vs. non-point
    d. Erosion
    e. Waste Management
    f. Storm water/flooding
    g. Water diversion
6. Sustainable use of water/solutions
    g. Conservation and preservation
    h. Reduced use
    i. Irrigation management
    j. Water rationing

| Water Resources | | | |
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| **Devil's Lake and Parfrey's Glen**<br>This is a brief overview given to students prior to a field trip to Devils Lake in Baraboo. The web links give students an idea of what to expect on the field trip. The trip includes crossing the Wisconsin River on the free Merrimac Ferry (the ColSac III can take a bus!) and a stop at Parfrey's Glen. You can collaborate with the history and PE teachers because the students get quite a work out. The handout is meant to be used as a springboard for discussion on many topics you may include such as local history, geology, water studies, economics, etc. Students should begin to appreciate how interconnected many of the things they take for granted are. | Field Trip (MS Word) | Download Handout | Meg McLaughlin, DeForest School District |
| **Inland Seas: Understanding and Protecting the Waters of the Great Lakes**<br>Featuring interviews with local scientists, water managers, and policy experts, Inland Seas explains the basics of our water resources from aquifers to watersheds and how they fit into the water policy picture. The movie makes connections to the Great Lakes Compact and presents ideas on how individuals can make an impact on water use and water policies. | Video | $15.00 from Great Lakes WATER Institute | Great Lakes WATER Institute |
| **Water Resources Overview**<br>General overview of water resources including: basic facts, pollution, clean water act, BOD, eutrophication, river decontamination, water shortages, salt water intrusion, waste water treatment. | PowerPoint (PDF) | PowerPoint | Pat Arndt, Berlin Area School District |
| **Wisconsin's Hydrologic Areas**<br>This web resource has maps and explanations of Wisconsin's major basins, water management units, watersheds, and hydrologic areas. It can be used when learning about watersheds of Wisconsin as well as a reference for topics such as the Great Lakes Water Compact | Website | Website | Wisconsin Department of Natural Resources. |
| **1. Characteristics of water on Earth** | | | |
| **Interactive Water Cycle Diagram**<br>This comprehensive website about the water cycle features a diagram of the water cycle and an in-depth discussion of each of the 15 topics on the diagram. | Website | Website | US Geological Survey |
| **a. Properties of water** | | | |
| **"Boyle-ing Water"**<br>Materials needed: room temperature water and a plastic syringe (approx. 200-400ml capacity). Activity is simple but effective. Draw up the water until syringe is full, push out any air, put your finger over the end, draw down syringe until a vacuum starts to appear above the water, keep drawing until water starts to bubble (boiling). The conclusion is that water is versatile, boils at various temperatures, moves heat for our planet, and is a key resource. | Demonstration | Website | James Spink, Lincoln Hills School |
| **b. Physical, chemical, biological aspects (adaptations)** | | | |
| **Stream Monitoring Data Collection Template**<br>This spreadsheet is used for data collection when monitoring streams for physical, chemical, and biological properties. Students enter data into the template to check their hand calculations. Only the yellow cells need to be filled in and the computer does the remainder of the calculations which assists in graphing and comparisons. | Lab (EXCEL) | Download Template | Cal Geiger, Mayville School District |
| **c. Distribution** | | | |

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| **Earth's Surface: Land and Water Percentages**<br>Have the class form a large circle. Teacher tosses an inflatable Earth globe to a student, specifies a hand (L or R), and finger (1-5), and records whether land or water is beneath that finger. Repeat. 25 tosses should generate enough data to show that 70% of Earth's surface is covered by water. | Activity | Purchase inflatable globe: $24.95 | Environmental Science Teacher |
| **d. Watersheds** | | | |
| **Determining Your Watershed**<br>The idea is for students to understand the concept of watershed by determining the area that collects the water that flows into a local river. Modify the worksheet to fit your local area. Make a map of the watershed area for each student but have them work in groups and share a colored topographical map so they can see the land features better. A possible extension is to get the average precipitation for your area and figure the volume of water flow. | Activity (MS Word) | Download Activity | Quan Banh, Prentice School District |
| **Surf Your Watershed**<br>This interactive map helps youi locate your watershed and associated watershed data and resources. | Website | Website | Environmental Protection Agency |
| **2. Surface water** | | | |
| **North Temperate Lakes Long Term Ecological Research Data**<br>Data on several Wisconsin lakes, some dating back to the 1850s, including several physical and biological parameters. | Online Data Set | Website | Center for Limnology – UW-Madison |
| **Turbidity Tube**<br>You can make inexpensive turbidity tubes for use for aquatic sampling with your students. Turbidity is a measure of the cloudiness of water. It is an important water quality parameter in drinking water provision and treatment. The document has background information on turbidity science and instructions with images. | Equipment (PDF) | Instructions | Michigan Technological University |
| **Wonderful, Wacky, Water Critters**<br>Small ID booklet for identifying aquatic macroinvertebrates. | ID Book | Print a copy<br><br>Request a copy from your county extension office | UW-Extension and Wisconsin DNR |
| **a. Fresh – lakes, streams and rivers, wetlands** | | | |
| **EarthTrends: Water Resources and Freshwater Ecosystems**<br>Click on the link for Water Resources ad Freshwater Ecosystems to find a searchable database of statistics, maps and country profiles of environmental, social, and economic trends that shape our world. Example information includes groundwater withdrawals, renewable water sources, river flows, and watershed maps. | Website | Website | World Resources Institute |
| **Understanding Climate Change and Our Rivers and Lakes: Systems Thinking**<br>An exercise on global climate change that helps students think about the big picture of how a phenomenon affects an entire ecosystem. Through readings and questions students explore the affects of rising temperatures on rivers and lakes. Pages 13-19 of the Special Focus: Energy | Activity (PDF) | Download Activity | AP Central – The College Board |

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| and Climate Change materials. | | | |
| **Ice Research**<br>UW Limnology researchers give us a snapshot of Wisconsin's environmental future, frozen in time. What can the ice covered lakes of the frozen tundra reveal? Data on seven lakes in Vilas County reach back to the early 1980s. Information for Lake Mendota in Madison has been kept for more than 150 years. Art Hackett reports on drastic shifts in the length of time ice covers Wisconsin lakes. A good connection to local climate change issues. 7 minutes. | Video | Website | In Wisconsin, Wisconsin Public Television |
| **Understanding Lake Data**<br>If you do field study with your students on a lake, this 20-page PDF does a great job of explaining the data you may gather. Portions can be copied and used in lecture as well. The guide was written to help people understand information about lake water quality and to interpret lake data. It explains the physical and chemical compositions of different types of lakes. | Publication (PDF) | Download Document | UW-Extension |
| **The Physical Features of One Mile Creek**<br>This lab measures velocity, stream channel, ad discharge of a creek or stream. This lab was modified from: *Field Manuel for Water Quality Monitoring*, Mitchell and Stapp, 12th ed., Kendall Hunt Publishing. | Lab (MS Word) | Download Lab | Harv Hayden, Wisconsin Rapids School District |
| **Stream Water Testing**<br>Citizens monitor 6 water quality parameters in streams that can be waded into safely. They monitor: dissolved oxygen, temperature, transparency, flow, habitat, and Macroinvertebrates. WAV provides citizens assistance in setting up local stream monitoring programs, training to learn methods for monitoring, written methods, data sheets, and ongoing educational programming. | Lab activities and supporting website | Website | Water Action Volunteers (WAV), UW-Extension |
| **b. Estuaries** | | | |
| **c. Salt - oceans** | | | |
| **EarthTrends: Coastal and Marine Ecosystems**<br>Click on the link for Coastal and Marine Ecosystems to find a searchable database of statistics, maps, and country profiles of environmental, social, and economic trends that shape our world. Example information includes aquaculture production, fisheries distribution, marine based nutrition, and hypoxic zones. | Website | Website | World Resource Institute |
| **3. Groundwater** | | | |
| **Ground Water Atlas of the United States**<br>Describes the location, extent, and geologic and hydrologic characteristics of important aquifers in the US. Use the online version or order the print version. Includes maps. | Website | Website | US Geological Survey |
| **Groundwater Model**<br>This elaborate, plexiglass model demonstrates the flow of water and toxins through differing gradients. It can demonstrate flow through confined and unconfined aquifers as well as the effects of pumping on these aquifers. Very beneficial for visual learners and students with special needs. | Equipment | Purchase model-$400<br><br>Borrow from WCEE EE Resource Library | UW-Stevens Point Student Chapter of AWRA Note: Participants receive a free model at yearly trainings. Contact Kevin Masarick: Kevin.masarick@uwsp.ed |

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| **Groundwater Supply**<br>This website provides a nice background on how water moves underground and why. It is very student-friendly and has some interactive aspects. | Website | Website | Michigan Tech |
| **a. Models** | | | |
| **b. Aquifer** | | | |
| **c. Artesian well** | | | |
| **d. Water table** | | | |
| **e. Zones – cone of depression, recharge, saltwater intrusion** | | | |
| **4. Human use** | | | |
| **Calculating Water Use**<br>After learning about water use in the US, students use a water use calculator to determine their household consumption. Resources are provided for ideas on how to reduce water use. | Activity (PDF) | Download Activity | ESA21 |
| **How Water Works**<br>This website allows you to navigate through a 3-D visualization of a water supply system. Follow the process from source to tap including treatment, distribution, collection, sewage treatment, and reuse. You can explore the internal system of a water tower, home, treatment plant, etc. | Online Interactive | Website | American Water Works Association |
| **a. Historical use** | | | |
| **b. Use sectors – agricultural, residential, commercial (including fisheries), municipal, industrial** | | | |
| **Independent Lens: A Fish Story**<br>Fish Story is the tale of two women in a battle for the ocean. Angela Sanfilippo and Shareen Davis, born into fishing families, both married men who make a living from the sea. Their way of life is threatened when environmental organizations file a lawsuit that could put hundreds of fishermen out of business. This story finds the women at the center of a political storm as they try to save both fish and fishermen. Delving into the behind-the-scenes world of politicians, environmentalists, journalists, and fishermen, A Fish Story confronts the hard choices faced when human needs and those of the environment collide. | Video | DVD: $24.95 from PBS Educational Media | PBS |
| **Water Treatment**<br>Students learn about the history of drinking water treatment and current steps for water treatment in municipal water systems. They then create a filtering apparatus and monitor the changes in water as it moves through the treatment process. | Activity (PDF) | Download Activity | ESA21 |
| **c. Demands and consumption** | | | |
| **The Story of Bottled Water**<br>This online video discusses the quality, consumption, and consequences of using bottled water. You can download the video, images from the video, annotated script, and fact sheet to use for a classroom lesson and discussion. | Video | Website (free download) | The Story of Stuff Project |
| **5. Impacts of water use** | | | |

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| **Hidden Life of Bottled Water**<br>Article about the issues related to bottled water. | Online Article | Article Link | Sierra Magazine – Sierra Club |
| **Water Quality and Measuring the Health of Aquatic Ecosystems**<br>This handout provides background on point and non-point source pollution, biomaginification, eutrophication, using microinvertebrates for biotic index, and qualities of water that can be sampled. A set of review questions is also included. | Activity (PDF) | Download Activity | Craig Kohn, Waterford Union High School |
| **Water Taste Test**<br>Students taste test bottled water and tap water. They compare the cost, taste, and environmental impact of bottled vs. tap water. | Activity (MS Word) | Download Activity | Kathy Cady, Winneconne School District |
| **a. Shortages** | | | |
| **b. Salinization** | | | |
| **c. Pollution/contamination – point vs. non-point** | | | |
| **A Civil Action**<br>In this story, the families of children who died sue two companies for dumping toxic waste. The novel and movie provide a look at the legal and ethical issues associated with Superfund. The concepts of groundwater, contamination, and plume are reinforced in some of the movie frames, which can be used in short clips for class discussions. The activity can be used to assess your students' understanding of the steps needed to determine if a water source is contaminated, how it got that way, and suggest possible methods of cleanup or remediation. | Book, video, lessons | Book and DVD available from Amazon.com<br><br>Online Lessons | Jonathan Harr (book); Learn Inc., (lessons) |
| **Poisoned Waters**<br>This 2009 Frontline special investigates America's troubled waterways. Human impacts on the environment and health are illustrated through interviews and stories. Each 10 minute segment is organized around a question. The video can be downloaded from the website which also features teaching resources. | Video | Website (segments 3 and 4 focus on agricultural impacts on water) | Frontline, PBS |
| **Pond Critter Search**<br>In this lab, students collect microinvertebrates and classify them to determine water quality. | Lab (MD Word) | Download Lab | Cynthia Landers, Hudson School District |
| **Seas of Plastic**<br>Capt. Charles Moore of the Algalita Marine Research Foundation first discovered the Great Pacific Garbage Patch – an endless floating waste of plastic trash. Now he's drawing attention to the growing, choking problem of plastic debris in our seas. | Online video | Website | TED: Ideas worth spreading |
| **Troubled Waters**<br>This video (narrated by Edward Norton) shows amazing footage and testimony of what happens to water when pollution seeps (or in some cases is dumped) in. This is part of National Geographic's Strange Days on Planet Earth series. Internet resources are available as support material. Approximately 50 minutes in length. | Video | Website<br><br>DVD $39.95 at Shop PBS<br><br>Borrow from WCEE EE Resource Library | National Geographic |
| **d. Erosion** | | | |

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| **e. Waste management** | | | |
| **Wastewater Treatment**<br>Students read about the wastewater treatment process then take a virtual field trip to a wastewater treatment facility. | Activity (PDF) | Download Activity | ESA21 |
| **Wastewater Treatment Field Trip Worksheet**<br>This is a two page worksheet that students complete as they take a field trip of a typical municipal wastewater treatment plant. After the field trip, the teacher would provide the students with an explanation and/or diagram of how a rural residential septic tank system works. The students finish the worksheet by comparing and contrasting the two different systems. | Worksheet (MS Word) | Download Worksheet | David Bendlin, Milton School District |
| **f. Storm water/flooding** | | | |
| **Poisoned Waters**<br>This 2009 Frontline special investigates America's troubled waterways. Human impacts on the environment and health are illustrated through interviews and stories. Each 10 minute segment is organized around a question. The video can be downloaded from the website which also features teaching resources. | Video | Website | Frontline, PBS |
| **Storm water Presentation**<br>A presentation that helps students understand what storm water is, how it affects the environment, and ways we can reduce storm water. | Presentation | PowerPoint | Kathy Cady, Winneconne School District |
| **g. Water diversion** | | | |
| **6. Sustainable use of water/solutions** | | | |
| **Champions of the Public Trust**<br>This 28 minute video from the Wisconsin DNR uses historical photos, video, and interviews to explain the Public Trust Doctrine and a history of water use in Wisconsin. Learn how Wisconsin anglers and other citizens have fought to ensure tat Wisconsin lakes and rivers belong to all state residents, and to secure the public's right to clean waters, good fishing, scenic beauty, and other benefits in those waters. | Video | View online | Wisconsin Department of Natural Resources. |
| **The Treat Lakes Water Wars**<br>A great resource that describes water laws and how they have affected the crafting of the Great Lakes Charter. It contains several case studies illustrating water law succeeding in its purpose and sometimes failing. Helps students gain an appreciation for the complexity of water law. | Book | Website | Written by Peter Annin |
| **Poisoned Waters**<br>This 2009 Frontline special investigates America's troubled waterways. Human impacts on the environment and health are illustrated through interviews and stories. Each 10 minute segment is organized around a question. The video can be downloaded from the website which also features teaching resources. | Video | Website (segments 11 through 13 focus on development) | Frontline, PBS |
| **The Story of Bottled Water**<br>The Story of Bottled Water is an eight minute video that takes viewers on a provocative and eye-opening tour of the real costs of bottled water. This is a look into how "manufactured demand" pushes what we don't need and destroys what we need most. Done in cartoon style, this video catches students' attention. | Video | Website (free download) | Annie Leonard |

## Living Resources

1. Living Resources & Biodiversity
    a. Food
    b. Shelter
    c. Clothing
    d. Recreation
2. Levels of biodiversity
    r. Genetic
    s. Species
    t. Ecosystem
3. Distribution of biodiversity
    aa. Species distribution
    bb. Hotspots
4. Value of biodiversity
    p. Economic
    q. Aesthetic and spiritual
    r. Ecologic
    s. Intrinsic
    t. Recreation and health
    u. Education
5. Threats to biodiversity
    e. Habitat destruction, fragmentation, climate change
    f. Invasive/Non-native species
    g. Pollution
    h. Bioaccumulation and biomagnification
    i. Human population and growth
    j. Overexploitation and illegal trade
    k. Characteristics of extinction prone species

6. Classification of species
    k. Stable species
    l. Endangered species
    m. Threatened species
    n. Extirpated and extinct species
    o. Game/non-game species
    p. Invasive species
7. Protecting biodiversity
    f. Species vs. ecosystem approach
    g. Wildlife management
    h. Preservation/conservation/restoration
    i. Regulation
    j. Education
    k. Habitat management

| Living Resources & Biodiversity | | | |
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| **Biodiversity Webquest**<br>In this webquest, students visit the Biodiversity Project website, read specific information, and answer questions about the definition of biodiversity, its values, and its threats. | Activity<br>(MS Word) | Download Activity | Harv Hayden, Wisconsin Rapids School District |
| **EarthTrends: Biodiversity and Protected Areas**<br>Click on the link for Biodiversity and Protected Areas to find a searchable database of statistics, maps, and country profiles of environmental, social, and economic trends that shape our world. Example information includes protected areas, endemic and extinct species numbers, wildlife trade, and non-native species. | Website | Website | World Resources Institute |
| **Prairie Nursery**<br>Great place for a field trip. Prairie Nursery offers live plants and seeds of species native to the Midwest, whether for prairies, woodlands, or wetlands. Guided tours of the display gardens are available. Call to set up a visit 608-296-3679. Open April-October. | Field Trip | Website | Prairie Nursery, Westfield, WI |
| **1. Living resources** | | | |
| **a. Food** | | | |
| **b. Shelter** | | | |
| **c. Clothing** | | | |
| **d. Recreation** | | | |
| **2. Levels of biodiversity** | | | |
| **Defining Biodiversity**<br>A brief overview of the three levels of biodiversity | Website | Website | The Habitable Planet |
| **a. Genetic** | | | |
| **b. Species** | | | |
| **c. Ecosystem** | | | |
| **3. Distribution of biodiversity** | | | |
| **Bug Biodiversity**<br>The purpose of this outdoor lab is to measure the differences in biodiversity in different habitats by counting insects caught in pitfall traps. All instructions, data sheets, and questions provided | Lab<br>(MS Word) | Download Lab | Craig Kohn, Waterford Union High School |
| **a. Species distribution** | | | |
| **b. Hotspots** | | | |
| **Biodiversity Hotspots**<br>A brief overview of the biodiversity hotspots. | Website | Website | The Habitable Planet |
| **Biodiversity Hotspot Project** | Activity | Download | Margie Winter, Fond du |

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| Students research a biodiversity hotspot on the Internet in teams of two and create a PowerPoint presentation to teach the class about their hotspot. Each team writes four questions about their presentation (in advance) and submits them to the teacher who creates a worksheet with all the questions. Students in the audience answer the questions as they listen to one another and also have a study guide for the Hotspot quiz. | (MS Word) | Activity | Lac School District |
| **4. Value of biodiversity** | | | |
| **Medicine Man**<br>Medicine Man is a PG-13 movie about a scientist living in the Amazon rain forest who is involved in a search for a cancer cure. The movie presents more to the students than the need for a cancer cure. It presents the economics behind the search, how the search impacts the indigenous population, as well as the intrinsic, aesthetic, and spiritual importance of the rain forest. | Movie | DVD: $7.00 from Amazon | Walt Disney Video |
| **The Wolf that Changed America**<br>PBS Nature series video that chronicles the exploits of Ernest Thompson Seton as he attempts to rid an area of wolves that are preying on ranchers cattle. He meets his match in a wolf named Lobo and over a period of years chasing this wolf he acquires a new and deep respect for wolves and wolf behavior. He goes on to become a great leader in conservation and preservation and starts the Boy Scouts of America. Running time about 50 minutes. Additional supporting materials online. | Video | Watch Online | PBS |
| **a. Economic** | | | |
| **Economics, Trade and Incentive Measures**<br>This website provides an overview of the economic aspects of biodiversity. There are links to articles, scientific papers, and policy information. | Website | Website | Convention on Biological Diversity |
| **b. Aesthetic and spiritual** | | | |
| **c. Ecologic** | | | |
| **d. Intrinsic** | | | |
| **e. Recreation and health** | | | |
| **Preserving Health through Biological Diversity**<br>Students read a series of articles about the benefits of biodiversity, environmental affects on disease behavior, and human's activities affect biodiversity. They answer a series of questions that help them consider how the loss of biodiversity might affect human health. | Website | Website | Science NetLinks |
| **f. Education** | | | |
| **5. Threats to biodiversity** | | | |
| **Deformed Frogs**<br>Background, information, and photos related to deformed frogs in Minnesota | Website | Website | Minnesota Pollution Control Agency |
| **Where Did All the Frogs Go?**<br>This webquest explores the decrease in frog populations in Wisconsin and walks students through possible causes for this problem. Students explore frog anatomy, behavior, and a few proposed theories then draw their own conclusion. | Webquest | Website | Unknown (tied to WI Model Academic Standards) |
| **a. Habitat destruction, fragmentation, climate change** | | | |

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| | **Croak!**<br>This interactive mystery has students investigate the balance of a population of frogs within a fictional town. Students meet various characters to get the backstory, interview residents to find facts, submit a possible solution, and later find out the solution. Students investigate ecosystems and ecological balance, water pollution, natural and exotic invaders and predators. | Online Mystery | Website | Access Excellence |
| | **Habitat Loss: Causes and Consequences**<br>A brief overview of the causes and consequences of habitat loss. | Website | Website | The Habitable Planet |
| **b.** | **Invasive/Non-native species** | | | |
| | **A Field Guide to Terrestrial Invasive Plants in Wisconsin**<br>This photographic field guide provides basic information on the major terrestrial invasive plants in Wisconsin. Accompanying text describes species characteristics to aid in identification, characteristics to tell the invasive species apart from look-alike species and control information. | Field Guide (PDF) | Download Guide | Wisconsin DNR |
| | **Garlic Mustard Identification and Control**<br>This 13 minute video is a good introduction to invasive species. The 2009 video covers what makes the plant invasive, life cycle and identification, methods of control, and principles of control. It would be great to show to students prior to a Weed Out type activity. Video clip can be downloaded for free. | Video | Website | Wisconsin Family Forests |
| | **Invaders**<br>This video (narrated by Edward Norton) shows amazing testimony of the drastic effects of invasive species. The video is approximately 50 minutes long and there are internet supplements. | Video | Borrow from WCEE EE Resource Library<br><br>Video Website | National Geographic and Tanya Monet-Bakken |
| | **Invasion Ecology**<br>This is a guide for investigating the behaviors of non-native and native species. Studying invaders such as zebra mussels, chestnut blight, purple loosestrife, and Phragmites, you will explore how scientists are fighting these aggressors with biological controls. The Student Edition has three sections: Background on the science of ecology and its place in the control of invasive species; protocols that scientists use in monitoring invasive species; worksheets to guide you through your own research. | Book | $7.95 from NSTA | NSTA |
| | **Invasive Plant Species Education Guide**<br>This resource helps educators provide background and outdoor opportunities for students to learn about forest ecology and invasive species. The activities can be even more successful when you make connections with local experts to support your work. | Website | Website | UW-Stout |
| | **Invasive Species**<br>Information about aquatic and terrestrial invasive species in Wisconsin from the WI DNR. Resources include species information, videos, photos, etc. | Website | Website | Wisconsin Department of Natural Resources |
| | **Invasive Species Unit**<br>This unit introduces students to invasive species in Wisconsin and helps them explore their impact on biodiversity. The PowerPoint provides an overview of invasive species including examples in Wisconsin. The Student Notes Sheet gives questions to accompany the PowerPoint presentation. The Lab Activity allows student to identify and document invasive | Unit (MS Word) | Unit Organizer<br><br>PowerPoint<br><br>Student Notes | Craig Kohn, Waterford Union High School |

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| species across a transect. | | Sheet<br><br>Lab Activity | |
| **Invasive Wisconsin Plants**<br>In this activity, students use the Wisconsin DNR website to research invasive plants in Wisconsin then create a poster to share their information with the class. | Activity (MS Word) | Download Activity | Joyce Johnson, Reedsburg School District |
| **IPAW Speakers Bureau**<br>The Invasive Plant Association of Wisconsin offers a searchable database of speakers around the state who can address various invasive plant topics. | Guest Speaker | Website | Invasive Plants Association of Wisconsin |
| **Overview of Invasive Plants**<br>An easy to read explanation of invasive plants, why they are a problem, what to do about them, associated costs, and links to more information. | Website | Website | The United States National Arboretum |
| **Wisconsin Invasive Species**<br>In this activity, students use the Wisconsin DNR website to research invasive species in Wisconsin then create a PowerPoint to share their information with the class. | Activity | MS Word<br><br>WDNR Invasive Species Website | Kathy Cady, Winneconne School District |
| **Zebra Mussels**<br>Zebra mussel sighting locations are represented on this map. Moving the cursor back and forth over the year indicators on the control bar allows you to view the spread of this invasive species backward and forward in time. | Website | Website | National Atlas |
| **c. Pollution** | | | |
| **d. Bioaccumulation and biomagnification** | | | |
| **Bioaccumulation in the Great Lakes Fishery**<br>In a hands-on activity, students simulate a food chain of the Great Lakes by feeding and examining the levels of chemical compound accumulation as PCBs and methyl Mercury move through the chain. Activity adapted from the Project Wild activity "Deadly Links" by Steve Krings of Southwest HS in Green Bay and then modified by Pat Gain. | Activity (MS Word) | Download Activity | Pat Gain – West Allis – West Milwaukee School District |
| **e. Human population growth** | | | |
| **Visit the Human Systems – Population section for population-related resources.** | | | |
| **f. Overexploitation and illegal trade** | | | |
| **Sustainable Fishing**<br>This activity involves fishing with different catch methods as a way of demonstrating how technology allows for larger catches than the resource (population) can sustain. | Activity (PDF) | Download Activity | Environmental Science Teacher |
| **Windows on the Wild: Wildlife for Sale: An Educators Guide to Exploring the Wildlife Trade**<br>This middle/high school guide provides 15 lessons on wildlife trade. Grade appropriate reading is provided as an introduction to the topic. The Wildlife for Sale module examines people's relationship with wildlife and how this can affect biodiversity. | Activity Guide | Borrow from WCEE EE Resource Library | World Wildlife Fund |
| **g. Characteristics of extinction prone species** | | | |

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| **6. Classification of species** | | | |
| **a. Stable species** | | | |
| **b. Endangered species** | | | |
| **International Crane Foundation**<br>The International Crane Foundation in Baraboo, WI is a great field trip location for teaching about endangered species management, wetland ecology, habitat restoration, and the need for international cooperation. The education staff provides tours including a multi-media presentation and guided tour of the crane exhibit area. | Field trip and worksheet (MS Word) | Download Document | David Bendlin, Milton School District |
| **c. Threatened species** | | | |
| **d. Extirpated and extinct species** | | | |
| **e. Game/non-game species** | | | |
| **f. Invasive species** | | | |
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| | **Zebra Mussels**<br>Zebra mussel sighting locations are represented on this map. Moving the cursor back and forth over the year indicators on the control bar allows you to view the spread of this invasive species backward and forward in time. | Website | Website | National Atlas |
| **7. Protecting biodiversity** | | | | |
| **a. Species vs. ecosystem approach** | | | | |
| **b. Wildlife management** | | | | |
| | **Counting Heads**<br>This lab is used to calculate the number of whitetail deer in a study area. Background on wildlife population studies is included. Students count scat in a study plot to determine population. This was created based on a workshop from the Wisconsin DNR. | Lab<br>(MS Word) | Download Lab | Cal Geiger, Mayville School District. |
| | **Deer Management**<br>This activity is based on the problems that many urban areas are facing with the burgeoning urban deer herds. The students are divided into groups and each group represents a real group that has a vested interest in how the deer overpopulation problem will be solved. The groups range from PETA to the Safari Club. The students groups develop a management | Activity<br>(MS Word) | Download Activity | Charlie Frisk, Luxemburg-Casco School District |

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| | solution for the deer overpopulation problem and present their solution at a mock city council hearing. | | | |
| | **Habitat 3-D Design Model**<br>Students research the habitat needs of wildlife species in Wisconsin and create a habitat model that addresses those needs. Buy a 4x8 sheet of insulation board at Home Depot and cut into 2x2 squares. Supply paint and glue and have the students supply the rest of the model materials. | Activity<br>(MS Word) | Download Activity | Teacher, Bangor School District |
| | **SAK Model Simplified – Estimating Wisconsin Deer Herd Populations**<br>Teachers present the Sex-Age-Kill method of estimating herd populations (used by the Wisconsin DNR) through the PowerPoint presentation provided. Students follow the presentation with a packet of information which includes explanations and some sample calculations. Additional calculations for students to attempt on their own once teachers have reviewed the process are also included in the handout. | PowerPoint and Activity<br>(MS Word) | PowerPoint<br><br>Download Activity | Pat Gain – West Allis-West Milwaukee School District |
| | **Wild and Forever Free**<br>The story of Wisconsin wildlife management by the Wisconsin Department of Natural Resources. Explore the world of DNR wildlife biologists as they protect prairies, wetlands, and forests by managing the species that live there. 30 minutes. 2001. To obtain a copy, contact Mary Kay Salwey, State Wildlife Education Specialist. | VHS video | MaryKay.Salwey@Wisconsin.gov | Wisconsin Department of Natural Resources |
| **c.** | **Preservation/conservation/restoration** | | | |
| | **Gray Wolves, Gray Matter**<br>This guide contains twenty seven activities on wolf management, illuminating such complex topics as depredation (the killing or harming of livestock and domestic animals), shrinking wild lands, stakeholder interests, wildlife management practices, reintroduction, and the development of wolf management plans. | Activity Guide | Website | International Wolf Center |
| | **The Lorax**<br>Read or show the movies of the Lorax by Dr. Seuss. Use this handout to generate discussion and help the student critically analyze the characters and their roles. The Lorax illustrates how humans impact the environment through whimsical characters. | Activity<br>(MS Word) | Download Handout<br><br>Borrow from WCEE EE Resource Library | DeForest Area School District |
| | **REGI – Raptor Education Group, Inc.**<br>REGI is a non-profit organization that is dedicated to caring for injured birds, especially birds of prey, and to educating the public about wildlife issues. They offer tours using live birds or they can bring birds into your school. They are located 5 miles southeast of Antigo. | Guest Speaker | Website | REGI – Raptor Education Group, Inc. |
| **d.** | **Regulation** | | | |
| | **Independent Lens: A Fish Story**<br>Fish Story is the tale of two women in a battle for the ocean. Angela Sanfilippo and Shareen Davis, born into fishing families, both married men who make a living from the sea. Their way of life is threatened when environmental organizations file a lawsuit that could put hundreds of fishermen out of business. This story finds the women at the center of a political storm as they try to save both fish and fishermen. Delving into the behind-the-scenes world of | Video | DVD: $24.95 from PBS Educational Media | PBS |

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| politicians, environmentalists, journalists, and fishermen, A Fish Story confronts the hard choices faced when human needs and those of the environment collide. | | | |
| **Major Laws and Treaties**<br>A brief overview of the legal measures in place to protect biodiversity. | Website | Website | The Habitable Planet |
| **e. Education** | | | |
| **f. Habitat management** | | | |