The Integration of Place-Based Activities Related to the Fox River and the Great Lakes Watershed into the 5th Grade Science Curricula for the Unified School District of De Pere.

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Abstract

The purpose of this project was to design and implement place based activities into a 5th grade science curriculum related to the Fox River and Great Lakes Watershed for the Unified School District of De Pere in De Pere, Wisconsin. De Pere is in Northeastern Wisconsin, along the Lower Fox River.

As humans, our respect for the environment begins with connection to the living world, nature. Many children in this day and age must face the difficult challenge of maintaining that human connection to nature. With the advent of technology, in the way of computers, ipods, cell phones, video games and TV, children and adults in this world today are consistently less in tune with the natural world. It is the challenge of parents and educators alike to be present, and continue to foster children’s positive connections to the environment. For this reason, it is critical to integrate place-based activities into the 5th grade science curriculum in the Unified School District of De Pere.

To accomplish this task of integrating place-based activities into the 5th grade science curriculum, the researcher used knowledge of environmental education and experiences through coursework to rewrite the ecosystems unit for 5th Grade Science as well as incorporate place-based activities into the other existing science curricula: geology, energy resources, and weather. Wisconsin State Science and Environmental Education Standards, and District Benchmarks were used while the curriculum was being rewritten. A teaching partner and the researcher piloted the new science curriculum in the fall of 2008. The researcher was then responsible for training the 5th grade teaching staff of the Unified School District of De Pere on how to implement the new curriculum. The researcher met for two in-services in the late winter of 2009 to train the 5th grade staff.

The teachers implemented the new place-based curriculum in the spring of 2009. Feedback for improvement was generated through an anonymous survey as well as through grade level discussions. The curriculum that was implemented is most likely not the end product, but rather a spring board from which to continue incorporating the local environment into science curricula for the 5th Grade in the Unified School District of De Pere.
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Chapter 1

Introduction

As humans, our respect for the environment begins with connection to the living world, nature. Many children of this generation must work to maintain a connection to nature. It isn’t or hasn’t come as naturally as in past generations. The amount of “free-play” for children in the outdoors has lessened for a number of reasons. First is the advancement of technology, another the “fear” factor that many parent’s unknowingly instill in their children that nature is a place that one may get hurt or get taken. Third is simply the diminished amount of open green space readily available to children (Louv, 2005). A British study, referred to in the book The Last Child in the Woods by Richard Louv found that an average eight-year-old was more apt to recognize characters from the Japanese Trading Card Game Pokémon than from native species in the area in which they lived (Louv, 2005). It is the challenge of parents and educators alike to allow for more time and education for students to explore and learn about their local environment in their local environment. For this reason, it is critical to integrate place-based activities into the 5th grade science curriculum of the Unified School District of De Pere.

Water resource education and awareness has become more and more vital to the instruction of our youth as well as the greater population. This is especially due to the current state of our world’s environment. Many communities in the United States as well as around the world are experiencing a shortage of clean water. Much of this shortage has to do with an overuse of water reserves on earth. In other words, we as a human race are using more water than the water cycle can provide and restore within a watershed. There are high concentrations of populations near city centers that draw on the water supply in excess. Instead of realizing that an area is unable to sustain the growing population and making necessary moratoriums on new construction, cities and towns petition other nearby communities to tap into their water supplies. Recently this has also led to communities to contemplate crossing watershed boundaries. Another current water issue is non-point source pollution which means that the source of the pollution is unknown. Much can be attributed to leakages of underground storage tanks, agricultural run-off and fertilizer and pesticide applications. Point source pollution also continues to be a problem for our waterways. Point source means that the source of the pollution is known and directly enters the body of water.
A great deal of the damage to many of our waterways was done years ago, but the clean-up is still continuing. With so much pavement covering the earth’s surface, issues with water filtration through the groundwater system is also a huge concern. All of these issues make the need for water resource education even more apparent and urgent. Today’s youth need to be informed and educated about their own watersheds. This need to not only make informed decisions in the future but also to hopefully educate their parents and grandparents about what can be done today.

The local watershed that the City of De Pere is part of is the Lower Fox River which is part of the Lake Michigan and Great Lakes Watershed. The Fox River has a rich history of industry along its shores most specifically the paper industry in De Pere and the fishing industry of of Green Bay. The paper industry in combination with other possible causes has left the Fox River in a polluted state. In the early 1970’s polycarbonate biphenyls or PCB’s became widely used in the production of carbonless paper. The waste product of PCB’s was discharged into the Fox River in large amounts which has led to the current economic issue in the Fox River Valley today, water contamination clean-up. The PCB clean-up in the Fox River has since been considered a designated superfund site by the Environmental Protection Agency because of the contaminated sediment. It is a major economic and environmental issue in the Fox River Valley. The macro-invertebrates in the river consume levels of PCB’s while feeding on the bottom of the river, the fish eat the macro-invertebrates and people and ducks eat the fish. The PCB’s build-up or accumulate in the systems of these organisms and can magnify up to 10,000 times (Fox River Watch, 2007). This process is called bioaccumulation. The levels of PCB are highest in the final link on the food chain namely the humans, after the consumption of fish.

When referring to the word “watersheds”, it should be noted that a watershed can include both water and land assets from brooks and rivers to forests, farms and cities (Dobson and Beck, 1999). The Fox River is not the only important aspect within the watershed surrounding De Pere. The plant life, trees, insects and wildlife are also very important to the area. It is extremely important that children make a connection to the ecosystems just outside their classroom windows. That connection and their more keenly developed sense of place could lead to a more concerned and environmentally-active generation. For the reasons stated above, the 5th grade students in the School District of De Pere, could most definitely benefit from the implementation of place-based activities into the science curriculum, using the local watershed as an integrating context.
The Unified School District of De Pere is located in the City of De Pere. It is situated in Northeast Wisconsin, just south of Green Bay. The Lower Fox River separates the east and the west side of the city. De Pere is fortunate to be part of the Great Lakes Watershed with Lake Michigan a mere boat ride through the Bay of Green Bay or a drive of about 35 miles to the east. By definition, a watershed is a region that drains into a particular body of water such as a river, pond, lake or ocean (Dobson and Beck, 1999). De Pere is just south of the 45th parallel (45°N Latitude), which means it is about halfway to the North Pole from the Equator. At this point in our earth’s geologic history the elevation of the area in Northeast Wisconsin stands at about 500-600 meters above sea level (Dutch, 2008). To the east of the city lies the western edge of the Niagara Escarpment which is a band of thick Silurian Dolomite bluffs that resist erosion and extend from Niagara Falls in New York to just south of De Pere near the tip of Lake Winnebago (Dutch, 2008).

With so many areas in the United States in a water crisis, the De Pere area is fortunate to be part of one of the most abundant watersheds in the world, the Great Lakes. Even within the State of Wisconsin there are communities that are running out of freshwater resources and are seeking alternatives. Originally the water source for De Pere and surrounding communities was from a sandstone aquifer west of the city. This aquifer was no longer able to support the local need. Due to these communities, being a part of the Lake Michigan watershed, De Pere and others have been able this past year to obtain their freshwater from a pipeline called the Central Brown County Water Authority which directly connects to Lake Michigan in Manitowoc, Wisconsin.

**Goal of the Project**

The purpose of this project was to design and implement place-based activities into a 5th Grade science curriculum related to the Fox River and Great Lakes Watershed for the Unified School District of De Pere in De Pere, Wisconsin.

**Rationale**

Using the environment as an integrating context can not only result in positive effects in the classroom for both the students and the teachers. Teachers who are enthusiastic help develop enthusiastic teachers (Lieberman and Hoody, 1998). Learning about their local
natural environment develops a bond between teacher and student that is focused on the same objective, understanding their natural surroundings and local community (Lieberman and Hoody, 1998). In the study called *Closing the Achievement Gap*, it was also pointed out that as the teachers and students work together to learn through environment-based projects and problems, teachers and students begin to treat each other with more respect. As the researcher in this project, I personally feel a revitalized interest in my profession and as stated in the study “attribute it to a renewed interest in the subject matter” (Lieberman and Hoody, 1998).

**The Sub-Problems**

**The First Sub-Problem:**
Explore the existing k-12 science curriculum to determine what areas place-based activities and environmental education can be infused, most specifically grade 5, in the Unified School District of De Pere, and research the environment within the Fox River watershed.

To incorporate the outdoor environment around De Pere, it is important to conduct research about the geology of the local area, the Fox River, the Bay of Green Bay and the Great Lakes Watershed. It is also important to explore and experience teaching the existing 5th grade science curriculum for the Unified School District of De Pere to find areas where the local environment can be integrated into instruction.

**The Second Sub-Problem:**
Gain school administrative support for the implementation of place-based activities, related to the Fox River and Great Lakes Watershed into a 5th grade science curriculum for the Unified School District of De Pere.

It is essential to obtain support and approval to design and implement the revised curriculum and units from the principal at Foxview Intermediate School as well as the curriculum director for the Unified School District of De Pere.

**The Third Sub-Problem:**
Develop a 5th grade science curriculum infused with place-based activities related to the Fox River and Great Lakes Watershed for the Unified School District of De Pere.
In order to implement the place-based activities that connect the local environment, it is important to revise, and for some units rewrite, the 5th grade science curriculum. There is a need for all of the teachers to have a similar guide to help them through the process of implementation of the curriculum.

**The Fourth Sub-Problem:**
Implement the 5th grade science curriculum infused with place-based activities related to the Fox River and Great Lakes Watershed in my own classroom.
Prior to the training and implementation of the new place-based curriculum, I, along with my teaching partner, must pilot the rewritten parts of the curriculum into our own science teaching to better understand and clarify the written curriculum.

**The Fifth Sub-Problem:**
Train Staff to implement the 5th grade science curriculum infused with place-based activities related to the Fox River and Great Lakes Watershed.
In order to assure success of the launch of the new curriculum, it is imperative that the 5th grade staff be trained to implement the revised and rewritten science curriculum through organized staff in-service.

**The Sixth Sub-Problem:**
Evaluate and analyze the 5th grade science curriculum implementation.
After the 5th grade teaching staff implements the curriculum, it is necessary for the staff to fill out an informal, yet anonymous survey of what worked well and what could be changed, deleted or added to improve the new curriculum. It is important to analyze the evaluations, and revise the curriculum accordingly.

**Hypothesis**

The development and implementation of the 5th grade, place-based activities related to the Fox River and Great Lake Watershed will provide students in the Unified School District of De Pere with the educational experiences necessary to help them connect to their local environment and develop a sense of place.
Limitations

1. This study will not attempt to predict the level of implementation of the proposed activities, in each of the twelve 5th grade classrooms in the Unified School District of De Pere.

2. This study will be limited to the 5th grade level in the Unified School District of De Pere.

3. This study will not provide EE curriculum for the 5th grade level at schools outside the Unified School District of De Pere.

4. This study will not guarantee the continued implementation of the 5th grade EE curriculum and units by all teachers at the 5th grade level in the Unified School District of De Pere.

The Definitions of Terms

The City of De Pere  The city of De Pere has about 20,500 people within its boundaries, and is about 5 miles outside of Green Bay, Wisconsin. The City of De Pere is located on the shores of the Fox River. The Unified School District of De Pere is one of two school districts within the city. It is located on the East side of the Fox River. The other district is the West De Pere School District on the west side of the river.

Unified School District of De Pere  The Unified School District of De Pere is made up of 3 elementary schools, 1 intermediate school, 1 middle school, and 1 high school. The enrollment for the district is 3,554. It is located in the City of De Pere, and draws from the surrounding towns of Ledgeview, Morrison, Wrightstown, and Glenmore. The district is comprised primarily of middle to upper class families.
Current 5th Grade Science Curriculum The 5th grade science curriculum includes units on the following topics without activities based on the local area and the environment: Geology-(Movements of the Earth), Geologic History-(Fossils, Geologic Time, Erosion and Weathering), Energy Resources (Fossil Fuels and Alternative Energy Sources), Weather and Climate, and Ecosystems (Environmental Science).

Intermediate A term used in the name Foxview Intermediate School to refer to grade levels 5 and 6. It is the school between the elementary schools with grades K-4, and the middle school with grades 7 and 8.

Environment Around Foxview Intermediate School The natural environment around Foxview Intermediate School, where all the 5th grade classrooms are within the Unified School District of De Pere, include the Fox River across the street to the west and a small school yard with large maple trees and pine trees to the south.

Lesson Plan Format Lesson plans will include standards/benchmarks, procedures, assessments and extensions.

Place-Based Lessons that incorporate the students' local environment, which can help make the connection between learning within the classroom and the natural world.

Environment as an Integrating Context (EIC) Learning based on the EIC Model™ is about using a school's surroundings and community as a framework within which students can construct their own learning, guided by teachers and administrators using proven educational practices (SEER, 2009).

Einstein Project The Einstein Project is a nonprofit organization partnering with schools and communities to provide leadership and support for science education in Wisconsin. It offers 41 inquiry-based science units, developed by the Smithsonian Institution and National Academy of Sciences, to schools giving children the opportunity to learn by doing (Einstein Project, 2009)
Interdisciplinary The integration of a variety of subject areas within a lesson or unit.

Thematic An overarching theme is chosen to infuse into all lessons and units. For the purposes of this thesis the theme is the local environment the Lower Fox River/Lake Michigan Watershed.

Lower Fox River/Lake Michigan Watershed The watershed that is part of the larger Great Lakes Watershed. De Pere is part of the above watershed; and all the water in the region drains into the Fox River, Bay of Green Bay and eventually Lake Michigan.

Abbreviations

USDD is the abbreviation for Unified School District of De Pere.
FV is the abbreviation for Foxview Intermediate School.
EE is the abbreviation for Environmental Education.
EIC is the abbreviation for Environment as an Integrating Context.
EP is the abbreviation for the Einstein Project.
LFR is the abbreviation for the Lower Fox River Watershed.

Assumptions

1. The First Assumption. The first assumption is that there is a need for EE and EIC in the current 5th grade science curriculum at FV in DP.

2. The Second Assumption. The second assumption is that 5th grade teachers will be willing to implement the designed 5th grade interdisciplinary thematic EE place-based lessons and units in the years to come.

3. The Third Assumption. The third assumption is that 5th grade teachers, and students will be able to use the natural environment to execute aspects of the units and curriculum.
Chapter 2

Review of Literature

Current Status of Environmental Education at the 5th Grade level at Foxview Intermediate School in De Pere, Wisconsin

Environmental education should be a vital part of the curriculum in all schools. EE is only infused into the science curriculum in the USDD. According to the Wisconsin Administrative Code PI 8.01 (2) (K), EE should be integrated into K-12 curriculum plans with greatest emphasis on art, health, science and social studies education (Engleson & Yockers, 1994). At the 5th grade level, the areas which the researcher has focused on are science and social studies education although health and art are many times infused within the core curriculum in the classroom. The 5th grade science curriculum lends itself well to the infusion of EE in almost every unit of study: Geology, Energy Resources, Weather and Ecosystems. Specific standards in EE were developed in 1998, but are not enforced or monitored for implementation as EE is not a core area of study nor is it specifically addressed in newly mandated state testing (Engleson & Yockers, 1994).

Benefits of Place-Based Integration Into Existing Science Curriculum

Place-based education is defined as the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies and other studies across the curriculum. It emphasizes hands-on, real-world learning experiences (Sobel, 2004). By definition place-based education teaches about the natural and built environment, and one of the major objectives is to blend landscape, community infrastructure, economics, watersheds, history and cultural traditions together (Sobel, 2004). Place-based education uses a school’s surroundings and community as a framework within which students can construct their own learning (Sobel, 2004). When adapting existing curricular benchmarks to create a place-based focus, one must take into account the specific locale, resources and student needs to create players in their community ecosystem (Sobel,
Place-based education can prepare students for citizenship in their own community and beyond (Sobel, 2004).

In a fact sheet on student gains from place-based education, the Children, Youth and Environments Center for Research and Design, found studies to support major benefits to place-based education. One major benefit was evidence to support higher test scores and grades for students who experience a curriculum that is focused on place-based education (Chawla & Escalante, 2007). Students have been shown to demonstrate more advanced critical thinking skills, and greater motivation for achievement in academic areas (Chawla & Escalante, 2007). Another benefit stated in the study was that students who have experienced place-based instruction have shown more responsible behavior in the classroom and community and better attendance (Chawla & Escalante, 2007).

The Tbilisi Declaration, which was the world’s first intergovernmental environmental education conference, created goals and objectives for the education of the environment on national, regional and global levels (UNESCO, 1977). The 3 major goals tie closely to the purpose for integration of place-based educational experiences into existing curricula. The goals include: fostering clear awareness of and concern about economic and social, political and ecological interdependence in urban and rural areas; providing every person with opportunities to acquire the knowledge, values and attitudes, commitment and skills needed to protect and improve the environment; creating new patterns of behavior of individuals, groups and society as a whole towards the environment (UNESCO, 1977). The objectives for environmental education put together at the Tbilisi Declaration began with awareness, knowledge, attitudes, skills, and finally ended with participation. These goals and objectives directly connect as benefits of place-based curricular integration.

**Importance of Using the Environment as an Integrating Context for Learning**

The Environment as an Integrating Context (EIC) has shown positive results for both teachers and students alike. According to an article, called *Closing the Achievement Gap*, many teachers report a renewal of interest in their profession and primarily accredit it to a renewed interest in the subject matter and the chance to explore new instructional methods (Lieberman & Hoody, 1998). There is also an increase in the motivation and involvement of the students in their own learning which in turn improves the interactions between students
and teachers as well as teachers with fellow colleagues. EIC provides added opportunities for professional development and personal growth for educators (Hoody & Lieberman, 1998). This is a learner-centered approach to infusing the environment into teaching which allows educators to be able to be learners along with their students.

EIC can be connected to the constructivist philosophy of teaching in that both require students to take an active role in learning and building on factual knowledge to improve investigation and critical thinking skills (Klein & Merrit, 1994). When the National EE Act passed in 1990, there was a reemphasis on the need to increase public understanding of the natural environment and to advance and develop EE and training (Klein & Merrit, 1994). EE infusion promotes constructivist teaching philosophies by regularly incorporating the four main constructivist teaching components: real life problems, student centered, productive group interaction and authentic assessment and demonstration of student progress. If constructivist philosophies and EE are infused wholly, student participation is encouraged by allowing the students to help determine the nature of the experiences in which they are involved (Klein & Merrit, 1994).

According to the Association for Supervision and Curriculum Development (ASCD) educators have a responsibility to help students understand the ecosystem where they live and the impact humans have on it (ASCD, 2000). This in itself is an important reason for schools to incorporate EE, but it is necessary that they have a scope and sequence so children don’t learn about the same things year after year while other topics are never covered. EE doesn’t add another layer to curriculum. It becomes the fabric that holds curriculum together. The statement above is a crucial element to the training of the educators who will be asked to integrate EE into their curriculum. In this time of more and more requirements asked of educators, it is commonly assumed that there will be more added to their “plate”, but in essence EE can bind their subject matter together. The environment can affect us in terms of health, loss of aesthetics and economics. For these reasons, it is not something that should be optional as far as curriculum integration (ASCD, 2000).

The EIC is reinforced in the Guide to Curriculum Planning in Environmental Education, by Engleson and Yockers (1994). They state the “preparation of world problem solvers is not only the responsibility of EE, but all education.” It is important to consider all aspects of the environment: natural, built, technological and social and their interdependence (Engleson & Yockers, 1994). It is important to form the link that the actions of today affect the future. Thus students will become more likely to be stewards of their environment as
adults. EE must be continuous, and it should be spread across all subject areas and must offer students experiences that are concrete and direct as possible (Engleson & Yockers, 1994). The incorporation of the EIC will help to develop an environmental ethic, responsibility, and commitment to the future.

The North American Association for Environmental Education in partnership with the National Environmental Education Training Foundation stated in a report in 2001 that the adoption of environment-based education can “help produce high-performance lifelong learners, effective future workers and problem solvers, thoughtful community leaders and participants, and people who care about the people, creatures, and places around them” (NAAEE and NEETF, 2001). The report goes on to state that using the environment as a basis for education provides opportunities for hands-on learning, critical thinking skills, cooperative learning, involvement in “real” world issue-based projects as well as action skills and strategies (NAAEE and NEETF, 2001). All of these lead to the development of leaders in their neighborhoods, schools, communities and their environment.

Importance of Watersheds as an Integrating Theme for Teaching Environmental Education in the 5th Grade Curriculum at Foxview Intermediate School

The decision to use the environmental theme of watersheds for the basis of the place-based curriculum came primarily from the obvious importance of the Fox River in the city of De Pere. The river runs through the center of the city. The Fox River has a rich history of industry along its shores most specifically the paper industry in De Pere, and the fishing industry of Green Bay and Lake Michigan. Beginning in the later 1800’s, the lower Fox River grew to become home to the largest concentration of paper production plants in the world. Sediments from pollution in the lower Fox and the Bay are known to contain over 100 known or potentially toxic substances including PCB’s, dioxins, mercury, lead, and other heavy metals. PCB’s cause the greatest risk to public health. The Environmental Protection Agency designates “Areas of Concern” along the Great Lakes, and the Fox River is one of them. The EPA charged the Wisconsin Department of Natural Resources with the responsibility to develop a Remedial Action Plan for the clean-up of the Fox River in 1987 along with a multi-stakeholder partnership with many agencies (EPA, 2009). Over 120 recommendations were made to restore the waterway and the surrounding watershed from building boat launches to cleaning up the PCB contamination in the Fox River sediment.
Since then, there have been some major steps taken towards the clean-up of the Fox River. Dredging equipment has begun operation in the Fox River in De Pere, and an area along the River in Green Bay as has been set aside for the collection and transportation of the dredged material. A facility has been built along the shores of the Fox River where the sediment will be “dewatered” or drained, and the water will be treated before it is returned to the river (Pastor, 2008). The remaining sediment will then be transported to a landfill. Obviously, this is only a step in the right direction. It’s not a complete solution to the environmental issue.

This problem alone makes it an important environmental issue of study for the students of the USDD, but the river is also part of the Lake Michigan/ Great Lakes Watershed. De Pere is fortunate to be a part of such a water rich watershed. Water in terms of its abundance is not a concern for the citizens of the area. On the other hand, the contamination and conservation of the watershed is of vital importance to the children of the USDD, even though they may not be aware of this as of yet. The conservation and clean-up of the watershed and all the components in it such as the water, wildlife, soils and humans is an imperative environmental issue for the children and adults of De Pere. Actions of today will affect Wisconsin’s waters in the future whether we take time to consider their effects or not (WASAL, 2003).

**Existing Resources in Environmental Education and Watersheds as an Integrating Theme for Curriculum**

There is a strong need for water resources education for our generation’s youth. There are many water resource issues facing our local area and the State of Wisconsin as well as many regions in the United States, these issues range from water contamination and invasive species to water shortages and flooding. According to the Environmental Resources Center (ERC) of the UW Extension Office in Wisconsin, today’s youth have the power to act as catalysts for change and “guide development of future activities to ensure the health of the nation's drinking water sources” (ERC, 2009).

There are many existing curriculum guides that incorporate not only the environment but also watersheds into science teaching. Many of these guides were used to develop the 5th grade place-based science curriculum for the USDD. The first is *The Great Lakes in Our World* activity guide, is a curriculum written for K-8th grade focusing on the Great Lakes as a
watershed and an ecosystem. It provides not only activities but also a lot of useful pictures, and appendices. It is tailored to students and teachers in the Great Lakes Watershed (Smith & Richardson, 2005).

The next guide that was used in the development of lessons for the curriculum is The Groundwater Study Guide developed by the Wisconsin Department of Natural Resources. It was written to provide activities focused on groundwater and contamination issues. The lessons are written to include visuals and hands-on activities that address topics such as: How Groundwater Moves, Household Water, Groundwater Contamination, and Hazardous Wastes (Temte, 1990).

The Economics and the Environment Activity Guide provides lessons that focus on economic concepts coupled with environmental issues. There are lessons that address common case studies in the area of environmental issues. These lessons are written to attend to a variety of learning styles from group work and presentation to hands-on activities (Schug & Morton, 1999). A few of the activities directly connect to watersheds as an integrating context.

A curriculum, titled Wisconsin River of Words, an Educator's Guide, contains activities that help students map their watershed. It provides wonderful learning opportunities for students to see how their watershed fits into Wisconsin’s watersheds as well as the Great Lakes Watershed. The curriculum guide incorporates writing and drawing as a way to explore the students’ surrounding environment. (Pardee, 2004)

Another very useful resource is the Great Lakes Information Network’s TEACH curriculum which is sponsored by the Great Lakes Commission through a grant from the Environmental Protection Agency. TEACH is a K12 curriculum which offers a lot of online information about the Great Lakes as well as graphics, pictures and videos. It focuses on the categories of environment, history and culture, business, geography and pollution. Lesson plans are provided online, and there are lists of links related to the Great Lakes (TEACH, 2009). The Great Lakes Information Network was started as a partnership that provides an online place for people to find and post information with regard to the Great Lakes. Finally, the Project WET curriculum guide contains many useful activities all that deal with water and watersheds (Higgins, Kesselheim & Robinson, 2005). It provides correlation to standards, grade levels and a variety of modifications and extensions. Many of the activities/lesson plans have multiple parts and vary in difficulty. The activities are hands-on, student friendly and written very clearly.
Chapter 3
Methodology

The First Sub-Problem:
Explore the existing K-12 science curriculum to determine what areas place-based activities and environmental education can be infused, most specifically grade 5, in the Unified School District of De Pere, and research the environment within the Fox River watershed.

The first sub-problem for the accomplishment of this project is to research information on the Lower Fox River Watershed, Lake Michigan/Great Lakes Watershed, and the geology and the history of the area of De Pere in Northeastern Wisconsin. It will also be imperative that the researcher experience teaching the existing 5th grade science curriculum as a teacher in the Unified School District of De Pere. At the onset of the researcher’s graduate work, the researcher was transitioning from a 5th grade teaching position in the Port Washington School District to a position in the USDD. It is important that the researcher experience what is already set in place for the 5th grade science curriculum to be able to recognize where the needs for revision and integration of the environment are most evident.

- Research history and status of the Lower Fox River/Lake Michigan Watershed. Participate in the Water Resources at UWSP Summer of 2006
- Find access point to Fox River and the Bay of Green Bay, and explore the shores of the Fox River and Green Bay. Summer 2006
- Research the Geologic History of the Area. Participate in the Environmental Geology for Educators at UWSP Summer 2008
- Experience and teach using existing 5th Grade USDD Curriculum. September 2006-May 2008

The Second Sub-Problem:
Gain school administrative support for the implementation of place-based activities, related to the Fox River and Great Lakes Watershed, into a 5th grade science curriculum for the Unified School District of De Pere.
The second sub-problem is for the researcher to gain administrative support for the development and implementation of the place-based activities into the 5th grade science curriculum.

- Gain approval from USDD school administration.
  Set up a meeting with Principal of Foxview Intermediate School.
  Spring 2008-Winter 2009

- Gain approval from USDD Director of Curriculum and Instruction
  Set up a meeting with Director.
  Spring 2008-Winter 2009

The Third Sub-Problem:
Development of the 5th Science Curriculum infused with place-based activities related to the Fox River and Great Lakes Watershed for the Unified School District of De Pere.

The third sub-problem is the development of the new 5th grade place-based science curriculum. After approval is given by the administration at the USDD, the next step in the process is to begin writing the new place-based activities primarily focusing on the infusion of the activities into the current Ecosystems Unit. The writing process will begin in the summer of 2008.

- Research EE curriculum materials that can be made available to 5th grade teachers.
  Explore Wisconsin Center for Environmental Education (WCEE), materials gained from University of Wisconsin Stevens Point-Environmental Education Graduate Program Coursework, Environmental Education curriculum guides, internet, current Foxview resources, and local organizations.
  Fall 2007- Spring 2008

- Develop curricular lessons and units with the place-based activities, using the Environment as an Integrating Context. Explore WCEE Library, the internet, current Foxview resources, local organizations, staff within the district.
  Summer 2008

The Fourth Sub-Problem:
Implementation of the 5th Grade Science Curriculum infused with place-based activities related to the Fox River and Great Lakes Watershed in my own classroom.

The fourth sub-problem is the implementation of the 5th grade place-based science curriculum in the researcher’s classroom. The researcher will ask a teaching partner/colleague to pilot the curriculum at the same time, in the fall of 2008. The curriculum will follow a three week unit on waste removal, recycling, landfills and
composting. It will then continue with the implementation of the Place-Based Ecosystems unit in order to work out any possible concerns. The researcher will work closely with a teaching partner/colleague to get feedback on the unit from an outside perspective before making final improvements.

Implement curricular lessons and units with the place-based activities, using the Environment as an Integrating Context
Fall of 2008

The Fifth Sub-Problem:
Train the USDD 5th grade teaching staff to implement the 5th grade science curriculum infused with place-based activities related to the Fox River and Great Lakes Watershed.

The fifth sub-problem involves the training of the 5th grade staff in the USDD through inservices in the winter of 2009. A pre-survey will be created to provide the researcher with needed information about the background knowledge of the USDD 5th grade staff in regards to EE and local environmental issues. The staff will need to be trained on how to implement the new place-based activities into the 5th grade science curriculum, most specifically in the Ecosystems Unit. The staff will need to be provided with the resources for the curriculum which will include needed materials to gain some background knowledge on topics within the curriculum. The staff will implement the new 5th grade place-based science curriculum in April and May of 2009.

Conduct staff development in-services on the new 5th Grade Science curriculum Late Winter 2008-2009

Implement curricular lessons and units with the place-based activities, using the Environment as an Integrating Context Spring 2009

The Sixth Sub-Problem:
Evaluate and analyze the implementation of the 5th grade science curriculum, infused with place-based activities related to the Fox River and Great Lakes Watershed.

The sixth sub-problem is the evaluation and analysis of the curriculum implementation. The researcher will provide a post survey asking for feedback on the implementation of the curriculum. This post-survey will be quantitative in nature and will be a series of questions
which will ask those surveyed to provide written responses. After responses are analyzed, the revisions of the curriculum will take place.

- Create a pre-survey for the 5th grade staff to evaluate the implementation of the 5th Grade Science place-based activities using the EIC Model. Spring of 2009

- Create a post survey for the 5th grade staff to evaluate the implementation of the 5th Grade Science place-based activities using the EIC Model. Spring of 2009

- Analyze the results of the pre and post surveys, and revise/improve the place-based science curriculum for use in the upcoming years, based on suggestions offered by the 5th grade staff.

- Make recommendations to USDD regarding the place-based program in the 5th grade science curriculum.

**Project Timeline**

- Summer 2006: Research the history of the Fox River and Great Lakes Watershed. Find access point to Fox River and the Bay of Green Bay that possible field trips could be conducted. Explore the shores of the Fox River and Green Bay.

- Fall 2006-Spring 2008: Experience and teach the existing 5th Grade Science Curriculum.

- Fall 2007-Spring 2008: Research EE curriculum materials available.

- Spring 2008: Gain Approval from USDD school administration and curriculum director.

- Summer 2008: Research the geologic history of the area within the Fox River watershed.

- Summer 2008: Develop place-based watershed lessons using the EIC Model.

- Fall 2008: Implement place-based watershed lessons into the researcher’s 5th grade classroom.

- Winter-Spring 2009: Create a pre and post survey to be given to 5th grade science teachers who will be trained and implementing the place-based 5th grade watershed lessons.

- Winter- Spring 2009: Conduct staff development in-services on the place-based watershed activities for the 5th grade science curriculum.
Spring 2009: Analyze the results of the evaluation, and revise/improve the place-based science curriculum for use in the upcoming years, based on suggestions offered by the 5th grade staff.

Spring 2009: Make recommendations to USDD administration regarding the place-based 5th grade science curriculum.
Chapter 4
Results

The First Sub-Problem:
Explore the existing K-12 science curriculum to determine what areas place-based activities and environmental education can be infused, most specifically grade 5, in the Unified School District of De Pere, and research the environment within the Fox River watershed.

After interviewing a few teachers in the USDD early on in the project in 2006, it was expressed that there was an overall lack of knowledge of EE and initiatives towards its integration. Many teachers seem unaware of the Wisconsin EE Standards, thus do not feel any obligation to implement the standards into the curriculum. The high school teacher I interviewed, who is an Environmental Science Teacher, expressed that she was concerned that the district is getting so big that it is hard to communicate across grade levels and subject areas. She was also very concerned about the lack of implementation of EE at the elementary/middle levels. After having taught in the USDD for the past 3 years, I too, share her concerns, it is hoped that after the integration of the new place-based 5th grade science curriculum, the elementary students in the USDD will at least have some background in EE.

The existing 5th grade science curriculum was separated into 4 major units: geology, energy resources, weather and ecosystems. The unit that seemed most plausible for EE integration was ecosystems. The existing ecosystems unit was outsourced from the Einstein Project of Green Bay. The Einstein Project is a non-profit organization that develops hands-on science units for schools to purchase and utilize on a yearly basis. The Einstein Project has developed a variety of units on different science themes. The ecosystems unit is the one that the 5th grade teachers were using. The teachers were trained in a 1 day in-service by a volunteer from the EP. They then were given the educator’s guide prior to the implementation of the unit. The curriculum for the EP was not locally based on the environment surrounding Green Bay and Northeast Wisconsin, and the Fox River Watershed or the Great Lakes were never mentioned. It primarily was based around the hands-on project for the students to create an Eco-Column which included a terrarium and an aquarium, with the addition of live plants and animals. It included a lot of student involvement at the onset, but after the Eco-Column was created, the lessons did not have much educational value or connection to the students’ local environment. For example, the
environmental case study that was incorporated into the curriculum was surrounding the Chesapeake Bay Watershed in Maryland and Virginia, many states away from the students at FV (EP, 2009).

After two years of implementing this existing ecosystems curriculum for the researcher, and many more years for the rest of the USDD 5th grade teaching staff, discussion and decisions were made that a new and improved curriculum was necessary, one which was based on the local environment. This curriculum should include lessons that engaged students’ thinking about the watershed around them as well as get them outdoors.

Research regarding the local environment in the Fox River watershed primarily came through graduate coursework. The projects that were completed for coursework related closely to gaining more knowledge about the local environment around the school and the Fox River Watershed. Courses covering Water Resources Education, Environmental Geology, Community Resources in Environmental Education, as well as Ecology, Environmental Issues and Forestry Education helped to gain a much better understanding of the watershed. Research into the philosophy of the place-based education, as well as the model for the Environment as an Integrating Context (EIC), also assisted the researcher in gaining background knowledge into why EE integration is so important. The Fox River watershed has a fortunate connection to the Lake Michigan/ Great Lakes watershed. There is an abundant amount of water resources within this watershed, and it is extremely important to conserve and preserve this resource. The Fox River watershed has a rich history for fish and wildlife habitat as well as water recreation and transportation. The watershed has had its share of issues with PCB contamination in the water Fox River itself as well as contamination of the air from the local industry. Problems with invasive species in the waterways such as Eurasian water milfoil, zebra mussels and sea lamprey are all evident as issues in the Fox River watershed. On land, within the watershed, issues include groundwater contamination due to non-point source pollution. Urban sprawl and development and issues with the gypsy moth infecting oak trees in the neighborhood are also evident around the school.

The Second Sub-Problem:
Gain administrative support for the implementation of place-based activities, related to the Fox River and Great Lakes Watershed into a 5th grade science curriculum for the Unified School District of De Pere.
Fortunately, this was a very smooth endeavor, as the need for curriculum improvement was evident to not only the teachers but also the administrators. The principal of Foxview Intermediate School up until that time was transitioning into the role of Curriculum Director for the USDD, and the assistant principal of the school was transitioning into the role of principal for the school. The researcher had spent the past 2 years working with the administration as a teacher, but also as a key member of the school's science committee. A meeting was set up with the administrators, and the need for a restructured Ecosystems unit was discussed as well as the need for more place-based activities integrated throughout the existing science curriculum. It was decided that the researcher would work to re-develop the ecosystems unit over the summer, pilot it in the researcher’s own classroom, and then train the 5th grade teaching staff for the USDD on the implementation of the curriculum. This meeting took place in the spring of 2008. After the curriculum was re-written, another meeting was set up in the winter of 2009 to discuss the implementation process as well as approval of the proposed re-developed curriculum.

The Third Sub-Problem:

Development of the 5th grade science curriculum infused with place-based activities related to the Fox River and Great Lakes Watershed for the Unified School District of De Pere.

After much research, experience and course work in Environmental Education, the integration of place-based activities into the 5th grade science curriculum began. One piece of this integration process was to begin re-writing the Ecosystems Unit for 5th Grade Science curriculum along with incorporating place-based activities into the other existing science curricula: Geology, Energy, and Weather. Wisconsin State Science and Environmental Education Academic Standards, and District Benchmarks were used during the writing process.

This new place-based science curriculum was organized around the 4 essential elements of an ecosystem: sun, water, soil, and living things (table 4.1). In addition to these 4 essential parts, there was a section on local environmental issues in the form of brief case studies, an issue investigation into the PCB contamination of the Fox River and the effects of that contamination. Activities include experiential learning both in the outdoors and within the classroom.
Table 4.1: Elements of an Ecosystem

**Sun and Air**
- Make up of Air
- Atmosphere
  (**Review Only
  Topics Covered in
  Weather Unit)**

**Soil**
- Geology
  (Information
  Should be
  Covered in
  Previous Unit)
- Soil Horizons

**Water**
- Water Cycle
  (Review Only)
- Watersheds
- Bodies of Water
- Groundwater
- Water Contamination

**Living Things**
- Needs
- Populations
- Interactions
- Relationships

**Humans**
- Effects on Ecosystems
- Negative: Pollution/Contamination
- Positive: Action
- Field Experiences
Through the 4 essential elements of an ecosystem, the curriculum brings in the local environment. For example when studying living population interactions, the students study how the introduction of the invasive gypsy moth affects oak trees in a local park. This included a visit by the local city forester and a study of the trees in the schoolyard around FV and a local park.

The unit also incorporates many lessons primarily focusing on water, and water resources in the local environment. The students experience the use of a groundwater model, as well as lessons to help map their own watershed, and explore where their own water comes from. A few years ago, the researcher and a fellow colleague participated in a seminar to learn how to teach using a “Groundwater Model” put together by students at University of Wisconsin-Stevens Point. With the agreement to use the model in our classrooms and share it with our fellow teachers, we were given a model for use in our home districts. Along with this, the researcher used the *Groundwater Study Guide* which provided some activities to partner with the model (Temte, 1990).

The students also are afforded the opportunity to explore local water resources within the Fox River watershed through a field trip to a local lake and pond in the Brown County area. The Fox River itself was used to do water testing and a macro-invertebrate sampling. Overall, the study of ecosystems in the new 5th grade science curriculum uses the environment as an integrating context and incorporates lessons based on the local environment in the Fox River Watershed.

The development process included the use of a variety of activity guides focusing on Environmental Education and most specifically activities that focused on water and the Great Lakes and Fox River watershed. As a basis for understanding watersheds, the researcher made the use of a watershed mapping activity in the *Wisconsin River of Words Educator’s Guide* (Pardee, 2004). This activity set the foundation for the students knowledge of what a watershed is, identifying with their own Fox River Watershed.

The next activity guide included in the development of the unit was *Project WET* (Higgins, Kisselheim & Robinson, 2005). *Project WET* is primarily focused on water. The activities that the researcher utilized from this guide relate to the water cycle, water pollution and stream flow. This guide was very practical, and there were many more activities that the researcher was unable to include due to lengthiness of the unit, and the time frame in which it is to be taught.
Another activity guide that the researcher used was *Great Lakes in My World* (Smith and Richardson, 2005). It is a compiled grouping of lessons associated with the Great Lakes Watershed, its people, animals, plants, water and beaches. The researcher used a few lessons from the guide that related to invasive species and population interactions within a watershed as well as a lesson that has to do with the idea of bioaccumulation. Bioaccumulation is the process by which the PCB’s increase in the bodies of the Fox River’s organisms. The researcher also used the Great Lakes creature cards that the activity guide provided.

Finally, *Economics and the Environment Activity Guide* was used to provide extensions to a few lessons in the curriculum (Shug & Morton, 1999). These activities help accomplish a lack of attention given to economics standards in the overall 5th grade curriculum in the Unified School District of De Pere. Each activity from this guide is centered on an environmental issue that is addressed in the place-based curriculum. If effectively included in the teaching of the unit, the students would get an additional perspective with the environment and the economy.

**The Fourth Sub-Problem:**

**Implementation of the 5th grade science curriculum infused with place-based activities related to the Fox River and Great Lakes Watershed in the researcher’s own classroom.**

The implementation of the 5th Grade Science Curriculum infused with place-based activities occurred in the fall of 2008. The researcher and a 5th grade teaching colleague piloted the newly revised 9-week long place-based ecosystems curriculum to work out any unforeseen issues or revisions. Throughout this process the researcher began collecting the needed supplementary materials to execute the lessons and put together bins from which teachers would be able access needed materials for the lessons. The pilot went very well. The researcher did notice that some lessons took longer than expected and thus adjustments were made to the final draft. The students seemed genuinely interested in the subject matter in the place-based curriculum, and in the activities that were used to help convey the objectives. The students seemed to be inspired to discuss the concepts and issues that were presented throughout the unit, especially when the lessons pertained to their local area. They were actively engaged in the activities, seemed to approach science class throughout the unit with positive outlooks.
A major emphasis was placed on the study of watersheds, and most specifically the Fox River watershed. Watersheds were the basis for the incorporation of the place-based activities, as all that occurs in a place occurs within a specific watershed. The researcher had implemented some of the lessons on watersheds in the past, but not in conjunction with the concepts put together in the newly revised curriculum, thus it should be noted that the researcher felt that the students understanding and learning increased when the lessons were incorporated one after another. Each lesson seemed to fit nicely in a logical order, and help the students scaffold their knowledge from one concept to another.

The place-based curriculum is outlined in Table 4.2. The place-based ecosystems curriculum started out with a lesson in which the students mapped their special outdoor place, and then the class went on a walk around the school and mapped the school ecosystem. When they returned from the walk they labeled the non-living and the living elements of their ecosystem. The purpose for this Lesson 1 was to define what an ecosystem is, and help students connect that an ecosystem can be right outside your back door or it could be as large as a biome. The students really appreciated the ability to draw and make observations of the outside schoolyard. They were simply excited to be out of the classroom and in the out of doors. This lesson was the foundation for the 9-week unit, because it provided the basis for what an ecosystem is composed of. The next couple of lessons help build on the essential factors in an ecosystems and being able understand how ecosystems are classified. Lesson 4 begins the integration of the water and watersheds, there is a review of the water cycle through an activity called the Incredible Journey developed by Project Wet, and again the students were asked to map their own watershed (Higgins, Kisselheim & Robinson, 2005). The students seemed to really enjoy this lesson, and wrote up a paragraph about what they had learned from their experience, and it appeared that the students had truly grasped the concept of a water cycle at a higher level. From there the lesson proceeds to spend time exploring the varied bodies of water, including groundwater. The students were very interested in the groundwater model as way to display groundwater flow and contamination. Lesson 5 focused on human effects on watersheds. After this lesson the class went on a field trip to a lake and a pond within the watershed to explore the bodies of water, and investigate macro-invertebrates in the specific aquatic ecosystem. In the days following the field trip the students experienced studying the biotic or living factors in an ecosystem. The students used the knowledge gained from the field-trip to connect with the concepts being learned in the classroom. During the study of animal population interactions,
the students studied endangered species, and they focused on those in Wisconsin vs. those in
the world outside of Wisconsin to connect to the local area. The next field trip that the
students participated in was a walk to the local park to meet the city forester who worked
with the students to learn about invasive gypsy moth species as well as the emerald ash borer
(Lesson 11). On the field trip the students also worked with the forester to do tree
identification in the park, and their assignment for home was to identify the trees in their own
backyard. We also identified the trees in the school yard as a preparation for the field trip.
This lesson was a great link to the local watershed and community, and it allowed for a
partnership with the city forester. Lesson 12 focuses on environmental case studies that are
prevalent in the local area for example: hunting and population control, urban development
and habitat destruction. The curriculum concludes with Lesson 13 an environmental issue
investigation that focuses on the PCB contamination issue in the Fox River. The students
walked to the Fox River to conduct some basic experiments in the river. They truly seemed
passionately concerned about the local waterway, and the contamination. The class had
many in depth discussions, with some great questions and concerns.

Table 4.2:
Place-Based Ecosystems Curriculum

• Lesson 1: What is an Ecosystem? ............................................................. 3-4
  *Extension Lesson: Economic Standard Link “Romancing the Past”
• Lesson 2: Climate Zones and Biomes ......................................... 5-7
• Lesson 3: Sun/Air/Soil - Water-Abiotic Factors ............................. 8-9
• Lesson 4: Ecosystem Address .................................................. 10-13
  ~Watersheds
  ~Bodies of Water
  ~Groundwater
• Lesson 5: Human Effects on Watersheds .................................... 14-17
  ~Sum of Parts - Waterway Contamination
  ~Groundwater Model - Groundwater Contamination-Non-Point Source Pollution
  ~Pucker Effect - Point Source Pollution
• Lesson 6: Organization of Living Things-Biotic Factors ............... 18-20
• Lesson 7: Basic Needs/Food Chain ........................................... 21-23
• Lesson 8: Relationships in an Ecosystem ................................... 24-28
  *Extension Lesson: Economic Standard Link
  “The Problem with Homeless Salmon?”
• Lesson 9: Population Interactions ............................................... 29-32
• Lesson 10: Endangered/Threatened Species of Wisconsin .......... 33-35
  *Extension Lesson: Economics Standard Link
  “Why are there so Few Whales and so many Chickens?”
• Lesson 11: Invasive Species of Wisconsin/Great Lakes .............. 36-40
  ~City Forester-Gypsy Moth Invasive, Emerald Ash Borer
• Lesson 12: Local Environmental Issues-Case Studies ........ ...... 41-50
  ~Urban Development (Waukesha Water Issue)
  ~Habitat Destruction (Hawks and Deer in Local yards)
  ~Hunting (Population Control/CWD Case Study)
  *Extension Lesson: Economics Standard Link
After piloting the implementation in the classroom, the researcher then conferred with the teaching colleague to discuss successes and drawbacks of the revised curriculum. One major success discussed was that the newly revised curriculum was much more relevant to the students' lives and better addressed the Wisconsin State Science Standards for 5th grade and the district benchmarks than the previous curriculum using the Einstein Project. One drawback however was that the unit has a lot included in it, and there simply isn’t enough time built into the curriculum to complete all of the activities and lessons included. They also discussed which lessons needed to be better explained, which ones would need training for the rest of the 5th grade teaching staff and what supplementary materials would need to be included. The implementation also helped to provide more accurate approximations of the duration of each lesson. The researcher was able to put together the needed appendices for the lessons, including worksheets and informational materials.

The Fifth Sub-Problem:
Train USDD 5th grade staff to implement the 5th grade science curriculum infused with place-based activities related to the Fox River and Great Lakes Watershed.

Two teacher in-services were held in winter of 2009 to provide the teachers with the curriculum materials and train them on some of the more complex lessons. The first in-service was conducted at an after-school collaboration (staff meeting) at which 10 of the 11 fifth grade teachers were able to attend. Only thirty minutes were allotted for both in-services. The assistant principal and the principal of Foxview were also in attendance. The researcher began with a survey from the NEEF on place-based education. A new technology was used that allows the respondents to put their answers anonymously into small remote controls which then send their responses to a computer which displays the question and answers so that the group can discuss the results and the questions. After a discussion of the survey, the researcher then spent time discussing place-based education and the EIC model to provide a basis for the revised curriculum. The book Last Child in the Woods was referenced in regards to the idea that many children are very unaware of their own
environment right outside their back door (Louv, 2005). The book seemed to peak the interest of many of the teachers attending the in-service. The researcher provided the definition of EJC, so that the teachers understood the premise for which the lessons were based.

The place-based ecosystems curriculum was handed out to the staff, and who were then led through the table of contents. The staff was then guided through the organization of the curriculum. After reading the completed pre-surveys of the teachers, it became evident that 3 out of the 6 teachers who returned their surveys were unaware of state of Wisconsin Environmental Education Standards. The 3 teachers who responded that they had heard of the standards but had never used them in their curricular planning. This made it necessary for the researcher to reference the standards in the place-based ecosystems curriculum binder. Due to the fact that the researcher was only allotted two meeting times of 30 minutes each, the time ran out quickly. Unfortunately, the emphasis at Foxview is language arts and math versus science and social studies. The intent of the researcher revising the science curriculum is to bring greater emphasis to environmental education and science. The staff was asked to read through the lessons in preparation for the following in-service a week later and to bring any questions or concerns to the next meeting.

A week after the first in-service, the teachers met again for the second and final in-service on the place-based ecosystems curriculum, which again was 30 minutes in length. All 12 teachers were in attendance at this meeting, as well as the administrators of Foxview. The researcher began with a brief summary of what was discussed at the previous in-service. Then a discussion was started about the lessons themselves. The teachers were asked to review the curriculum after the last in-service. The feedback was positive and overall, the teachers seemed inspired by the relevance of the lessons to the student’s local area. A few teachers seemed a bit overwhelmed by the amount of lessons included. The researcher reassured them that this is the first year, and that the curriculum was designed to include more than was necessary so that the teachers would have some flexibility to pick and choose.

The in-service then proceeded to include an overview of Lesson 3, 4 and 5 from the curriculum (included in the appendix C), as these three lessons are very detailed and may be confusing without some explanation. Lesson 3 included an activity from Project WET, titled “Incredible Journey” (Higgins, Kisselheim & Robinson, 2005). It was a interactive lesson about the water cycle, and can be very effective with students if done correctly. The researcher walked the teachers through a simulation of this activity. Lesson 4 the
“Ecosystem Address” utilized activities from *Wisconsin River of Words Educator’s Guide* (Pardee, 2004). The activities involve mapping watersheds and determining which watershed Foxview/De Pere is a part of. The teachers were very interested to learn about watersheds as a basis for the environmental effects in an area. The concept of watersheds was very new to the teachers, and it seemed to the researcher that the teachers were definitely enlightened by learning about them. Finally, Lesson 5 “Human Effects on Watersheds/Ecosystems” was demonstrated and discussed. This lesson includes the use of the Wisconsin Groundwater Model. The researcher needed to train the teachers how to use the model as a teaching tool. This lesson also included an activity from Project WET, titled “Sum of Parts”, which had to do with waterway contamination (Higgins, Kisselheim & Robinson, 2005).

This in-service concluded with a presentation of the supplementary material in the curriculum. At this point, the teachers asked if it was possible for the supplementary material be placed directly behind the corresponding lessons. The researcher agreed, but no extra time was given to complete this task. The teachers decided that it would be done during the common planning time given each day for teams of teachers, and if any questions or concerns arise they would contact the researcher for support.

The Sixth Sub-Problem:

Evaluate and analyze the implementation of the 5th grade science curriculum, infused with place-based activities related to the Fox River and Great Lakes Watershed.

In order to better train the USDD 5th Grade staff, the researcher created a pre-survey to be able to gain information on their background knowledge in the areas of EE and local environmental issues. The pre-survey was qualitative in its design. The survey questions provided some needed information about the knowledge base of the 5th grade teaching staff in the USDD (See Appendix A). Overall, 6 of 10 surveys handed out were returned. When asked about awareness of Environmental Education Standards, about half of the teachers who completed the pre-survey were not aware that there were Wisconsin State Standards for EE, and the other half that knew of them had never actually seen or used them to guide their curricular planning. When asked what the teachers would like to see in the revised curriculum, respondents stated connections to the local region, authentic hands-on activities, and more real-world applications. The teachers then were asked if they were familiar with the philosophy of place-based education, and 100% (6 of 6) of the teachers surveyed had
never heard it. All but one of the teachers surveyed did not know what watershed they lived in, and that one teacher had worked closely with the researcher to pilot the lessons before the survey had been handed out. Finally, the teachers were asked to list the environmental issues that they found to be of concern in the local area. Responses included: pollution from factories, road salt, fertilizers, contaminated drinking water, and unsafe water resources such as streams, rivers, lakes, and bays, water conservation issues and invasive species. Overall, the pre-survey provided the researcher with needed information for tailoring an in-service that would meet the needs of the 5th grade teachers who were to be implementing the place-based ecosystems curriculum.

Throughout the 4th quarter (a period of 9 weeks) in the spring of 2009, that the 5th grade teachers were implementing the place-based ecosystems curriculum, feedback was given to the researcher via emails and conversations. Supplementary materials were provided as needed. The researcher was also available for assistance with any portion of the curriculum as the teachers proceeded through the lessons.

At the end of the nine week quarter in which the teachers had implemented the curriculum, the researcher passed out a post-survey (appendix A) for feedback and future improvement on the curriculum. Post-survey included 6 questions, qualitative in nature where teachers could write their comments and concerns. Eight out of ten surveys handed out were returned with feedback.

The first question asked whether the curriculum was user-friendly, and overall 8 of 8 surveys answered yes, but the supplementary materials for each lesson were originally placed at the end of the curriculum as an appendix. Six out of eight teachers felt it would be easier to follow if the materials were directly behind the lessons. Question #2 stated: “What went well while teaching the new curriculum?” and “What lessons were most memorable to the students?” As far as what went well, the teachers felt the hands-on aspect of the curriculum was a successful improvement. They also felt that the amount of background information included in the curriculum was helpful to the success of the implementation. Finally, the teachers felt that the incorporation of the local area helped make a positive connection between the concepts studied to the local watershed/ecosystem. The lessons that were the most memorable were Lessons 4 and 5 (appendix C) focusing on watershed basics and human effects on watersheds. These lessons included the use of the groundwater model, and a few activities from Project WET and Wisconsin River of Words. It was also mentioned that
the students and teachers alike appreciated lessons 10 and 11 on endangered and invasive species which utilized the Wisconsin DNR’s website for kids titled EEK!(WDNR, 2009).

The 3rd question on the post-survey asked about what lessons needed improvement or additional training. All eight surveys returned stated very different comments for improvement. One stated that more discussion on each lesson would be helpful provided there is common time allotted for this by the administration. Another stated that as teachers we need to discuss what absolutely needs to be covered, and what can be extensions. A few felt that they would like more training on the watershed activities to be able to implement them more effectively. A few provided no response at all to this question. Follow-up questions seemed to indicate that they were content with the lessons as they were. It was also suggested that we be sure to update the information in Lesson 13 (appendix C) on the PCB’s in the Fox River as the clean-up continues and new developments arise.

Question #4 asked the teachers if they felt the new place-based ecosystems curriculum was worth keeping as opposed to the previous curriculum used from the Einstein Project (EP, 2009). Six of the eight teacher’s surveyed felt that they enjoyed teaching the new place-based ecosystems curriculum as opposed to the Einstein Project curriculum. The other two teachers surveyed liked both curriculums, but felt that the new curriculum was a bit overwhelming for the first year. The last two questions on the post-survey asked if there were any supplementary materials that should be added or purchased to aid in the implementation of the curriculum. The only two suggestions given on all eight surveys was the need for more beads for Lesson 3 (appendix C), and more kid-friendly articles for Lesson 12: Environmental Issues-Case Studies.
Chapter 5
Summary, Conclusions and Recommendations

Summary
The purpose of this project was to develop and implement a place-based ecosystems unit which is related to the Fox River and the Great Lakes Watershed for the fifth grade science curriculum in the Unified School District of De Pere. There have been many changes from the early planning of this project to the one that has been developed. One piece has remained, and that is that this project was related to the Lower Fox River watershed. The focus shifted from the Fox River and the issues with PCB’s to the inclusion of the entire Fox River Watershed as a theme for the curriculum.

In spring of 2008, as the researcher began the planning and development of the curriculum, it became evident that the science unit in which to integrate the environment, and place-based activities was the ecosystems unit. After a meeting with the administrators at Foxview Intermediate School, all the pieces of the project began to fall into place. The ecosystems unit for the 5th grade science curriculum needed re-development, and it was to be the researcher’s responsibility to develop said curriculum and to train the fifth grade staff to implement the curriculum successfully in their classrooms. A pre-survey was developed to gain information to assist the researcher with the background knowledge of the teachers who would be implementing the curriculum. The ecosystems curriculum prior to the re-development by the researcher was lacking a lot of depth and connection to the local watershed. The changes were anticipated and welcomed by the 5th grade educators.

After two short in-services, the curriculum was implemented over a nine week period by all 11 of the 5th grade teachers in their own classrooms. The implementation went as smooth as could be expected for the first time, and with minimal training on the lessons and activities. The post-survey was developed to help the researcher evaluate what went well, and what needed to be improved during the implementation of the place-based ecosystems curriculum. The 5th grade science teachers filled out the surveys anonymously and were able to write comments as a way to assess how they felt their classroom implementation went.
Conclusions

It can be concluded that this project was a success for three major reasons. First, the curriculum allowed for a more focused, standards-based approach to teaching about ecosystems by utilizing the Wisconsin State Science and Environmental Education standards as well as the Unified School District of De Pere’s science benchmarks. Second, the curriculum utilized the local Fox River watershed as an integrating context. It allowed for the teachers and the students to focus on their local area, and created a place-based learning environment in the science classroom. The students hopefully gained a greater understanding for their local watershed although the researcher did not conduct any data collection on the knowledge gained from experiencing the curriculum. Finally, the place-based ecosystems curriculum was a success because it provided an opportunity for all of the 5th grade teachers to work on the same curriculum so that the students at Foxview Intermediate School would leave 5th grade having a common learning experience in the science classroom in regards to the study of ecosystems especially local ones.

Recommendations

Writing of curriculum is a fluid process. Thus the curriculum that was implemented is most likely not the end product, but rather a spring board from which to continue incorporating the environment into Science curricula in the Unified School District of De Pere. It is the recommendation of the researcher that USDD should maintain the place-based ecosystems curriculum incorporating the Fox River watershed as an established part of the 5th grade science curriculum. It was apparent in the post-survey results that the teachers found the implementation of the curriculum to be a success. Based on the observation of the students in the researcher’s classroom, it seemed that the students responded well to the improved curriculum.

It is also the recommendation of the researcher that more common in-service trainings be scheduled for the 5th grade teachers to work through each lesson to discuss procedure, relevance and improvements that are needed. More time should also be allotted for the in-services, as only 2-30 minute meeting periods were given for training previously. The in-services were too short in duration to cover all of the lessons and activities in detail.
Over time the information in the curriculum will need to be updated, thus it is recommended that on a yearly basis the curriculum is re-visited to make improvements, changes or updates to be sure to include relevant information and supporting resources. It is the recommendation of the researcher that the USDD pursue incorporating place-based learning into other aspects of the science curriculum, as well as within other subject areas. In the future, it is the recommendation of the researcher that data be collected to provide a comparison between students prior knowledge on their local watershed with knowledge gained after experiencing the place-based ecosystems curriculum.

Another recommendation for the future would be to further research regarding what the students gained from experiencing the curriculum, and how their learning was changed, enhanced or improved. It is also the recommendation of the researcher that future research be done to compare how 5th grade students perform on the science portion of the state test before and after experiencing the place-based ecosystems curriculum.

After completing this process of curriculum development of place-based activities within the science curriculum, I, the researcher have learned much from this experience. There are a few recommendations I have for other teachers interested in integrating place-based activities into their curriculum. The first recommendation would be to research your local area, to determine what environmental issues are evident. Attempt to become familiar with the watershed in which you live including plants, animals, water etc, so that you feel as if you are knowledgeable about your local area before beginning to plan lessons and activities. The second recommendation would be to experience your existing curriculum by teaching it for at least a year while having place-based integration on your mind, to find appropriate areas where integration would be appropriate. I would also be sure to experience the activities you have chosen in the classroom before sharing them with fellow staff members, so as to be sure that you truly feel that the activities provide a benefit to the student’s learning, and that they are user-friendly for the teaching staff. Consider how your school or district approves and implements new curriculum, so that you can find a way to best share your newly developed curriculum.

In summary, the place-based ecosystems curriculum incorporating the Fox River and Great Lakes watershed was a worthwhile improvement to the 5th grade science curriculum at Foxview Intermediate School in the Unified School District of De Pere.
References


Chawla, Louise & Escalante, Myriam (2007, November). *Student Gains From Place-Based Education*. University of Colorado at Denver: Children, Youth and Environments Center for Research and Design.


Appendix A

Pre and Post Surveys of the Place-Based Ecosystems Curriculum
Pre-Survey:
Place-Based Ecosystems Curriculum

1. Were you aware that there were standards for Environmental Education in Wisconsin?

2. What do you feel went well with the previous Ecosystems Unit?

3. What did you feel needed to be improved, changed or removed from the previous Ecosystems Unit?

4. What types of things would you like to see in the new Ecosystems Unit?

5. Have you heard of the philosophy of place-based education? If yes, describe what you think it is.

6. Do you know what watershed we live in? If yes, please list below.

7. What environmental issues do you believe are a concern in our local area of Northeast Wisconsin?
Post-Survey:  
Place-Based Science Ecosystems Curriculum

1. Was the ecosystem’s unit user friendly? If no, please explain.

2. What went well while teaching the new Ecosystems Unit? Which lessons were most memorable with the students?

3. What areas/lessons do you feel need improvement or more training? Please explain.

4. Do you feel that this unit is something to keep for the following year or would you like to see the Einstein Project back in the 5th Grade Curriculum?

5. What kinds of supplementary materials could be added to make the implementation of the unit in the future?

6. Was there anything missing from the Ecosystem’s kits that you feel we need or should purchase?
Appendix B

Staff In-service Documents
**Place-Based Ecosystems Curriculum Training**  
Foxview Intermediate School LMC  
Wednesdays, March 4\textsuperscript{th} and 11\textsuperscript{th}, 3:00-3:30 p.m.

**Agenda: March 4\textsuperscript{th}**

1. NEETF Environmental Awareness Survey using the Clickers.
2. Discuss results of each question of the above survey.
3. Define Place-Based Education and the EIC Model.
5. Hand out the Place-based Ecosystems Curriculum.
   - Overview the set-up of the curriculum.
   - Overview the Environmental Education Standards and District Benchmarks
6. Wrap-up and focus for the following in-service.

**Agenda: March 11\textsuperscript{th}**

1. Review of previous in-service discussion.
2. Curriculum and Lesson feedback and discussion with Teachers.
3. Lesson 3, 4, and 5 Training
4. Overview of Curricular Supplementary Materials.
5. Wrap-up
Lessons from the Environment:
Test Your Environmental Knowledge!
Reference: http://www.neefusa.org/resources/roper2001-b.htm

This quiz covers issues that have been discussed in the media. The questions are designed to tell us how much accurate information people are getting from television, newspapers, magazines, and other sources. Write down your answers and compare them to the correct answers below.

1. There are many different kinds of animals and plants, and they live in many different types of environments. What is the word used to describe this idea? Is it...
   a. Multiplicity
   b. Biodiversity
   c. Socio-economics
   d. Evolution?
   Don't know

2. Carbon monoxide is a major contributor to air pollution in the U.S. Which of the following is the biggest source of carbon monoxide? Is it...
   a. Factories and businesses
   b. People breathing
   c. Motor vehicles, or
   d. Trees?
   Don't know

3. How is most of the electricity in the U.S. generated? Is it...
   a. By burning oil, coal, and wood
   b. With nuclear power
   c. Through solar energy
   d. At hydro-electric power plants?
   Don't know

4. What is the most common cause of pollution of streams, rivers, and oceans? Is it...
   a. Dumping of garbage by cities
   b. Surface water running off yards, city streets, paved lots, and farm fields
   c. Trash washed into the ocean from beaches, or
   d. Waste dumped by factories?
   Don't know

5. Which of the following is a renewable resource? Is it...
   a. Oil
   b. Iron ore
   c. Trees, or
   d. Coal
   Don't know
6. Ozone forms a protective layer in the earth's upper atmosphere. What does ozone protect us from? Is it ...
   a. Acid rain
   b. Global warming
   c. Sudden changes in temperature, or
   d. Harmful, cancer-causing sunlight?
   Don't know

7. Where does most of the garbage in the U.S. end up? Is it in...
   a. Oceans
   b. Incinerators
   c. Recycling centers, or
   d. Landfills?
   Don't know

8. What is the name of the primary federal agency that works to protect the environment?
   Is it the...
   a. Environmental Protection Agency (the EPA)
   b. Department of Health, Environment, and Safety (the DHES)
   c. National Environmental Agency (the NEA), or
   d. Federal Pollution Control Agency (the FPCA)?
   Don't know

9. Which of the following household wastes is considered hazardous waste? Is it...
   a. Plastic packaging
   b. Glass
   c. Batteries, or
   d. Spoiled food?
   Don't know

10. What is the most common reason that an animal species becomes extinct? Is it because...
    a. Pesticides are killing them
    b. Their habitats are being destroyed by humans
    c. There is too much hunting, or
    d. There are climate changes that affect them?
    Don't know

11. Scientists have not determined the best solution for disposing of nuclear waste. In the U.S., what do we do with it now? Do we...
    a. Use it as nuclear fuel
    b. Sell it to other countries
    c. Dump it in landfills, or
    d. Store and monitor the waste?
    Don't know
12. What is the primary benefit of wetlands? Do they…
   a. Promote flooding
   b. Help clean the water before it enters lakes, streams, rivers, or oceans
   c. Help keep the number of undesirable plants and animals low, or
   d. Provide good sites for landfills?
Don't know

Click here to compare your responses to the responses of a random survey of Americans.

Click here for a report card on Americans' environmental knowledge.

(Answers: 1. b, 2. c, 3. a, 4. b, 5. c 6. d, 7. d, 8. a, 9. c, 10. b, 11. d, 12.b)
Appendix C

Place-Based Ecosystems Curriculum
Unit: Ecosystems

5th Grade

Place-based Ecosystems Curriculum

Foxview Intermediate School

Composed by: Stephanie Lehnert

5th Grade Teacher
Ecosystems Unit

Introduction: Ecosystem Unit Overview
This is a place-based unit on the study of Ecosystems, incorporating the local area of the Fox River/Great Lakes Watershed. The lessons are aligned with benchmarks for the Unified School District of De Pere and Wisconsin State Science as well as Environmental Education Standards.

Place Based Connections to the Local Fox River Watershed/Ecosystem
- Waste Removal and Recycling of the Local Area-Household Hazardous Wastes Search
- Model Landfills-Issue with Deposition of PCB’s in Landfills Locally-Biomass Energy
- Composts-Creation of a Composts in the Classroom
- Recycled Paper Making-Link to the Paper Industry of Northeast Wisconsin
- Waterway Contamination-PCB’s in Fox River
- Groundwater Contamination- Local Morrison Issues
- Soil-Guest Speaker from a Soil Testing Company (Local)
- Invasive Species-Examples of Great Lakes Invasive Species
- Invasive Species of Wisconsin (Wanted Posters)
- Wisconsin Endangered/Threatened Species
- Field Experience to Meet with the City Forester at Legion Park to examine Gypsy Moths, and Local Tree Identification
- Field Experience to local Water sources-Lilly Lake, Neshota Pond, Fox River and Kewanee Fish Hatchery
- Local Environmental Issues- Case Studies
  ~Urban Development (Waukesha Water Issue)
  ~Habitat Destruction (Hawks and Deer in Local yards)
  ~Hunting (Population Control/CWD Case Study)
- Local Environmental Issue Investigation
  ~PCB’s in the Fox River
Unit Design

Elements of an Ecosystem

Sun and Air
- Make up of Air
- Atmosphere
  (**Review Only
  Topics Covered in Weather Unit)

Soil
- Geology
  (Information
  Should be
  Covered in
  Previous Unit)
- Soil Horizons

Water
- Water Cycle
  (Review Only)
- Watersheds
- Bodies of Water
- Groundwater
- Water Contamination

Living Things
- Needs
- Populations
- Interactions
- Relationships

Humans
- Effects on Ecosystems
- Negative: Pollution/Contamination
- Positive: Action
- Field Experiences
Foxview Intermediate School
5th Grade Ecosystems Unit/Curriculum

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<th>Life Science: Ecosystems and Biomes</th>
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Skip: Lesson 4- Cycles of Life

Time Frame: Spring April-May
1 ½- 2 Months
(1 class period a day or 2 class periods every other day)

Textbook: Macmillan McGraw-Hill Science: Life Science Unit B

Unified School District of De Pere Life Science Benchmarks

F. Students will demonstrate an understanding of the characteristics and Structures of living things, the processes of life, and how living things interact with one another and their environment.

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<th>Benchmark</th>
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<tr>
<td>F.8.7</td>
<td>Identify and define the location, climate, and some major consumers and producers within each biome</td>
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<td>F.8.8</td>
<td>Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs (Einstein)</td>
</tr>
<tr>
<td>F.8.8</td>
<td>Identify how human activities affect an ecosystem in beneficial or harmful ways (Einstein)</td>
</tr>
<tr>
<td>F.8.9</td>
<td>Understand how people can develop solutions to lessen the effects of pollutants (Einstein)</td>
</tr>
<tr>
<td>F.8.10</td>
<td>Understand how humans affect the biomes</td>
</tr>
</tbody>
</table>
Wisconsin State Science and Environmental Education Standards

Wisconsin Model Academic Standards

Science, Standard F: Life and Environmental Science
Performance Standards - Grade 8

By the end of grade eight, students will:

STRUCTURE AND FUNCTION IN LIVING THINGS

F.8.1 Understand the structure and function of cells, organs, tissues, organ systems, and whole organisms

F.8.2 Show how organisms have adapted structures to match their functions, providing means of encouraging individual and group survival within specific environments

F.8.3 Differentiate between single-celled and multiple-celled organisms (humans) through investigation, comparing the cell functions of specialized cells for each type of organism

REPRODUCTION AND HEREDITY

F.8.4 Investigate and explain that heredity is comprised of the characteristic traits found in genes within the cell of an organism

F.8.5 Show how different structures both reproduce and pass on characteristics of their group

REGULATION AND BEHAVIOR

F.8.6 Understand that an organism is regulated both internally and externally

F.8.7 Understand that an organism's behavior evolves through adaptation to its environment

POPULATIONS AND ECOSYSTEMS

F.8.8 Show through investigations how organisms both depend on and contribute to the balance or imbalance of populations and/or ecosystems, which in turn contribute to the total system of life on the planet

DIVERSITY AND ADAPTATIONS OF ORGANISMS

F.8.9 Explain how some of the changes on the earth are contributing to changes in the balance of life and affecting the survival or population growth of certain species

F.8.10 Project how current trends in human resource use and population growth will influence the natural environment, and show how current policies affect those trends.
A. QUESTIONING AND ANALYSIS

Content Standard
Students in Wisconsin will use credible research methods to investigate environmental questions, revise their personal understanding to accommodate new knowledge and perspectives, and be able to communicate this understanding to others.

Rationale:
Developing an understanding of the environment and environmental sustainability depends on students willingness and ability to ask questions about the world around them, speculate and hypothesize, seek information, and develop answers to their questions. Environmental literacy requires a familiarity with some basic modes of inquiry; a mastery of fundamental skills for gathering, organizing, interpreting, synthesizing, and evaluating information; developing explanations; and communicating these understandings to others.

By the end of grade 8 students will:
A.8.1 Identify environmental issue* questions that can be investigated using resources and equipment available (see SC Inquiry; LA Research)
A.8.2 Collect information from a variety of resources, conduct experiments, and develop possible solutions to their investigations*
A.8.3 Use techniques such as modeling and simulating to organize information gathered in their investigations* (see Mathematics [MA] Process)
A.8.4 Use critical-thinking strategies to interpret and analyze gathered information (see SC Inquiry)

B. KNOWLEDGE OF ENVIRONMENTAL PROCESSES AND SYSTEMS

Content Standard
Students in Wisconsin will demonstrate an understanding of the natural environment and
the interrelationships among natural systems.

Rationale:
The foundation of environmental education is a basic understanding of the processes of the interacting systems that comprise the environment. Therefore, it is essential that students have knowledge of the earth as a dynamic, physical, and living system that has been affected over time by various human societies. This knowledge is a necessary prerequisite for problem-solving activities required for individual and community response to environmental issues.

By the end of grade 8 students will:

Energy and Ecosystems
B.8.1 Describe the flow of energy* in a natural and a human-built ecosystem* using the laws of thermodynamics (see SC Physical Science)
B.8.2 Explain how change is a natural process, citing examples of succession,* evolution,* and extinction
B.8.3 Explain the importance of biodiversity*
B.8.4 Map the levels of organization of matter; e.g., subatomic particles through biomes (see SC Physical Science)
B.8.5 Give examples of human impact on various ecosystems*
B.8.6 Describe major ecosystems* of Wisconsin (see SC Life and Environmental Science)
B.8.7 Illustrate the conservation of matter using biogeochemical cycles; e.g., carbon, nitrogen, phosphorous
B.8.8 Explain interactions among organisms or populations of organisms
B.8.9 Explain how the environment is perceived differently by various cultures* (see SC Nature of Science)
B.8.10 Explain and cite examples of how humans shape the environment
B.8.11 Describe our society* as an ecosystem*

Natural Resources and Environmental Quality
B.8.12 Provide examples of how different cultures* use natural resources reflecting the economic, aesthetic, and other values* of that culture
B.8.13 Diagram how resources are distributed around the world (see SC Nature of Science; Social Studies [SS] Political Science and Citizenship: Power, Authority, Governance, and Responsibility)
B.8.14 Identify the natural resources* that are found in Wisconsin and those that are imported
B.8.15 Analyze how people impact their environment through resource use
B.8.16 Recognize the economic, environmental, and other factors that impact resource availability and explain why certain resources are becoming depleted
B.8.17 Explain how human resource use can impact the environment; e.g., erosion, burning fossil fuels
B.8.18 Identify major air, water, or land pollutants and their sources
B.8.19 Distinguish between point* and nonpoint source* pollution*
B.8.20 Identify types of waste* and methods for waste* reduction *(see SC Earth and Space Science)*
B.8.21 Identify and analyze individual, local, regional, national, and global effects of pollution* on plant, animal, and human health
B.8.22 Identify careers related to natural resources* and environmental concerns *(see SC Applications)*
B.8.23 Identify governmental and private agencies responsible for environmental protection and natural resource* management
B.8.24 Create a timeline of Wisconsin history in resource management *(see SC Nature of Science)*

C. ENVIRONMENTAL ISSUE INVESTIGATION SKILLS

Content Standard
Students in Wisconsin will be able to identify, investigate, and evaluate environmental problems and issues.

Rationale:
Solving environmental problems and issues requires skills in environmental investigations. These skills, in turn, provide students with opportunities to apply and improve their capacity for systems thinking and their understanding of a sustainable world and society. Focusing on environmental issues offers students a means of integrating their knowledge of human and environmental systems and a way of finding personal relevance in that knowledge.

By the end of grade 8 students will:
C.8.1 Define and provide examples of environmental issues,* explaining the role of beliefs,* attitudes, and values* *(see SS Political Science and Citizenship: Power, Authority, Governance, and Responsibility)*
C.8.2 Use environmental monitoring techniques; such as, observations, chemical analysis, and computer mapping software to collect data about environmental problems* *(see LA Media and Technology; MA Measurement)*
C.8.3 Use questioning and analysis skills to determine beliefs, attitudes, and values held by people involved in an environmental issue.

C.8.4 Evaluate the credibility of information, recognizing social, economic, political, environmental, technological, and educational influences (see LA Writing).

D. DECISION AND ACTION SKILLS

Content Standard

Students in Wisconsin will use findings from environmental issue investigations to develop decision-making skills, and to gain experience in citizen action skills.

Rationale:

Students need decision-making and action skills to contribute toward environmental sustainability. In addition, these skills enable them to analyze the effectiveness of individual versus group action, develop issue-resolution plans that incorporate one or more citizen participation skills, and consider these plans in terms of social, cultural, and ecological consequences and implications.

By the end of grade 8 students will:

D.8.1 Identify options for addressing an environmental issue* and evaluate the consequences of each option.

D.8.2 List the advantages and disadvantages of short-term and long-term solutions to an environmental issue* or problem*.

D.8.3 List reasons why an individual or group chooses to participate or not participate in an environmental activity in the home, school, or community.

D.8.4 Explain the political, legal, and budgetary options for resolving local, state, and national environmental issues* (see SS Political Science and Citizenship: Power, Authority, Governance, and Responsibility).

D.8.5 Explain how personal actions can impact an environmental issue,* e.g., doing volunteer work in conservation.

D.8.6 Develop a plan for improving or maintaining some part of the local environment and identify their role in accomplishing this plan.

D.8.7 Identify examples of how personal beliefs* can influence environmental decisions.

D.8.8 Give examples of education, economic, and government institutions influence on an environmental issue,* and the role of citizens* in policy formation (see SS Political Science).
E. PERSONAL AND CIVIC RESPONSIBILITY

Content Standard
Students in Wisconsin will develop an understanding and commitment to environmental stewardship.

Rationale:
Environmentally literate students recognize how their individual behaviors affect the environment. They have the knowledge, skills, and confidence to act on their own about what should be done to maintain an economically and ecologically sustainable environment. They will recognize that their participation in activities can lead to resolution of environmental challenges.

By the end of grade 8 students will:
E.8.1 Formulate a personal plan for environmental stewardship*
E.8.2 Explain the importance of characteristics (such as, trust, patience, self-discipline, respect, and open-mindedness) that enable people to function together to resolve environmental issues*
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Field Trips to Schedule:

- Ecosystems with Fallen Timbers (Neshota Pond, Lilly Lake, Besadny Fish Hatchery)
- Walking to Legion Park (De Pere City Forester)
- Walking to Fox River at Voyageur Park
Lesson Title: Lesson 1- What is an Ecosystem?

Overview: This lesson will focus on defining what an ecosystem is, what factors make up an ecosystem and where one might encounter ecosystems. It also allows students to recognize that they too, are part of an ecosystem.

Length: 2- 45 minute class periods (1 block)

Standards/Benchmarks:

USSD Benchmarks
• F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.

Wisconsin EE Standards:
• B.8.6 Describe major ecosystems* of Wisconsin
• B.8.11 Describe our society* as an ecosystem*

Materials:
• Picture Book: Dear Children of the Earth, by Schim Schimmel
• Textbook: Macmillian /McGraw Hill Science: Unit B Living Things and Their Environments
• Notebooks
• Blank White Paper
• Clipboard

Vocabulary:
• Ecosystem: All of the Living things and non-living in an area.
• Abiotic Factors: Non-living parts of an ecosystem. Ex. water, minerals, sunlight, air, climate, soil.
• Biotic Factors: Living parts of an ecosystem. Ex. animals, plants, fungi, protests, and bacteria.

Procedure:
1. Have the students draw a map of their own outdoor space, whether it be their backyard, cottage, camp etc. it should be what they think of when someone says “outdoors”. The map can be a sketch, give them about 10-15 mins to do so.

2. Have students share their maps in partners, groups, to the whole class, however you feel is appropriate for your students. (It might be nice if you draw one too, as an example on the overhead or board)
Unit: Ecosystems

3. Discuss the fact that what each person has drawn is a type of ecosystem, lead this into what makes up an ecosystem. (Living and non-living things) Define “ecosystem” on the board. Have the students record the definition in their notebooks.

4. Read an introduction about ecosystems in the textbook pgs. 6-7. Have the students define “Abiotic and biotic” factors in their notebooks. Then have students label the abiotic and biotic factors on their own maps of their ecosystems.

5. Explain to the students that the class will be taking a walk to “map the ecosystem” around the school. Have the students bring a clipboard and a pencil to sketch what they see, both living and non-living parts of the ecosystem. Remember to include man-made elements such as building, pavement etc. Then have a discussion about how these man-made elements can affect how an ecosystem functions. Such as: habitat loss for animals, run-off of chemicals from the parking lot etc.

6. Final Thought: Refresh with the students that we are all part of an ecosystem, and everywhere you look there is some element that makes up an ecosystem.

Assessment:

- Provide a picture of an ecosystem to each group of about 4 students. (can be a picture of the outdoor scene from a magazine, old calendar, photograph)

- Have the students write why they think this is considered an ecosystem, and list the abiotic and biotic factors on a separate sheet of paper.

Extensions:

- Extension Lesson: Economic Standard Link- “Romancing the Past” (See Attached) NCEE-National Council on Economics Education
What Is an Ecosystem?

This diagram shows two different pictures of what could be a single environment. One picture focuses on abiotic factors and the other on biotic factors. The small drawings in each picture show close-ups of some of the smaller factors.

Answer these questions about the diagram above.

1. Name three biotic factors in the diagram.

2. Name three abiotic factors in the diagram.

3. What factors are in the biotic close-up?

4. What factors are in the abiotic close-up?
LESSON TWO

ROMANCING THE PAST

BACKGROUND
Today the standard of living for most Americans is higher than ever before. And research from many sources indicates that the environment is cleaner today than it was 25 years ago. The air and water are cleaner. There are more trees, not fewer. There is more food. People today live longer than at any time in our past. Yet public opinion polls show that Americans worry increasingly about the destruction of forests and wetlands, the extinction of endangered species, a depleted ozone layer, global warming, melting glaciers, and dirty air and water.

ECOMYSTERY
If the environment is cleaner today than it was 25 years ago, why are people so worried about it?

ECONOMIC REASONING
Scarcity exists because people's wants are never satisfied. What people want depends usually on how wealthy they are. Poor people in poor nations face starvation and disease. For them, basic issues include the provision of clean drinking water, for prevention of disease, and effective land use, for food production.

People in wealthier nations want clean water and enough food to eat, too, but they can satisfy such wants more easily than poorer people can. They do not have to spend all or most of their time and money on basic matters of survival. They can afford to take an interest in environmental quality: in clean water for swimming and fishing, not merely for drinking; in forests to camp in, not merely forests to clear away so that crops can be planted. It is wealth, created by economic growth, that enables people to address these problems of environmental quality. As the U.S. economy has grown, Americans have sought increasingly to improve environmental quality.

ECONOMIC CONCEPTS
Economic growth
Scarcity

OBJECTIVES
1. Students compare and contrast the quality of life in the United States today and in the past.
2. Students analyze why rich nations have a cleaner environment than poor nations.
3. Students discuss whether their generation will have a lower or higher standard of living than their parents' generation.
4. Students analyze why greater wealth leads to a greater demand for environmental quality.

TIME
Two class periods

MATERIALS
♦ Visuals 5 and 6
♦ Activities 4 and 5

PROCEDURE
A. Tell students that the class is going to discuss whether people in the United States today live better or worse than they did when they were born and when their parents were born.

B. Distribute Activity 4. Tell students that their homework for this evening is to interview a family member of a different generation and to write down responses to the questions on the poll sheet.

C. On the following day, compile the results of the poll and discuss them. At this time, do not discuss the reasons for the answers. However, do make a list of household items we use today that did not exist when the students' older family members were born.

D. Give each student a copy of Activity 5, The Good Old Days? Either give students the rest of the period to read the chapter from Trashing the Planet or assign it as homework.

E. Discuss Activity 5. Ask students:
LESSON TWO

1. How did the quality of the air 50 years ago compare to the quality of the air today? (Coal, wood furnaces, and pollution from factories made air worse 50 years ago.)

2. What are some common household appliances today that did not exist 50 years ago or in some cases 20 years ago? (Televisions, VCRs, computers, calculators, CD players, word processors, food processors, microwaves, and so on.)

3. How does medical care today compare to the medical care of 50 years ago? (Fifty years ago food poisoning was common; there were more infectious diseases; tuberculosis and polio were common; antibiotics did not exist; and the state of medical technology was much lower.)

4. Has the rate of improving the way people live been increasing or decreasing during the past several years? (Increasing. The rate of improvement in the way humans live has improved more in the past 50 years than in all of human history.)

5. What are some ways that life today is worse than it was 50 years ago? (There is more crime. AIDS is a problem. People often have difficulty coping with the expansion of knowledge and changes in technology.)

6. Would you rather live today or 50 years ago? (While answers may vary, it would seem difficult for students to argue that life was preferable 50 years ago.)

7. Do increases in knowledge and technology appear to make life better or worse? (Based on the improvements cited in the reading, knowledge and technology make life better.)

F. Now compare these answers to the responses to the poll. It is likely that family members believe that life in the past was worse than today, but answers may vary.

G. Ask students: If the environment is cleaner today, why are people so concerned about it? (People are wealthier, and one of the goods they demand more of is a cleaner environment. Also point out that wealthier countries have a cleaner environment than poorer countries.)

H. Explain that economic growth is the increase in the amount of production from one year to another. If all of the nation's final goods and services were in a cupboard, the amount of stuff in the cupboard would be greater at the end of the year than at the beginning—if economic growth occurred. Economic growth makes it easier for us to afford more of the things we would like to have. If there is economic growth, people can afford to improve the environment. This is why wealthy nations have a cleaner environment than poor nations.

I. Display and discuss Visual 5. Point out that a market economy promotes economic growth, and economic growth helps the environment. Discuss why Dr. McCloskey believes only war and socialism will cause America to decline. (A market economy creates incentives for economic growth.)

CLOSURE

Display Visual 6 and discuss the mystery. Display The Principles of EcoDetection and focus the students' attention on principles 1 and 3 to help them solve the mystery. (People's choices influence the environment. As a nation's economy grows, citizens are more willing to use more of their resources to improve the environment. People's choices are influenced by rewards. In the United States and in other developed nations, people are rewarded for being productive. People receive better incomes, for example, when they are successful in business. Rewards for being productive create wealth, and the economy grows. Some resources can be used to improve the environment. When people are not rewarded for being productive, economies shrink. Some nations have experimented with economies that failed to reward productive activities. These nations have experienced little economic growth and have had few resources to devote to environmental improvement. The former Soviet Union in an example of this.)
LESSON TWO

ASSESSMENT

Multiple Choice

1. What is the most important factor in improving the standard of living?
   a. A stronger national defense.
   b. More government programs.
   *c. More economic growth.
   d. More rules and regulations to protect the environment.

2. Which type of country has the cleanest environment?
   a. Poor nations, because they have few factories.
   *b. Rich nations, because they can afford to pay for environmental programs.
   c. Socialist nations, because their greater government control forces people to clean up the environment.
   d. Nations with warmer climates, because they need to burn less fuel.

Essay

Do you believe you will have a better or worse life than your older family members?
(Answers will vary, but there is every reason to believe that the United States will continue to have economic growth and that students' lives will be better.)

Journal

Interview a grandparent or someone of that generation; find out what life was like when these people were your age. Discuss technology, use of leisure time, family size, disease, working conditions, and schooling.
“America is not declining. In the modern world, no income per head actually declines in absolute terms, unless through war and socialism.

“The world is converging. No one is going to be Top Nation in that happy era when the whole world has an American suburban standard of living and more. America will go on growing, as it has slowly for two centuries, and the latecomers will join the parade. That’s the good news, enriching us all. Give thanks: The sky is not falling.”

Donald N. McCloskey
Phi Beta Kappa Key Reporter
Winter, 1994-1995
If the environment is cleaner today than it was 25 years ago, why are people so worried about it?
Ask your family the following questions and carefully record their answers.

1. Do you believe the environment is cleaner or dirtier today than it was when I was born?
   - Cleaner
   - Dirtier

2. Do you think people live better or worse today than when I was born?
   - Better
   - Worse

3. What are some household items that we have today that did not exist when you were born? (List five items.)

   ____________________________

   ____________________________

   ____________________________

   ____________________________

   ____________________________

4. Do you believe that when I grow up I will be better or worse off than you?
   - Better off
   - Worse off

   Why do you think so?

   ____________________________

   ____________________________

   ____________________________

   ____________________________

   ____________________________

   ____________________________

   ____________________________

Lesson 2- Climate Zones and Introduction to Biomes

Overview: This lesson will focus on how the earth is separated into 3 major climate zones: polar, temperate and tropical. This will help the students understand why there is varied climates in different areas on the earth. This lesson should be a review due to the geographical vocabulary that should have been studied in Soc. St. It is primarily teacher directed and should be done as a class. The second half of this lesson includes the introduction of the 6 major biomes on earth.

Length: 2 or 3 - 45 minute class periods

Standards/Benchmarks:

USSD Benchmarks
- F.8.7 Identify and define the location, climate, and some major consumers and producers within each biome.
- F.8.10 Understand how humans affect the biomes.

Wisconsin EE Standards:
- B.8.6 Describe major ecosystems* of Wisconsin

Wisconsin Science Standards:
- F.8.7 Understand that an organism's behavior evolves through adaptation to its environment
- E.8.3 Using the science themes during the process of investigation, describe climate, weather, ocean currents, soil movements and changes in the forces acting on the earth

Materials:
- Map of the Earth-Climate Zone
- Textbook: Macmillian /McGraw Hill Science: Unit B Living Things and Their Environments
- Science Notebooks

Vocabulary:
- **Climate:** The average temperature and precipitation of a given area for extended periods of time.
- **Longitude:** Imaginary lines on earth that run North to South, but measure East to West of the Prime Meridian.
- **Latitude:** Imaginary Lines on earth that run East to West, but measure North and South of the Equator.
- **Equator:** Imaginary line that measures 0°latitude on the earth.
- **Polar Zone:** The area on earth that surrounds the north pole beginning at the Arctic circle and the south pole beginning at the Antarctic circle
- **Temperate Zone:** The area on earth that has mild climate, with seasonality between the polar zone and the tropical zone north and south of the equator.
- **Tropical Zone:** The area just north and south of the Equator from 25°N to 25°S latitude. The climate is wet and hot.
Unit: Ecosystems

Procedure:

Day 1:
1. Define climate with the students on the board. (See definition above)

2. Provide the students with a map of the world (see attached). Ask them to label with you the equator, the Arctic circle, Antarctic circle, Tropic of Cancer, Tropic of Capricorn. Then have the students get out 3 different colored pencils.

3. Have the students make a key in the corner of their maps with a box for each of the 3 colored pencils they have. Then discuss that there are 3 major climate zones on earth, polar, temperate, and tropical. Have the students make educated guesses as to where each of the separate zones fit on their maps.

4. As a class label the 3 zones, and have the students color the bands of each zone on their maps. Explain that these climate zones determine what types of ecosystems will be present on the continents and oceans within the zones.

5. After they have finished mapping, discuss that large ecosystems on earth are called Biomes, and the many biome locations on earth are determined by the climate zones on earth. Read pgs. B64-B65 in the Science Textbook as an introduction to biomes.

6. Final Thought: Have the students define a “biome” in their notebooks.

Day 2: Overview: This part of the lesson will include 6 stations around the room, with each biome having a station. At each station there should be supplementary books about each biome and pictures as visual examples of each biome. These pictures can come from old calendars, magazines or off the internet. Each student should have a clipboard, pencil, note-taking sheet provided as well as their Science Textbook.

Textbook pages
- Grasslands: B66
- Taiga: B67
- Tundra: B68
- Desert: B69
- Deciduous Forest: B70
- Tropical Forest: B71

7. Students will be working in groups to learn more about the 6 major biome ecosystems on earth. They will be reading about each biome at a station, looking at pictures and taking notes about each biome. They will also need to sketch something that might be found at each biome. The note-taking sheets are attached. (There are supplementary texts in the book room on each biome if you would rather those vs. the textbook.)

Assessment:
- Check Quiz: Provide a picture of each Biome and have students write down which biome they think it is, based on the elements in the photograph. (can be a picture of the outdoor scene from a magazine, old calendar, photograph)

Extensions:
- There is a video in the LMC titled: Discovery Channel: Habitats of the World
Unit: Ecosystems

- Biome Research Project-This is where many of you could insert your projects from previous years.
Biomes

Fill in the blanks. Reading Skill: Summarize - questions 10, 22

What Is a Biome?

1. The six major kinds of large ecosystems are called ________________.
2. Rich topsoil over clay is found in the ________________.
3. Acidic soil with a surface of decayed pine needles describes the ________________.
4. A biome with nutrient-poor soil near the equator is the ________________
   ________________.
5. You would find a soil poor in animal and plant decay products, but rich in minerals in a(n) ________________.
6. Nutrient-poor soil and permafrost are found in the ________________.
7. Rich topsoil and few trees characterize a(n) ________________.

What Are Grasslands?

8. Prairies and savannas are two types of ________________.
9. Grasslands in the United States are ________________, meaning mild.
10. Grasslands are called the ________________ of the world because they produce so much wheat, corn, and oats.

What Is the Taiga Like?

11. Lakes and ponds in the taiga were formed by moving ________________.
12. Taigas are mostly ________________ forests.

What Is the Tundra?

13. The biome located between the taiga and the polar ice sheets is the ________________.
14. Permanently frozen soil, or ________________, keeps water from flowing downward.
Biomes

Match the correct letter with the description.

1. a forest biome with many kinds of trees that lose their leaves each autumn
2. one of Earth’s large ecosystems, with its climate, soil, plants, and animals
3. a hot, humid biome near the equator, with much rainfall and a wide variety of life
4. a cold, treeless biome of the far north, marked by spongy topsoil
5. most lakes, streams, rivers, and ponds
6. a sandy or rocky biome, with little precipitation and little plant life
7. a cool, forest biome of conifers in the upper Northern Hemisphere
8. have tides, an upper region with many fish and whales, and a dark bottom

Identify the biome described by each of the following.

9. few plants live on its floor because little sunlight penetrates the thick canopy
10. plants grow deep roots to find scarce water
11. small plants have shallow roots and short growing seasons because of the permafrost
12. rainfall is irregular and much of this biome has been turned into farmlands
13. mostly conifer trees in a cool climate
14. leaves turn color and fall during autumn
15. has boiling vents on the dark floor
16. where frogs, turtles, and brook trout live

Vocabulary

a. biome
b. taiga
c. tundra
d. desert
e. deciduous forest
f. tropical rain forest
g. freshwater ecosystems
h. saltwater ecosystems
Biomes

Vocabulary

- minerals
- leaves
- tundra
- taiga
- permafrost
- grasslands
- plants
- biomes

Fill in the blanks.

Six major ecosystems, or ________, are located around Earth. The desert has soil that is rich in ___________. Prairie dogs and snakes live in American ___________. The cold biome in the far north is the ___________. Here, a layer of permanently frozen soil called ___________ keeps water from flowing downward. The greatest diversity of ___________ can be found in tropical rain forests. Mostly conifers grow in the ___________. Deciduous forests have many different trees that lose their ___________ each autumn.
What Is the Desert Biome Like?

15. A sandy biome with little precipitation and plant life is a(n) _____________.
16. Every continent has a desert, but the ________________ in Africa is the largest.

What Is a Deciduous Forest?

17. Many trees lose their leaves each year in a(n) _________________.
18. The word “deciduous” means ________________ to the ground.

What Are Tropical Rain Forests?

19. Tropical rain forests are near Earth’s _________________.
20. Little sunlight reaches the ground in a tropical rain forest because of the thick _________________.
21. Most of the life in a tropical rain forest is high up in the _________________.

What Are Water Ecosystems Like?

22. The main difference between Earth’s water ecosystems is _________________.
23. Organisms that float on the water are called _________________.
24. Organisms that swim through the water are _________________.
25. Organisms that dwell on the bottom are _________________.
27. Photosynthetic organisms cannot live in the _________________. region of the ocean because there is no sunlight.

Can Humans Change Water Ecosystems?

28. Many species of whales are threatened with _________________.
29. Whales were used for food, oil, and _________________.
30. The United States banned citizens from buying products made from whales in _________________.
Biomes
The World's Ecosystems

Name ___________________________
<table>
<thead>
<tr>
<th>Grassland</th>
<th>Taiga</th>
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<td>Location:</td>
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<td>Animals:</td>
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<td>Sketch:</td>
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<tr>
<td><strong>Tundra</strong></td>
<td><strong>Desert</strong></td>
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<td><strong>Location:</strong></td>
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<td><strong>Sketch:</strong></td>
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<td>Tropical Rain Forest</td>
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<td><strong>Sketch:</strong></td>
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</tbody>
</table>
What Is a Biome?

Maps like this one show one aspect of Earth. In this case, biomes are highlighted. Make sure you look at how each biome is indicated. Then read the map to see where various biomes can be found.

Study the map of biomes and answer the questions below.

1. What biome is found near the equator? _______________

2. What biome stretches across northern Africa? __________________

3. What biome is found just below the North Pole? _______________

4. What are the three main biomes found in the United States?

5. What biome do you live in? __________________
What Are Biomes?

The illustration below shows the Earth’s Climate Zones. As you read from North Pole To South Pole on the Earth, you will see that the climate zone changes. To the right, read the captions to become familiar with what kind of seasons are typical of each zone.

NORTH POLE

SOUTH POLE

Use the illustration below to answer the questions.

1. What is a climate? Name the type of climates shown above.

2. Why are climates different throughout the Earth?

3. Aside from sunlight, what else affects a climate?

4. What is the difference between a tropical climate and a polar climate?
Lesson Title: Lesson 3- Sun/Air/Soil-Water-Abiotic Factors

Overview: This lesson will focus on the abiotic factors in an ecosystem including sun, air, soil and primarily water. This lesson takes into consideration that the students have already learned about soil horizons in their study of geology, and that they have some background knowledge about the sun and air and their importance to life on earth.

Length: ~2 - 45 minute class periods

Standards/Benchmarks:

USSD Benchmarks

- F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.

Wisconsin EE Standards:

- C.8.2 Use environmental monitoring techniques; such as, observations, chemical analysis, and computer mapping software to collect data about environmental problems
- B.8.5 Give examples of human impact on various ecosystems
- B.8.6 Describe major ecosystems of Wisconsin
- B.8.16 Recognize the economic, environmental, and other factors that impact resource availability and explain why certain resources are becoming depleted
- B.8.17 Explain how human resource use can impact the environment; e.g., erosion, burning fossil fuels

Wisconsin Social Studies Standards:

- A.8.2 Construct mental maps of selected areas
- A.8.5 Identify and compare natural resource bases of areas
- D.8.7 Identify the location and use of natural resources
- A.8.1 Use a variety of geographic representations

Materials:

Day 1:
- 3 Glass Jars
- Water
- Apple
- Knife
- White Boards

Day 2:
- Posters for Game (Science Ecosystem Kit)
- Cards for Game (Science Ecosystem Kit)
- Beads (Science Ecosystem Kit)
- String (Science Ecosystem Kit)
- Dice
Abiotic Factors: Non-living parts of an ecosystem. Ex. water, minerals, sunlight, air, climate, soil.

Biotic Factors: Living parts of an ecosystem. Ex. animals, plants, fungi, protests, and bacteria.

Procedure:

Day 1:
1. Ask the students to use white boards to list the abiotic factors of an ecosystem (Sun, Air, Soil, Water). Write them on the board as the students suggest them to the class. Then ask the students to write underneath each abiotic factor, a purpose for that abiotic factor. Listed below are some examples, but it is possible for the students to come up with many more possibilities.

Examples:
- Sun: “Helps plants go through photosynthesis” or “heats the earth”
- Air: Provides Oxygen for life to breathe.
- Soil: Provides a place for plants to grow and water to filter through into groundwater.
- Water: Hydrates organisms on earth for growth and survival.

2. Explain that for the moment we are going to review what makes up the air. Have the students think back to their study of weather and remember what gases make up the air 78% -Nitrogen, 21% Oxygen, 1% Other Gases. Explain that what remains on earth is soil and water. Present an apple and explain that the apple represents earth, then cut 4 quarter slices (about $\frac{1}{4}$) of the apple. Ask the students how many quarters of the apple represents the land on earth and how many pieces represent the amount of water. Three of the quarters ($\frac{3}{4}$) is the amount of water, about 70%, and 1 quarter ($\frac{1}{4}$) is the amount of land (soil), 30%. Emphasize the importance of water on earth for organisms survival.


4. Explain that the next class period in science we will be focusing on the water on earth and in ecosystems.

- The students will use beads, string and dice to experience and review the parts of the water cycle in our ecosystem.

Assessment:
- Students will use the notes that they have taken from the Incredible Water Journey, to write a summary paragraph of the journey their water droplet took in their ecosystem.

Extensions:
<table>
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<th>Know</th>
<th>Want to Know</th>
<th>Learned</th>
</tr>
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</table>
Where will the water you drink this morning be tomorrow?

Summary
With a roll of the die, students simulate the movement of water within the water cycle.

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

Materials
- 9 large pieces of paper
- Copies of Water Cycle Table (optional)
- Marking pens
- 9 boxes, about 6 inches (15 cm) on a side (Boxes are used to make dice for the game. Gift boxes used for coffee mugs are a good size or inquire at your local mailing outlet. There will be one die [or box] per station of the water cycle. [To increase the pace of the game, use more boxes at each station, especially at the clouds and ocean stations.] The labels for the sides of the die are located in the Water Cycle Table. These labels represent the options for pathways that water can follow. Explanations for the labels are provided. For younger students, use pictures. Another option is to use a spinner—see the activity "A Drop in the Bucket" for spinner design. It is necessary to design a spinner for each station.)
- A bell, whistle, buzzer, or some sound maker

Making Connections
When children think of the water cycle, they often imagine a circle of water, flowing from a stream to an ocean, evaporating to the clouds, raining down on a mountaintop, and flowing back into a stream. Role-playing a water molecule helps students to conceptualize the water cycle as more than a predictable two-dimensional path.

Background
While water does circulate from one point or state to another in the water cycle, the paths it can take are variable.

Heat energy directly influences the rate of motion of water molecules (refer to the activity "Molecules in Motion"). When the motion of the molecule increases because of an increase in heat energy, water will change from solid to liquid to gas. With each change in state, physical movement from one location to another usually follows. Glaciers melt to pools which overflow to streams, where water may evaporate into the atmosphere.

Gravity further influences the ability of water to travel over, under, and above Earth's surface. Water as a solid, liquid, or gas has mass and is subject to gravitational force. Snow on mountaintops melts and descends through watersheds to the oceans of the world.

One of the most visible states in which water moves is the liquid form. Water is seen flowing in streams and rivers and tumbling in ocean waves. Water travels slowly underground, seeping and filtering through particles of soil and pores within rocks.

Although unseen, water's most dramatic movements take place during its gaseous phase. Water is constantly evaporating, changing from a liquid to a gas. As a vapor, it can travel through the atmosphere over Earth's surface. In fact, water vapor surrounds us all the time. Where it condenses and returns to Earth depends upon loss of heat energy, gravity, and the structure of Earth's surface.
Using station illustrations, create a one page graphic on which students record their movements during the Incredible Journey.

Water condensation can be seen as dew on plants or water droplets on the outside of a glass of cold water. In clouds, water molecules collect on tiny dust particles. Eventually, the water droplets become too heavy and gravity pulls the water to Earth.

Living organisms also help move water. Humans and other animals carry water within their bodies, transporting it from one location to another. Water is either directly consumed by animals or is removed from foods during digestion. Water is excreted as a liquid or leaves as a gas, usually through respiration.

When water is present on the skin of an animal (for example, as perspiration), evaporation may occur.

The greatest movers of water among living organisms are plants. The roots of plants absorb water. Some of this water is used within the body of the plant, but most of it travels up through the plant to the leaf surface.

When water reaches the leaves, it is exposed to the air and the sun's energy and is easily evaporated. This process is called transpiration.

All these processes work together to move water around, through, and over Earth.

**Procedure**

\[\text{Warm Up}\]

Ask students to identify the different places water can go as it moves through and around Earth. Write their responses on the board.

\[\text{The Activity}\]

1. Tell students that they are going to become water molecules moving through the water cycle.

2. Categorize the places water can move through into nine stations: Clouds, Plants, Animals, Rivers, Oceans, Lakes, Ground Water, Soil, and Glaciers. Write these names on large pieces of paper and put them in locations around the room or yard. (Students may illustrate station labels.)

3. Assign an even number of students to each station. (The cloud station can have an uneven number.) Have students identify the different places water can go from their station in the water cycle. Discuss the conditions that cause the water to move. Explain that water movement depends on energy from the sun, electromagnetic energy, and gravity. Sometimes water will not go anywhere. After students have come up with lists, have each group share their work. The die for each station can be handed to that group and they can check to see if they covered all the places water can go. The Water Cycle Table provides an explanation of water movements from each station.

4. Students should discuss the form in which water moves from one location to another. Most of the movement from one station to another will take place when water is in its liquid form. However, anytime water moves to the clouds, it is in the form of water vapor, with molecules moving rapidly and apart from each other.

5. Tell students they will be demonstrating water’s movement from one location to another. When they move as liquid water, they will move in pairs, representing many water molecules together in a water drop. When they move to the clouds (evaporate), they will separate from their partners and move alone as individual water molecules. When water rains from the clouds (condenses), the students will grab a partner and move to the next location.

6. In this game, a roll of the die determines where water will go. Students line up behind the die at
Where will this student go next on water's incredible journey?
# Water Cycle Table

<table>
<thead>
<tr>
<th>STATION</th>
<th>DIE SIDE LABELS</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>one side <em>plant</em></td>
<td>Water is absorbed by plant roots.</td>
</tr>
<tr>
<td></td>
<td>one side <em>river</em></td>
<td>The soil is saturated, so water runs off into a river.</td>
</tr>
<tr>
<td></td>
<td>one side <em>ground water</em></td>
<td>Water is pulled by gravity; it filters into the soil.</td>
</tr>
<tr>
<td></td>
<td>two sides <em>clouds</em></td>
<td>Heat energy is added to the water, so the water evaporates and goes to the clouds.</td>
</tr>
<tr>
<td></td>
<td>one side <em>stay</em></td>
<td>Water remains on the surface (perhaps in a puddle, or adhering to a soil particle).</td>
</tr>
<tr>
<td>Plant</td>
<td>four sides <em>clouds</em></td>
<td>Water leaves the plant through the process of transpiration.</td>
</tr>
<tr>
<td></td>
<td>two sides <em>stay</em></td>
<td>Water is used by the plant and stays in the cells.</td>
</tr>
<tr>
<td>River</td>
<td>one side <em>lake</em></td>
<td>Water flows into a lake.</td>
</tr>
<tr>
<td></td>
<td>one side <em>ground water</em></td>
<td>Water is pulled by gravity; it filters into the soil.</td>
</tr>
<tr>
<td></td>
<td>one side <em>ocean</em></td>
<td>Water flows into the ocean.</td>
</tr>
<tr>
<td></td>
<td>one side <em>animal</em></td>
<td>An animal drinks water.</td>
</tr>
<tr>
<td></td>
<td>one side <em>clouds</em></td>
<td>Heat energy is added to the water, so the water evaporates and goes to the clouds.</td>
</tr>
<tr>
<td></td>
<td>one side <em>stay</em></td>
<td>Water remains in the current of the river.</td>
</tr>
<tr>
<td>Clouds</td>
<td>one side <em>soil</em></td>
<td>Water condenses and falls on soil.</td>
</tr>
<tr>
<td></td>
<td>one side <em>glacier</em></td>
<td>Water condenses and falls as snow onto a glacier.</td>
</tr>
<tr>
<td></td>
<td>one side <em>lake</em></td>
<td>Water condenses and falls into a lake.</td>
</tr>
<tr>
<td></td>
<td>two sides <em>ocean</em></td>
<td>Water condenses and falls into the ocean.</td>
</tr>
<tr>
<td></td>
<td>one side <em>stay</em></td>
<td>Water remains as a water droplet clinging to a dust particle.</td>
</tr>
<tr>
<td>STATION</td>
<td>DIE SIDE LABELS</td>
<td>EXPLANATION</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Ocean</td>
<td>two sides <em>clouds</em></td>
<td>Heat energy is added to the water, so the water evaporates and goes to the clouds.</td>
</tr>
<tr>
<td></td>
<td>four sides <em>stay</em></td>
<td>Water remains in the ocean.</td>
</tr>
<tr>
<td>Lake</td>
<td>one side <em>ground water</em></td>
<td>Water is pulled by gravity; it filters into the soil.</td>
</tr>
<tr>
<td></td>
<td>one side <em>animal</em></td>
<td>An animal drinks water.</td>
</tr>
<tr>
<td></td>
<td>one side <em>river</em></td>
<td>Water flows into a river.</td>
</tr>
<tr>
<td></td>
<td>one side <em>clouds</em></td>
<td>Heat energy is added to the water, so the water evaporates and goes to the clouds.</td>
</tr>
<tr>
<td></td>
<td>two sides <em>stay</em></td>
<td>Water remains within the lake or estuary.</td>
</tr>
<tr>
<td>Animal</td>
<td>two sides <em>soil</em></td>
<td>Water is excreted through feces and urine.</td>
</tr>
<tr>
<td></td>
<td>three sides <em>clouds</em></td>
<td>Water is respired or evaporated from the body.</td>
</tr>
<tr>
<td></td>
<td>one side <em>stay</em></td>
<td>Water is incorporated into the body.</td>
</tr>
<tr>
<td>Ground Water</td>
<td>one side <em>river</em></td>
<td>Water filters into a river.</td>
</tr>
<tr>
<td></td>
<td>two sides <em>lake</em></td>
<td>Water filters into a lake.</td>
</tr>
<tr>
<td></td>
<td>three sides <em>stay</em></td>
<td>Water stays underground.</td>
</tr>
<tr>
<td>Glacier</td>
<td>one side <em>ground water</em></td>
<td>Ice melts and water filters into the ground.</td>
</tr>
<tr>
<td></td>
<td>one side <em>clouds</em></td>
<td>Ice evaporates and water goes to the clouds (sublimation).</td>
</tr>
<tr>
<td></td>
<td>one side <em>river</em></td>
<td>Ice melts and water flows into a river.</td>
</tr>
<tr>
<td></td>
<td>three sides <em>stay</em></td>
<td>Ice stays frozen in the glacier.</td>
</tr>
</tbody>
</table>
Unit: Ecosystems

Lesson Title: Lesson 4 - Ecosystem/Watershed Address

Overview: This lesson will focus on the ecosystem and watershed that the students at Foxview live in. They will be comparing their personal geographical address with their “Ecosystem Address”.

Length: ~3-45 minute class periods

Standards/Benchmarks:

USSD Benchmarks

- F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.

Wisconsin Science Standards:

- F.8.10 Project how current trends in human resource use and population growth will influence the natural environment, and show how current policies affect those trends.
- B.8.4 Describe types of reasoning and evidence used outside of science to draw conclusions about the natural world

Wisconsin EE Standards:

- B.8.6 Describe major ecosystems of Wisconsin
- B.8.16 Recognize the economic, environmental, and other factors that impact resource availability and explain why certain resources are becoming depleted
- C.8.2 Use environmental monitoring techniques; such as, observations, chemical analysis, and computer mapping software to collect data about environmental problems

Wisconsin Social Studies Standards:

- A.8.2 Construct mental maps of selected areas
- A.8.5 Identify and compare natural resource bases of areas
- D.8.7 Identify the location and use of natural resources
- A.8.1 Use a variety of geographic representations

Materials:

Day 1:

- White Boards
- Pictures of Branching Patterns Courtesy of Project WET, pg.132
- Maps of basic watersheds, Courtesy of River of Words Curriculum, pgs.27-28 & 34 * Student Copies Needed
- Transparencies of Watersheds in Wisconsin, Courtesy of River of Words Curriculum, pgs. 34-50.
- Thin Markers

Day 2:

- Groundwater, Wisconsin’s buried Treasure in Groundwater Kit in Science Storage Room, Downstairs.
Unit: Ecosystems
- Groundwater Model, Stored in Room B109, Stephanie Lehnert’s Room.

**Vocabulary:**
- Watershed: An area that all water in the region drains into.
- Lake: A body of water surrounded by land.
- River: A flowing body of water that begins at a source and opens at a mouth into another body of water such as a lake, pond or ocean.
- Stream: A small body of water that flows from a larger body of water.
- Ocean: A large body of saltwater on Earth.
- Groundwater: Water that is found underground between cracks in rock and soil.

**Procedure:**

**Day 3:**
1. Have the students think about their address. Ask them the following questions and have them record their answers on their white boards.
   - What planet do we live on?
   - What hemisphere on this planet?
   - What continent in this hemisphere?
   - What country on this continent?
   - What region in this country?
   - What state in this region?
   - What part of the state?
   - What county in this part of the state?
   - What city/town in this county?
   - What is your street address?

*After going over the answers stress the purpose of this small activity is to help the students be able to define where they live. Explain that organisms have ecosystem addresses too. It begins with biomes, climates, then **watersheds**, then micro-climates/ecosystems. Since we have studied biomes already we are going to focus on what is a watershed, and what is your watershed address.*

2. Hand out the student copy from Project WET, with different types of branching patterns, such as veins in a body, branches on a tree, systems of roads, and finally drainage patterns of rivers and streams in a watershed. On the other side of the page there is a map of streams and rivers in the Missouri River watershed pg. 27. Ask the students to get out a red, blue, purple and green thin marker.

Provide the following directions and do the same on an overhead of the same watershed:
- Starting where the Missouri River meets the Mississippi River (mouth of the river), have the students use their blue marker and trace only the Missouri River, not the branching patterns.
- Then have the students trace the rivers that branch out only from the Missouri River with a red marker.
- Then have the students trace in green the rivers/streams that branch out from the rivers they traced in red.
- Finally, take the purple marker and place dots at the end of green rivers and streams. Then use that marker to draw a curving line that connects the dots from the Mouth of the Missouri River system all the way around to create a closed area. This is called the Missouri River Watershed.
3. Define Watershed on the board: Watershed: An area that all water in the region drains into.

4. Explain that all continents are made up of watersheds. Display the map of Wisconsin’s Sub-Watersheds. Have the students use a marker to trace the line on the map that says “Lake Michigan Watershed” on the East Side and “Mississippi River Watershed” on the West Side. It starts at the far south-eastern corner of the map and follows North passing Milwaukee, curving over to the west and then North again to the border with Upper Michigan. This means all of the water to the east of that line drains to Lake Michigan to the Atlantic Ocean, and all of the water to the west of that line eventually drains to the Mississippi River to the Gulf of Mexico. It is called the Sub-Continental Divide.

5. Next, explain that each watershed has a major water source that all the rivers and streams branch out of. It could be a lake, or a large river. Ask the students what major river runs through our city? (Fox River) Our Watershed is called the Fox River Watershed. Many watersheds are named for the major water source. Find the Fox River Watershed on the Wisconsin Watershed Map and have the students shade it in or trace around it.

6. Finally, summarize our Watershed Address. Have the students figure out what watershed we live in. They should be able to deduce that we are a part of the Lake Michigan/Fox River Watershed. Emphasize, that the reason for knowing this information is because we need to know where we get our water from, and where all of our water will return to. Ask if someone knows where the people in De Pere/Ledgeview get their water? (Answer: A pipeline to Lake Michigan) If they live in Morrison, they would get their water from a well drilled into the groundwater, and explain that we will be studying groundwater tomorrow.

Day 4:

1. Yesterday, we took a look at watersheds. Review the watershed we live in, Lake Michigan/Fox River Watershed. Provide the students with a United States Map, (in the back of their atlases). Have them brainstorm in small groups or partners why we might be very lucky to be part of the watershed we live in compared to someone living in the Southwest United States (Arizona, Nevada, New Mexico). Answer: We have easy access to a lot of fresh, drinkable water with the Great Lakes nearby, as well as the fact that Wisconsin’s climate allows for a lot of precipitation in the form of snow and rain which adds more water to the watershed compared to desert region of the Southwest which doesn’t get a lot of precipitation.

2. Why do we need water? What do we use it for? List on the board with the class uses for water.
   - Plant growth
   - Bathing
   - Drinking
   - Cooking
   - Cleaning
   - Flushing the Toilet
   - Brushing your Teeth
   - Washing Clothes

3. Explain that yesterday we learned that we get our water from Lake Michigan, but there are many people around the world who get their water from the ground.
Unit: Ecosystems

4. Hand out the Groundwater: Wisconsin’s Buried Treasure Booklets. Read with the class and discuss along with the reading pg. 3-7. Have the groundwater model on display, while reading to help demonstrate the cross-section of our groundwater flow under the surface of the earth.

5. Using the Groundwater Model, insert blue dye into the model to show the flow of groundwater through the sediments. Point out that groundwater always flows back to major water source in the watershed. (Please ask Cara Berken or Stephanie Lehnert to give you a brief training on the model before use)

6. Have the students take a blank piece of white paper and draw a diagram of the groundwater model and the flow of the groundwater. Include the steps in the water cycle on the diagram.

7. Finally, ask students to brainstorm how humans can affect watersheds? Examples: Pollution Directly into the water sources, Leakages of contaminants into the groundwater, Shortages of water, Acid Rain. In the next lesson we will focus on how humans affect watershed ecosystems.

Assessment:

- Optional Assessment: Assess the student’s basic knowledge and understanding of watersheds by having them write a paragraph describing the water drainage patterns of the Fox River Watershed, as part of the Lake Michigan Watershed. They can use the pictures, maps and models created in class to help them compose their paragraphs.

Extensions:
Lesson Title: Lesson 5- Human Effects on Watersheds - Waterway Contamination/Groundwater Contamination

Overview: This lesson will focus on how humans can affect watershed ecosystems, and what are some results of those actions. The lesson emphasizes point source pollution, and non-point source pollution.

Length: 3-45 minute class periods.

Standards/Benchmarks:

USSD Benchmarks
- F.8.8 Identify how human activities affect an ecosystem in beneficial or harmful ways.

Wisconsin EE Standards:
- B.8.15 Analyze how people impact their environment through resource use
- B.8.18 Identify major air, water, or land pollutants and their sources
- B.8.19 Distinguish between point* and non-point source* pollution*
- B.8.21 Identify and analyze individual, local, regional, national, and global effects of pollution* on plant, animal, and human health

Wisconsin Science Standards:
- H.8.2 Present a scientific solution to a problem involving the earth and space, life and environmental, or physical sciences and participate in a consensus-building discussion to arrive at a group decision

Materials:
Day 1:
- Lesson: Sum of Parts from Project WET
- White paper (Create the shoreline before class begins, depending on the amount of students in the class 12 on each side for a class of 24 people)
- Pencils
- Colored chips to represent types of pollution:
  Orange: Hazardous Waste
  Brown: Wastewater contamination
  Black: Oil/Gasoline Pollution
  Green: Fertilizers
  Red: Garbage

Day 2:
- Water Contaminants Chart
- KWL Chart

Day 3:
- Groundwater Model
- Groundwater: Wisconsin’s Buried Treasure Booklets
Branching Patterns

- Human nervous system
- Watershed drainage pattern
- Road system
- Tree in winter
The Great Lakes Watershed

[Map of the Great Lakes watershed showing major lakes, rivers, and states involved.]

- Lake Superior
- Lake Michigan
- Lake Huron
- Lake Erie
- Lake Ontario
- Hudson Bay
- Ogoki River
- Kenogami River
- Albany River
- Agassiz River
- Long Lake
- Lake Nipigon
- Straits of Mackinac
- St. Marys River
- Chicago Waterway System
- Illinois River
- St. Clair River
- Detroit River
- Welland Canal
- Niagara River
- St. Lawrence River
- Atlantic Ocean
- Ontario
- Quebec
- Michigan
- Indiana
- Ohio
- Pennsylvania
- New York
- Minnesota
- Wisconsin
- Illinois
Sub-Watersheds in Wisconsin

- Saint Croix
- Chippewa
- Black-Buffalo Trempealeau
- La Crosse-Bad Axe
- Wisconsin
- Grant-Sugar-Pecatonica-Platte
- Illinois-Fox
- Fox
- Wolf
- Milwaukee
- Root-Pike
- Sheboygan
- Lake Shore
- Green Bay

Watershed Boundaries
Counties
Bodies of Water
Rivers
Lesson Title: Lesson 5- Human Effects on Watershed Ecosystems- Water Contamination/Groundwater Contamination

Overview: This lesson will focus on how humans can affect watershed ecosystems, and what are some results of those actions. The lesson emphasizes point source pollution, and non-point source pollution.

Length: 3- 45 minute class periods.

Standards/Benchmarks:

USSD Benchmarks
- F.8.8 Identify how human activities affect an ecosystem in beneficial or harmful ways.

Wisconsin EE Standards:
- B.8.15 Analyze how people impact their environment through resource use
- B.8.18 Identify major air, water, or land pollutants and their sources
- B.8.19 Distinguish between point* and non-point source* pollution*
- B.8.21 Identify and analyze individual, local, regional, national, and global effects of pollution* on plant, animal, and human health

Wisconsin Science Standards:
- H.8.2 Present a scientific solution to a problem involving the earth and space, life and environmental, or physical sciences and participate in a consensus-building discussion to arrive at a group decision

Materials:

Day 1:
- Lesson: Sum of Parts from Project WET
- White paper (Create the shoreline before class begins, depending on the amount of students in the class 12 on each side for a class of 24 people)
- Pencils
- Colored chips to represent types of pollution:
  - Orange: Hazardous Waste
  - Brown: Wastewater contamination
  - Black: Oil/Gasoline Pollution
  - Green: Fertilizers
  - Red: Garbage

Day 2:
- Water Contaminants Chart
- KWL Chart

Day 3:
- Groundwater Model
- Groundwater: Wisconsin’s Buried Treasure Booklets
Day 4: All items can be found in Ecosystem Science Kit.
• Grape Kool-Aid Powder
• Glass Cake Pan
• Water Spray Bottle
• 6-Aluminum Pans
• Sand
• Lemonade Powder Mix
• pH strips

Procedure:

Day 1: Sum of Parts
1. In this activity students will explore point and non-point source pollution in river waterways, and more specifically tying it to the Fox River.

Scenario: Each student inherited a piece of waterfront property. Tell the students that money is no object, and have them sketch what they would do with their property. Try not to lead them in any specific direction, and don’t let them know that all of these sketches will be connected at the end.

2. Students will draw a map of what they would put on a river front property they own. Each student will be given a piece of paper with a blue water line drawn mid-way down the page. There will also be a number on the back of the page to match it to the rest of drawings in the class.

3. After the pictures/maps have been drawn the students will put them together on the floor to create the river shoreline. Each student will describe their property. As they describe their property your responsibility is to explain the pollution that they have contributed to river and their neighbors. Examples: Farms-Chemical Fertilizers in the river, manure contamination, overuse of the water for irrigation. Buildings/pavement: Run-off of oils and chemicals from cars etc. Noise Pollution, garbage, wastes, companies displacing wastes into the river etc.

4. A discussion will follow regarding how one persons contact with a river waterway affects the environment up and down stream of them and throughout the watershed.

5. Direct students to a list of possible contaminants to waterways in their area. Split the class into 5 groups, designate one contamination source per group. Ask the students to brainstorm 1-2 possible solutions or ways they could do to help remedy the source of contamination. After they have met in their groups they will need to have one representative share their group’s ideas with the rest of the class.

6. Summarize that all of this water contamination can be separated into two types and have the students record these definitions in their notebooks:

   Non-Point Source Pollution: Indirect pollution from a source that is unknown.
   Point Source Pollution: Direct pollution from a known source.

y 2: Waterway Contamination
Unit: Ecosystems

1. Activate prior knowledge by having students fill in a KWL chart about water and water contamination in their city or town. K-What the students already know. W-What the students want to know. The L (What the students have learned.) portion of the chart should be reserved for the assessment at the end of the lesson on waterway contamination.

2. Have the students access the list of possible water contamination sources, and the brainstormed solutions that the students came up with. Prepare ahead of time an object that stands for each source of contamination.
   a. Litter – Dirty plastic bottle and/or empty wrappers
   b. Pet Waste – Large tootsie roll candy, unwrapped or empty toilet paper roll
   c. Yard Waste – Bag of leaves or grass clippings
   d. Fertilizers and Lawn Chemicals – Empty plastic bottle with grape Cool-aid in it.
   e. Salt from winter storms – Empty Bag of Salt from Winter or Salt Shaker
   f. Car Wash Water (oils, gas, engine fluids etc.) – Empty 2 liter bottle of “dirty” water
   g. Waste motor oil and antifreeze - Empty container of oil or jug of Chocolate milk
   h. Household hazardous wastes - Can of Paint
   i. Dirty Construction Sites – Bag of Sand or dirt
   j. Sewage Treatment Plant Overflow – Flat pan or Tupperware with not completely solid green gelatin in it.

As you display each item, and explain what it stands for pour some of it into a large, clear Tupperware container to act as the storm sewers. Keep reminding the students that this will be what needs to be cleaned up at the water treatment plant before it is ready for you to drink. This is done for shock effect, and to display how serious the contamination problem really is.

3. Students will need to list, in the “L” column of their KWL charts, at least 5 new things that they have learned about waterway contamination.

Day 3: Groundwater Contamination using the groundwater model

1. Display the groundwater model and review with students how water flows in the groundwater system back to the major water source.
2. Read pgs. 10-15 in Groundwater: Wisconsin’s Buried Treasure, about “Threats to Groundwater.” Have the students add to the list from the previous lesson of the possible contaminants that could get into the groundwater.
3. Use the groundwater model to demonstrate the movement of contamination through the groundwater system, from the leaky landfill, well contamination and direct contamination with the soil.

Day 4: “Pucker Effect”

1. Demonstrate the “Plume of contamination” by putting sand in a glass cake pan. Bury ahead of time some grape Kool Aid in an area of the pan, and cover it with a bit more sand. Show students the pan of sand and ask them if they think the sand is contaminated? Then use a spray bottle to simulate rain on the sand. Soon if you look at the bottom of the pan you will see a “plume” of purple that starts out small in diameter. Prop up the pan on one end, with the contamination at the high end. Leave it sit while the students are doing an activity, and check it later. (The “plume” should get significantly larger in diameter to simulate the spreading of contamination in the soil.
2. “Pucker Effect” Activity: Provide students with the “Pucker Effect” Data Sheets, a tin pan, with sand in it, and a small spoonful of lemonade (hence the “pucker”-lemon makes your lips pucker)

Present the following scenario:
Tell the students that the Limonada Lemonade Factory had a contamination spill of the lemon powder that goes into their lemonade production. It seems that the residents nearby were finding that their lips were “puckering” after drinking their tap water. You are part of a soil testing company sent to investigate
Unit: Ecosystems

where the spill is. Use pH strips to determine where the contamination of lemon powder is. (You may need to refresh student’s memory about the colors of pH strips and their meaning.)

3. In small groups, students should bury the lemon powder in an area and draw it on their data sheet. Then they will be trading with another group to “investigate”.

4. Conclusion: You may think that lemonade is not a contaminant for the groundwater, but any substance in large quantities can be considered a contaminant, even milk.

Assessment:

Extensions:

***Invite a guest speaker to come to your class, and speak about water contamination. The focus in this case would be the sources of water contamination, and the process that occurs after it rains. This could be someone from your county’s land and water conservation organization, or a group such as the Fox River Clean River Project. Search your city or county’s website for more information.

1. Students should listen attentively to the speaker, and ask their prepared questions when appropriate. If they should have more questions, they can ask more if there is enough time.

2. Students should answer the following questions as a way to evaluate the guest speaker.
   - Did the speaker share their knowledge in a way that was easy to follow?
   - What did you learn from the speaker that you did not before?
   - Would you recommend that this speaker be asked to present for future classes?
**Project Pucker Effect: Data Sheet**

Team Name ___________________________________ Teacher: ___________________________________

Team Members __________________________________ Date: ____________________________

Misting Water pH Value: ______________________ Affix Paper Here

### SITE MAP

| Raised end of tray (marked “X”) |
|---------------------------------

Low end of tray

---

The Pucker Effect
Project WET Curriculum and Activity Guide
What if Water Cost as Much as Gasoline?
Activity Sheet

Sale on water! Only _________ per gallon!

A) Multiply the number of gallons of water listed after each use below by the price per gallon. Put this answer in the space provided. An example has been done for you using the price of $1.00 per gallon of water.

example: Bath 30 gallons x $1.00 = $30.00 per bath

B) Each time you use water:

1. Put a mark (I) after the type of water use. Keep a tally of each use.

2. The price listed under "cost" will tell you how much to pay for that water use. Now put that amount of money in your envelope.

<table>
<thead>
<tr>
<th>Use</th>
<th>Price per Gallon</th>
<th>Cost per Use</th>
<th>Check here each time you use water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washing dishes by hand</td>
<td>10 gallons</td>
<td>X _________  = _________ each use</td>
<td>☐</td>
</tr>
<tr>
<td>Automatic dishwasher</td>
<td>11 gallons</td>
<td>X _________  = _________ each use</td>
<td>☐</td>
</tr>
<tr>
<td>Flushing toilet</td>
<td>4 gallons</td>
<td>X _________  = _________ each use</td>
<td>☐</td>
</tr>
<tr>
<td>Cooking &amp; drinking</td>
<td>3 gallons</td>
<td>X _________  = _________ each use</td>
<td>☐</td>
</tr>
<tr>
<td>Washing hands</td>
<td>1 gallon</td>
<td>X _________  = _________ each use</td>
<td>☐</td>
</tr>
<tr>
<td>Brushing teeth (water running)</td>
<td>2 gallons</td>
<td>X _________  = _________ each use</td>
<td>☐</td>
</tr>
<tr>
<td>Shower</td>
<td>18 gallons</td>
<td>X _________  = _________ each use</td>
<td>☐</td>
</tr>
<tr>
<td>Bath</td>
<td>30 gallons</td>
<td>X _________  = _________ each use</td>
<td>☐</td>
</tr>
<tr>
<td>Washing clothes</td>
<td>30 gallons</td>
<td>X _________  = _________ each use</td>
<td>☐</td>
</tr>
<tr>
<td>Water Contaminants</td>
<td>Solutions</td>
<td>Metaphor Example</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td>Litter</td>
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<td>Pet Waste</td>
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<tr>
<td>Yard Waste</td>
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<tr>
<td>Fertilizers and Lawn Chemicals</td>
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<tr>
<td>Salt from winter storms</td>
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<tr>
<td>Car Wash Water (oils, gas, engine fluids etc.)</td>
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<tr>
<td>Waste motor oil and antifreeze</td>
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<tr>
<td>Household hazardous wastes</td>
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<tr>
<td>Dirty Construction Sites</td>
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</table>
Unit: Ecosystems  
Lesson Title: Lesson 6- Organization of Living Things

Overview: This lesson will focus on how living things are organized in an Ecosystem. The lesson will use the Blackland Prairie ecosystem in North America as an example ecosystem, and the living things in that ecosystem. It is primarily based out of the textbook, and will require whole class reading and ecosystem vocabulary.

Length: 1- 45 minute class periods

Standards/Benchmarks:

USSD Benchmarks

- F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.

Wisconsin EE Standards:

- B.8.8 Explain interactions among organisms or populations of organisms
- B.8.11 Describe our society* as an ecosystem*
- B.8.4 Map the levels of organization of matter; e.g., subatomic particles through biomes

Wisconsin Science Standards:

- F.8.2 Show how organisms have adapted structures to match their functions, providing means of encouraging individual and group survival within specific environments

Materials:

- Textbook: Macmillian /McGraw Hill Science: Unit B Living Things and Their Environments
- Worksheet: “Organization of Living Things”

Vocabulary:

- Population: All organisms of a species living in an area.
- Community: All the populations living in an area.
- Habitat: The place where an organism lives.
- Niche: The role of an organism in the community.

Procedure:

1. Explain that each ecosystem has special components as far as living and non-living elements that are unique to that ecosystem. The Blackland Prairie is the largest prairie ecosystem remaining in the United States. In our reading today we will be learning about this ecosystem and its biotic and abiotic factors.

2. Read pgs. B8-B10 in the Textbook listed above in the materials section. Have the students help you generate a chart of the abiotic and biotic factors in this prairie ecosystem on the board.
Unit: Ecosystems

3. Explain at this point that we will be taking a closer look at the biotic factors of ecosystem (living things/organisms) for the next few days. Living organisms are all part of groups/families just as you are part of a family, a school, a classroom, an age group etc.

4. Hand out the worksheet with the “Organization of Living Things” and read pgs. B11-13 in the textbook. The students should be filling out the definitions on the worksheet as we go along.

Assessment:

• Have the students complete the portion of the worksheet that helps them practice with the “Organization of Living Things”.

Extensions
Organization of Living Things

Population: Black Bear
Community: Habitat:
Niche:

Population: Polar Bear
Community: Habitat:
Niche:

Population: Robin
Community: Habitat:
Niche:

Population: Penguin
Community: Habitat:
Niche:
Unit: Ecosystems

Lesson Title: Lesson 7- Basic Needs of Living Things

Overview: This lesson will focus on the basic needs of living things and understanding the food chain in Earth's ecosystems.

Length: 2- 45 minute class periods

Standards/Benchmarks:

USSD Benchmarks

- F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.

Wisconsin EE Standards:

- B.8.4 Map the levels of organization of matter; e.g., subatomic particles through biomes
- B.8.8 Explain interactions among organisms or populations of organisms

Wisconsin Science Standards:

- F.8.2 Show how organisms have adapted structures to match their functions, providing means of encouraging individual and group survival within specific environments

Materials:

- Textbook: Macmillian /McGraw Hill Science: Unit B Living Things and Their Environments
- “Basic Needs” Chart

Vocabulary:

- Food Chain: The path that energy takes from producers to consumers to decomposers.
- Producer: A plant organism that can be consumed by other organisms.
- Consumer: An organism that eats other organisms plants or animals.
- Omnivore: An animal that eats both animals and plants.
- Carnivore: Animals that eat other animals. (Meat)
- Herbivore: Animals that eat only plants.
- Decomposer: Organisms that break down dead matter into substances that can be used by producers.

Procedure:

Day 1:

1. Have the students fill in the “Basic Needs” chart for People, Pets, Wildlife with a pencil so that they can change their answers after our discussion. Discuss the basic needs of the three categories of living things. The message should be that all organisms have the same basic needs: Food, Water, Shelter and Space.

2. Next take the students outside for an activity that demonstrates living things in their habitats. It is called the “Habitat Lap Sit” taken from Project Wild. Have the students stand in a circle
Unit: Ecosystems

shoulder to shoulder. Then have them go around the circle and assign different needs such as food, water, shelter, and space. Tell them they are all the basic needs in an animal’s habitat. Then ask them to turn to face the back of the person in front of you, and take one giant step into the circle. Then ask them to sit back on the lap of the person behind you like you are sitting in a chair. Some students at this point will fall down and there will be some laughter. When that happens compare the collapse to what would happen if one of the basic needs of an animal are taken away.

3. Experiment with a variety of different scenarios such as tell one of the students that represents water that there was a drought year, and tell them to step out of the circle. The circle should collapse. Some other options are pollution of food or water supply, urban sprawl to limit availability of some basic needs.

Day 2:

1. Read pgs. B 18-19 in the textbook focusing on the food chain.
2. Have the students create a 3 fold booklet. Label one end fold producers, one end fold consumers and the middle fold the Food Chain. Define each one of those terms right below each term.
3. Explain to the students that we will be taking a walk outside and you will need to record the living things you encounter on the walk on the producer and consumer folds of the booklet. Tell the students that they will be making the food chain drawings when we go back inside. (Take clipboards out on the walk).
4. When the students are finished, take them back to the classroom to complete their food chain drawings.
5. Read pgs. B20-B24. Have the students record the definitions of the terms carnivore, herbivore, omnivore, decomposer.

Assessment:

- Individual Population Interaction Activity with animals in our local Great Lakes Watershed see “Great Lakes in Our World Curriculum Guide” Creature Cards. (Make 4 sets). Provide students with a variety of the creature cards for the Great Lakes, and have them create food chains/webs using the local organisms. Directions specifically are detailed on the deck of cards. (*An adaptation to the Explore Activity on p. B 17 in the textbook)

Extensions:

- Tangled Web (Explore 10) taken from Great Lakes in My World Curriculum Guide. Students make a yarn web of connections between Great Lakes Species, and discuss the significance of the complexity of the web and discover the impacts of changes to the web. (See attached)
<table>
<thead>
<tr>
<th>Producers</th>
<th>Consumers</th>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Food Chains in Foxview’s Ecosystem</strong>...</td>
<td><strong>More Food Chains</strong></td>
</tr>
<tr>
<td>1.</td>
<td>3.</td>
</tr>
<tr>
<td>2.</td>
<td>4.</td>
</tr>
</tbody>
</table>
Animal Food Consumption

Carnivore:

Examples:

Herbivore:

Examples:

Omnivore:

Examples:
### Where does your food come from?

<table>
<thead>
<tr>
<th>Type of Food:</th>
<th>Type of Food:</th>
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<tbody>
<tr>
<td>Flow chart:</td>
<td>Flow chart:</td>
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</table>
Where does your food come from?

<table>
<thead>
<tr>
<th>Type of Food:</th>
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<tbody>
<tr>
<td>Flow chart:</td>
<td>Flow chart:</td>
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</table>
What Is a Food Chain?

This illustration shows the members of a prairie food chain. You can see both producers and consumers. Identify where you think the food chain starts. Then follow the chain from one member to the next.

Answer these questions about the illustration above.

1. Where does the food chain start?

2. What producers are in the food chain?

3. What is the first consumer in the food chain?

4. What other consumers are in the food chain?

5. What is the direction of energy flow in this food chain?

6. What happens to the hawk?
Where Do Organisms Live?

Some diagrams are supposed to be read in a certain order. They may have arrows to show you the order to follow.

The diagram below shows a food chain of the forest biome. Use the arrows to guide you through the chain.

Forest Food Chain

Answer these questions about the diagram above.
1. How does the grasshopper obtain energy from the sun?
   
2. Which animal is a third-level consumer and which animal does it consume?
   
3. How does the sparrow get energy from the first-level consumer?
   
4. What is the last element in this food chain?
Snakes → Hawks → Mountain lions

Insect-eating birds → Snakes

Rabbits → Insect-eating birds

Grasshoppers → Insect-eating birds

Mice → Insect-eating birds

Grass → Grasshoppers

Bark beetles → Seedeating birds

Trees → Seeds

Earthworms

Fungi
**summary**

Students make a yarn web of connections between Great Lakes species, discuss the significance of the complexity of the web and discover the impacts of changes to the web.

**objectives**

- List five to eight connections between Great Lakes organisms in a food web.
- Explain the impacts of changes in a Great Lakes food web.
- Diagram a small food web.

**prerequisite**

Lake Connection, Eco-Language, Fish Observation, A Closer Look

**vocabulary**

*Food web:* the whole group of interacting food chains in a living community

**materials**

- Creature Cards with asterisk (*)
- Ball of yarn
- Masking tape

**resouces**

Food Web sites:
- Environmental Protection Agency
  www.epa.gov/glncp/atlas/images/big05.gif
- Michigan Sea Grant
  www.miseagrant.umich.edu/education/foodweb.html
- Michigan Tech
  www.techaline.mtu.edu/meed/module08/FoodWeb.htm
background

Information on the eating habits of the organisms can be found on the backs of the Creature Cards. Food chains that show feeding relationships in an ecosystem are part of large and complex food webs. By exploring these relationships, students become familiar with the concept of food webs, as well as the different plants and animals that inhabit the Great Lakes. Information on eating habits can be found on the backs of the Creature Cards.

procedure

1. Have students brainstorm a list of species in the lake. Use the Creature Cards to help guide their responses. Give each student one Creature Card. Using those from the aquatic ecosystem will work best (with asterisks). Include organisms students have learned about in the two previous activities.

2. Have students hold the cards or attach them to their shirts with masking tape so that everyone can see the pictures. Have students sit in a circle and announce the names of their organisms.

3. Holding the ball of yarn, tell students that you represent the sun. You will give your energy to one of the plants, e.g., algae, by holding onto the end of the yarn and passing the ball to a student with a plant card. When a student receives the ball of yarn, she or he should hold it onto one end, and pass the ball to a student with the card of an organism that his/her organism could eat OR be eaten by. For example, the algae could pass the yarn to a zooplankton, who could pass it to a forage fish or vice versa. Students should look at the backs of their Creature Cards to determine what the organism eats or is eaten by. Continue passing the yarn until it has reached everyone at least once. Continue the game as long as you can find new connections. Since each student is holding onto a piece of the yarn, a web should be forming between the students.

4. It is very important that each time the yarn is passed, students realize that it can go to the organism that eats their creature OR to an organism their species eats. Otherwise, a food web will not be created. Some creatures may be included more than once. Make sure all creatures become part of the web. This may involve some problem-solving.

5. At this point, give a hypothetical situation (positive or negative) that affects a species. For example, if the lake trout have been over-fished, have the “lake trout” give a light tug on his/her piece of the yarn. Have students “tug back” when they feel the tug, raising their hands as they tug for a visual of the web interconnections. For each species, at least two others will feel a tug on the yarn. Soon all students will be gently. You can also have the “lake trout” drop the yarn and have the rest of the class readjust the web to account for the change. Other scenarios could include: (+) a comeback in the yellow perch population, wetland habitat restoration, or (-) a wetland is filled, impacting species who spawn in the wetland; mercury has entered the lake, causing aquatic birds to die; or zebra mussels have entered the food web, reducing the amount of food available for native fish.

6. Discuss:
   • What did the yarn look like after it had been passed to everyone? A web.
   • Why did it look like this instead of a straight line or circle? The food web connections are complex, like a web.
   • What happened when one organism dropped the yarn? Did the web stay the same, fall apart completely, or something else? The rest of the web had to readjust. Other organisms were impacted, but the whole web did not collapse because it is complex enough that it can change and still survive.

7. What would happen if more and more scenarios were introduced, eliminating more parts of the food web? The food web would ultimately look a lot different from the way it looked originally, and would be more simplified. Food webs that lack complexity are not as resilient to change as those with a diverse group of organisms.

Satisfy Your Curiosity QUESTION IDEAS

• Where does my species fit into the food web?
• What eats my species?
• What does my species eat?
• What other organisms does my species impact?

wrap-up

Use the journal pages for the following:

1. Food Web Diagram: Have each student create a food web diagram that includes five to eight organisms. The food web should include several food chains. Use arrows to indicate who eats who, and include all types (decomposers, producers, herbivores, omnivores, carnivores, scavengers). Students may need to ask questions of others who had different Creature Cards.

2. Have each student write a brief essay that articulates how his/her organism fits into the food web. In the essay, the student should explain the effect of changes in the food web, and begin to draw conclusions about what happens to a food web when species are eliminated.

assessment

Rubric on page 86
[1] Draw a picture of a lake food web. Include 5-8 species in your picture, and arrows to show how they are connected.

[2] Write about how your organism fits into the food web. Explain the impact changes have on the food web. Draw conclusions about what happens to a food web when species are reduced or increased.
Great Lakes in My World

Creature Cards

Over 60 illustrated information cards featuring Great Lakes plants and animals
Great Lakes Creature Cards familiarize students with sixty of the plants and animals that inhabit the region, an essential part of learning about the Great Lakes. They have illustrations on one side and information on the other and can be used in various ways.

**Why**
Great Lakes Creature Cards familiarize students with sixty of the plants and animals that inhabit the region, an essential part of learning about the Great Lakes. They have illustrations on one side and information on the other and can be used in various ways.

**How To Use**
Use the cards with the Great Lakes In My World curriculum activities listed below. You can also use them as flashcards, or have students sort them into various groups (by kingdom, class, habitat, position in food chain, etc.). With two sets, students can play a variety of card games such as Memory, Go-Fish, Old Maid or Rummy.

**Use Great Lakes Creature Cards with:**

**Lake Unit:**
- Satisfy Your Curiosity
- A Closer Look
- Fish Observation
- Web of Life
- Tangled Web
- What's New?
- It Adds Up and Up

**Dune Unit:**
- Satisfy Your Curiosity
- Adaptations and Observations
- Adaptation Stories
- Succession
- Living Dune
- Dune Project
- Indoor Dunes

**Human Communities Unit:**
- Who Lives in My Community?

**History Unit:**
- Something's Fishy

**Name:**
Species' common and scientific names are provided.

* Indicating that this card can be used in the activities Tangled Web and Web of Life.

**who?**
**description**
A description of the species that includes type, physical characteristics and species status (endangered, invasive, etc.)

**where?**
**environment**
An explanation of the species' general environment and specific habitat

**what?**
**characteristics**
Facts about the species role in the food web, reproduction and other distinguishing habits

---

**Scale:** A scale conveys the relative size of the species. A darkened column indicates the species place in the size range. The sizes for each column are as follows:

- #1: less than .6 cm/.25 in
- #2: .6 cm/.25 in - 6.3 cm/2.5 in
- #3: 6.6 cm/2.6 in - 30 cm/12 in
- #4: 31 cm/12.1 in - 61 cm/24 in
- #5: 63.5 cm/25 in - 122 cm/48 in
- #6: 123 cm/48.5 in - 183 cm/72 in
- #7: more than 183 cm/72 in

**Size:**

---

**Interesting Fact**
Characteristics that make this plant or animal unique
Lesson Title: Lesson 8- Relationships in an Ecosystem

Overview: This lesson will focus on organism relationships in an ecosystem, and how different organism relationships can affect populations of organisms negatively and positively.

Length: 2-45 minute class periods

Standards/Benchmarks:

USDD Benchmarks

- F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.

Wisconsin EE Standards:

- B.8.8 Explain interactions among organisms or populations of organisms

Wisconsin Science Standards:

- F.8.8 Show through investigations how organisms both depend on and contribute to the balance or imbalance of populations and/or ecosystems, which in turn contribute to the total system of life on the planet
- F.8.9 Explain how some of the changes on the earth are contributing to changes in the balance of life and affecting the survival or population growth of certain species
- F.8.10 Project how current trends in human resource use and population growth will influence the natural environment, and show how current policies affect those trends.

Materials:

- Preserved specimen in the Ecosystem Kit of Great Lakes Invasive Species-Sea Lamprey
- Photo of a Sea Lamprey Attached to a fish

Vocabulary:

- Symbiosis: A relationship between two kinds of organisms in nature over a long period of time.
- Mutualism: A relationship where two organisms benefit from one another.
- Parasitism: A relationship where one organism lives on another organism and may harm that organism.
- Commensalism: The relationship where one organism benefits from another and the other is not harmed.

Procedure:
Day 1:
1. Read pg. B22-23 in textbook regarding how different populations of organisms are connected including the human connection to other organisms.
2. Begin the activity called “The Problem with Homeless Salmon?” Follow the procedure in the attached pages.

Day 2:
1. Review the previous day's lesson about relationships, ask students to discuss the following question in small groups. **What type of relationship does the salmon have with the human population?** (Possible Answers: The Human population values the salmon, but overeats/fishes for it, thus the population is decreasing as well as the habitat polluted.)
2. Introduce that today we will be learning how organisms are connected in an ecosystem. Write the word **Symbiosis** on the board. Read pg. B24 as a class and hand out the relationship worksheet to take notes. (see attached)

3. Read pg. B25 about mutualism, have the students define it on their sheets. Explain that another example of this type of relationship is a Sea Anemone and a clown fish. Show the brief clip from the movie **Finding Nemo**, as a way to brainstorm examples of mutualistic relationships.

4. Read pg. B26 about Parasitism, have the students define it on their sheets. Provide the local example of a sea lamprey and fish in the Great Lakes or the wood tick and a human as examples. Display pictures of such examples as well as show the preserved specimen in the Ecosystem Kit of Great Lakes Invasive Species. See Attached

5. Read pg. B27 about commensalism, have students define it on their sheets. Provide other examples (see attached.) monarch butterfly, barnacles and cattle egret.

Assessment:

Extensions:
- Overhead-Visuals
- **Econ: Cost:** The loss or penalty especially in gaining something
- **Econ: Benefit:** What is gained from a choice made.
- **Econ: Incentive:** Something that incites determination or action
1. The Monarch butterfly (*Danaus plexippus*) feeds as a larva on species of milkweeds (*Asclepias* spp.). The milkweeds contain a group of chemicals called cardiac glycosides. Cardiac glycosides are poisonous to vertebrates (although not to invertebrates). The larvae store these cardiac glycosides and the later adult contains them as well. If a bird (or other vertebrate such as a mouse or frog) eats a Monarch it finds them distasteful to begin with and is later sick. Experimentally birds learn to avoid Monarchs. The Monarch advertises its inedibility by a bright orange and black coloration.

2. Barnacles are sedentary, highly modified crustaceans resembling conical pyramids. Barnacles live by using long, feathering appendages to sweep the surrounding water for small, free-floating organisms. The critical resource for barnacles is a place to stay. Barnacles attach to rocks, ships, shells, whales, and just about anywhere else they can gain a foothold. In the example on the left the two barnacles are attached to the shell of a scallop. The barnacle gains a place to live and, presumably, the scallop is not harmed by the presence of the barnacles. Therefore the relationship is commensalisms.
The Cattle Egret (*Bubulcus ibis*) forages in pastures and fields among livestock such as cattle and horses, feeding on the insects stirred up by the movement of the grazing animals. The egrets benefit from the arrangement, but the livestock, generally, do not. However as in most cases of commensalism, there is a "but". Cattle Egrets have been observed perching on the top of cattle picking off ticks, lending a slight tinge of mutualism to the arrangement.

Cattle Egrets are originally from Africa where they were adapted to following the large herds of herbivores as they moved across the savannah. They first appeared in South America in the 19th century and have since spread to the eastern United States and California. The Cattle Egret breeds in colonies near water (as almost all herons do), but feeds almost exclusively with herds of cows and horses.

Courtesy of:

http://www.nearctica.com/ecology/pops/commens.htm
Unit: Ecosystems

Photo of Sea Lamprey Attached to a Fish

Photo of a Wood Tick on a Human Finger
lh4.ggpht.com/.../cj-ZRBspccI/DSC00870.JPG
LESSON ONE

THE PROBLEM OF THE HOMELESS SALMON

BACKGROUND
Chinook salmon populations in the Columbia and Snake River areas of the United States have been declining, even though most people want them to increase. The wild fish are valued by commercial fishermen, sports fishermen, biologists, and other citizens. Salmon are part of the environment that makes the Pacific Northwest unique. Efforts by Washington, Oregon, and the U.S. government to produce more salmon with fish hatcheries have not worked well. The salmon population is still declining, although more slowly. In addition, hatchery fish are different from the native wild salmon that spawn in riverbeds and live the rest of their lives in the ocean. These wild salmon are the most endangered.

ECOMYSTERY
The wild salmon is the most popular fish in the Pacific Northwest. Everyone wants to increase the wild salmon population. But the estimated salmon population continues to fall. Why?

ECONOMIC REASONING
Salmon are owned by nobody, or everybody, and they suffer from a problem of common ownership. If salmon are harvested, people can benefit; but no one in the fishing business will benefit from holding back on harvesting in order to help the fish reproduce. If one person holds back, someone else may harvest the fish. Private ownership of fish schools could provide the incentive to maintain the fish population. The rivers where salmon spawn are also owned in common, so nobody can exercise ownership rights to foster wild salmon reproduction. Private ownership of water rights and spawning beds may create the incentives necessary to maintain the salmon population.

ECOMONOMIC CONCEPTS
- Choices
- Incentives
- Costs
- Benefits

OBJECTIVES
1. Students identify four principles of ecodetection.
2. Students use the principles of ecodetection as a guide in reasoning about environmental mysteries.

TIME
One class period

MATERIALS REQUIRED
- Visuals 1, 2, 3, and 4
- Activities 1, 2, and 3

PROCEDURE
A. Welcome students to the world of environmental mysteries. Introduce the idea that environmental problems often puzzle people. For example, everyone wants clean air, yet most people help pollute the air when they drive their cars or ride on a bus. Most people like wild animals and fish, yet our uses of land and water sometimes cause the population of wild animals and fish to decline. Why do these contradictions between desire and action exist? The mysteries in this curriculum invite the students to learn about these contradictions and to understand why they exist. Students also work on deciding how to correct environmental problems. Lesson One provides the first illustration of how the ecode­tective process works.

B. To begin the environmental investigations, students follow the story of the Chinook Salmon. Display Visual 1 and invite the students to speculate on why salmon populations are decreasing. Display Visual 2 and ask what pattern is indicated by these numbers. (The population has been declining; each year there have been fewer salmon.)

C. Distribute Activity 1, which describes a Chinook Salmon, its habitat, and its life cycle. Ask:

1. Where do the Chinook Salmon live? (North Pacific Ocean and the rivers in streams of Alaska, British Columbia,
LESSON ONE

Washington, Oregon, and Northern California.

2. Where do the small-fry fish travel? (They leave stream beds and travel through streams and rivers to the ocean.)

3. Why do the Chinook leave the ocean? (After growing, they return to the place where they were born—to leave eggs.)

4. What dangers do the Chinook face in returning to the rivers and streams? (Death caused by people, bears, other fish, nets, dams, and low water.)

D. Display Visual 3, showing the rivers of the Pacific Northwest. Trace the journey of the Chinook Salmon. The Chinook that make their way to the ocean live there for several years, constantly moving. Then instinct tells them to return to their birthplace and spawn, leaving behind new eggs to produce new salmon. After spawning, the Chinook die, and their remains are eaten by eagles, crows, and other scavengers.

E. Explain that salmon is a very popular fish, served in the best restaurants in the world. Many people make their living catching the fish in the high seas or at the mouths of rivers when the fish return from the ocean to spawn. Sports fishermen pay very high prices to hire guides and purchase equipment in order to fish for salmon every fall in the Pacific Northwest.

F. Explain that the student’s task is to propose a solution to the Northwest Power Planning Council to correct the problem of the declining salmon population. The Northwest Power Planning Council was established by the United States Congress to develop a program to protect the Columbia River Basin’s fish and wildlife. Ask: How can conditions in the rivers and oceans be changed to allow the number of salmon to increase? Encourage a variety of responses.

G. Explain that one way to solve this problem is to apply a set of principles as a starting point for thinking logically about the evidence.

H. Display Visual 4, The Principles of EcoDetection. Explain that this visual introduces the principles students use to solve eco-mysteries. Stress the first assumption of ecodetection: people’s choices influence the environment. For example, environmental detectives ask: Why do people make the choices they make? What benefits do they expect? What costs do they encounter?

I. Show how the principles of ecodetection work by asking students to use them in thinking about possible explanations of the salmon mystery. Ask:

1. Do fishermen choose to catch so many salmon that none will exist for the next year? (No.)

2. Can fishermen continue catching fish if they catch so many that none will exist after one year of fishing? (No.)

J. Distribute Activity 2, and divide the class into small groups. Explain that this activity shows how the principles of ecodetection can be used to solve an environmental mystery. Allow students time to read and discuss Activity 2, using the discussion questions as a guide. Discuss the group responses:

1. What human choices affect the environmental quality of the salmon’s spawning areas? (People choose to use electricity, buy paper, build homes, eat food, and so on.)

2. What unintended consequences have resulted from consumers’ choices to obtain food and shelter? (The choices encouraged producers to ignore the salmon habitat and to reduce salmon populations.)

3. What difference does it make that the salmon are wild and no one owns the right to raise and harvest them, as people do with cattle and chickens? (No one is rewarded for helping the salmon reproduce by protecting their breeding areas. With cattle and chickens, ranchers...
who raise and care for the animals also benefit by selling them to the consumer. The prospect of this benefit creates an incentive to raise and care for the animals.)

4. What might be done to increase the salmon population?
(If people owned the rights to water, schools of salmon, and their spawning areas, then fishermen and producers of electricity and lumber could negotiate deals which would allow them to protect the salmon and produce their goods and services also.)

CLOSURE
Ask students to review The Principles of EcoDetection. Stress that environmental problems are the result of human choices; therefore, they can be corrected by providing incentives to encourage people to make environmentally friendly choices.

Distribute the EcoDetection Cards in Activity 3, giving one card to each student. Ask students to keep their cards nearby—in wallets or taped in their notebooks—so they can be used whenever the students encounter instances of mysterious behavior in their subsequent work in studying the environment.

ASSESSMENT
Multiple Choice
1. Which of the following statements is consistent with The Principles of EcoDetection?
   a. The salmon population is declining because no one cares about the salmon.
   b. The salmon population is declining because people use salmon for food.
   *c. There are few incentives for people to preserve salmon habitat.
   d. If farmers didn't irrigate their crops, the salmon population would increase.

2. Which of the following groups will pay higher costs if the salmon population is preserved and increased?
   a. Logging companies operating near salmon-spawning schools.
   b. Electrical companies operating dams on rivers where salmon travel to spawn.
   c. Consumers.
   *d. All of the groups listed above will pay higher costs.

Essay
Explain how incentives influence human behavior toward salmon and contribute to the decline in salmon populations.
(People are rewarded for harvesting the salmon population. They are not rewarded for helping new salmon hatch and grow to mature adults. Therefore, people spend more time and resources harvesting salmon than they do helping salmon populations grow.)

Journal
Many animals exist in students' neighborhoods. They can note which are increasing in number and which are decreasing in number. For example, is the population of rabbits, cats, deer, dogs, or goldfish changing? Science teachers can help in identifying these population changes. Use The Principles of EcoDetection to explain why these changes are taking place.
Why are the salmon in the Snake River area declining in number when people want them to increase?

1. People’s *choices* influence the environment.

2. People’s choices have *unintended results*.

3. People’s choices are influenced by *rewards*.

4. People are more likely to take better care of things they *own and value*. 
LESSON ONE

ACTIVITY 1
THE LIFE CYCLE OF THE SALMON

Name _______________________

The Chinook Salmon lives in the North Pacific Ocean and the rivers and streams in Alaska, British Columbia, Washington, Oregon, and Northern California. It has lived in these waters for one million years.

The fish begin life as eggs left by their mother in the gravel of stream beds. The mother dies shortly after laying the eggs. When the eggs hatch, the small-fry fish must find their way to the ocean, traveling through the rivers and streams of the Pacific Northwest. They live in the ocean for several years, growing to large sizes.

Mature Chinook Salmon may weigh anywhere from 10 to 100 pounds. At some point in their adult life they attempt to return home—to the exact place where they were born—where they will leave eggs to produce the next generation. After spawning, the Chinook Salmon die.

Many animals, fish, and people like to eat salmon. For the species to continue, enough salmon must avoid bears, predator fish, nets, dams and low-water levels in rivers and streams to make it back to their places of birth to plant the new eggs.

QUESTIONS FOR DISCUSSION

1. Where do the Chinook Salmon live?
2. Where do the small-fry fish travel?
3. Why do the Chinook leave the ocean?
4. What dangers do the salmon face in returning to the rivers and streams?
ACTIVITY 2
WHY CAN'T A SALMON RETURN HOME?

Name __________________________

Why are the salmon in the Snake River area declining in number when people want them to increase? The following analysis uses The Principles of EcoDetection to explain this mystery and suggest a solution to the problem.

PRINCIPLE 1
PEOPLE’S CHOICES INFLUENCE THE ENVIRONMENT.
The salmon population in the Snake and Columbia River areas has been declining sharply. Salmon have used these rivers for centuries. Native Americans caught the fish and used them as their basic diet. They caught relatively few fish, however, and their fishing did not reduce the salmon population. Now, environmental changes have affected the salmon’s spawning grounds, and a larger human population and improved fishing equipment have increased the number of salmon caught by fishermen.

The salmon are declining in number in the Snake River area and in other parts of the Pacific Northwest. Until recently, this fish was very abundant. In the 1800s salmon migrated up the streams each fall in such numbers that people could almost walk across the backs of the fish to cross the stream. Now so few salmon remain that recently people were not allowed to fish for them at all during the fall migration season. How did people's choices influence this change in the salmon population?

To answer this question, it is important to remember two things. First, the salmon need to return "home" (to their spawning beds) in order to reproduce. They are born in streams near large rivers and hatch from eggs left there by their mothers. After hatching, the small fish migrate to the ocean, avoiding predator fish and animals if they can, where they live for a number of years, growing strong and large. Then instinct tells them to return to their birthplace to die; but just before their death they leave more eggs to produce future generations. No one knows how the salmon find their way from the oceans to the exact place where they hatched. It is a miracle of nature. But if the salmon fail to reach that location, they cannot leave their eggs and help the species reproduce. When people block off rivers with dams, or destroy spawning areas in streams, they prevent the salmon from returning home.

Salmon used these rivers and streams before human beings lived in the Pacific Northwest. The original Americans lived off these fish, but their catch was so small it did not diminish the population. Now environmental changes and a larger human population have made a serious impact on the salmon’s spawning grounds.

PRINCIPLE 2
PEOPLE’S ENVIRONMENTAL CHOICES HAVE UNINTENDED RESULTS.
Must the salmon remain homeless, blocked off from their birthplace? Not necessarily. There is plenty of space for them, just as we have space for cattle, buffalo, and birds. Why are we having a problem with the salmon?

No one set out to harm the salmon. Instead, people chose to improve their own environmental conditions. People chose to use electricity to heat and cool their homes; this choice led them to build huge dams on the Columbia River. These dams block the salmon’s migration routes to their spawning grounds.

People also chose to eat salmon, and this choice encouraged commercial fishermen to expand their catch of salmon in the ocean and at the river mouths. The fisherman’s success meant fewer salmon could return to their spawning grounds. Bigger boats, more nets, and better radar helped fishermen increase their catch.

People chose to cut down trees in order to build homes and manufacture paper products. The log-
gging activities that provided these products caused soil erosion, flushing mud down hillsides to cover the sand and rock beds in the streams where salmon leave their eggs.

All of these choices were made to improve the lives of humans. None was intended to ruin salmon’s habitat, but that was the unintended effect.

**Principle 3**

**People’s Choices Are Influenced by Rewards.**

People who use the salmon’s habitat or catch the salmon are rewarded for their behavior. Fishermen get paid for the salmon they catch. Loggers are paid to cut trees, not to protect streams from mud. Electric companies satisfy customers by providing electricity from dams, not by providing water for fish to live in. But who is rewarded for helping salmon? Anyone who wants to help the salmon must do it without receiving monetary rewards. Some people do help anyway, but most people cannot spend their time cleaning streams or helping fish pass by the large dams. Therefore, today, the wild Chinook Salmon are not cared for. They are only captured or neglected.

**Principle 4**

**People Are More Likely to Take Better Care of Things They Own and Value.**

Compare wild salmon with cows or chickens. The salmon are nobody’s property. If they were someone’s property, the owners would not have ruined the salmon’s water and habitat. Dairy farmers, after all, do not destroy barns or pastures. But since no one owns the salmon or their habitat, the fish can be taken and the habitat can be changed with no obvious cost to the person making the change. No one who has used the salmon or the salmon habitat has had to pay anybody for that use. Lumber companies were not required to restore the stream habitat. Consumers were not required to pay extra so that money would be available for restoring the salmon population. Electricity customers were not required to compensate anyone for reducing the amount of water available for salmon migration.

Would the decline of the salmon population have occurred if someone had owned the salmon and the salmon habitat? Probably not. If people had been allowed to own and benefit from the wild salmon, fishing and habitat choices would have been made much differently. Not everyone could have caught a salmon. Only people who owned the salmon or paid the owner could have harvested salmon.

But how could we create ownership rights to salmon? There are several possibilities. One idea would be to sell water rights. How would this work? Remember that there is much competition for different uses of the water in the Columbia and Snake Rivers. The United States government could pass legislation making the use of water a privilege that people could purchase. The government could then sell water rights along the Snake and Columbia Rivers to people who wanted to protect the salmon and who would eventually be able to benefit from a regulated harvest of the salmon. Electric companies would be required to pay the owners of water rights for permission to use the water. This requirement would encourage the electric companies to be careful in their use of water resources. The electric companies would seek alternative ways of producing electricity if the costs of water became too high.

Another idea would be to sell the salmon’s spawning beds. Land developers and logging companies often change the river in such a way that the salmon’s spawning beds are destroyed. When this happens, salmon obviously are not able to return to their home to spawn. If the spawning beds were sold to people who wished to protect and eventually harvest salmon, developers and loggers would either have to pay for permission to change the environment or seek other alternatives.

Still another idea might be to have the United States government sell schools of salmon to private owners. This alternative would involve iden-
LESSON ONE

ACTIVITY 2 (continued)

tifying schools of wild salmon and using large
gates installed at the mouths of the rivers to block
the passage of the salmon into the ocean. The pri­

vate owners of salmon would become “salmon
farmers.” They would manage their salmon popu­
lations, harvesting a few every year but making
sure that salmon would thrive into the future.

After all, the salmon farmers’ livelihoods would
depend on a sustained salmon population.

Will the salmon survive? We don’t know. Some
efforts are being made to help the salmon through
governmental programs—limiting the fishing sea­
on, for example, or changing river water levels,
or regulating the impact of logging on streams—
but it is hard to solve the problem of the wild
salmon in these ways. The salmon can be taken
by anyone in the oceans 200 miles beyond our
shorelines. No one cares for the salmon in remote
ocean environments. And within the United
States there are many incentives to use rivers and
streams for purposes other than salmon habitat.
Unless some type of ownership plan is developed
for the salmon, it is likely that the population will
continue to decline.

QUESTIONS FOR DISCUSSION

1. What human choices affect the environmental
   quality of the salmon’s spawning areas?

2. What unintended consequences have resulted
   from the choices of consumers to obtain food
   and shelter?

3. What difference does it make that the salmon
   are wild and no one owns the right to raise
   and harvest them, as people do with cattle
   and chickens?

4. What might be done to increase the salmon
   population?
### ACTIVITY 3
**ECODETECTION CARDS**

<table>
<thead>
<tr>
<th>The Principles of EcoDetection</th>
<th>The Principles of EcoDetection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. People's choices influence the environment.</td>
<td>1. People's choices influence the environment.</td>
</tr>
<tr>
<td>2. People's environmental choices have unintended results.</td>
<td>2. People's environmental choices have unintended results.</td>
</tr>
<tr>
<td>3. People's choices are influenced by rewards.</td>
<td>3. People's choices are influenced by rewards.</td>
</tr>
<tr>
<td>4. People are more likely to take better care of things they own and value.</td>
<td>4. People are more likely to take better care of things they own and value.</td>
</tr>
</tbody>
</table>

**The Principles of EcoDetection**

1. People's choices influence the environment.
2. People's environmental choices have unintended results.
3. People's choices are influenced by rewards.
4. People are more likely to take better care of things they own and value.

Lesson Title: Lesson 9 - Population Interactions

Overview: This lesson will focus on how populations of various organisms in an ecosystem can affect one another. This lesson is a continuation of the previous lesson 8.

Length: 2 - 45 minute class periods

Standards/Benchmarks:

USDD Benchmarks

- F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.

Wisconsin EE Standards:

- B.8.8 Explain interactions among organisms or populations of organisms

Wisconsin Science Standards:

- F.8.8 Show through investigations how organisms both depend on and contribute to the balance or imbalance of populations and/or ecosystems, which in turn contribute to the total system of life on the planet
- F.8.9 Explain how some of the changes on the earth are contributing to changes in the balance of life and affecting the survival or population growth of certain species
- F.8.10 Project how current trends in human resource use and population growth will influence the natural environment, and show how current policies affect those trends.

Materials:

- 4 Buckets
- 4 Paper Cups
- Water
- 100 candies or 100 cubes/chips from the math carts.

Vocabulary:

- Energy Pyramid: Demonstrates that less and less food and energy are available as you go from the base of the pyramid to the top. (See diagram on p. B28 and B29 of textbook).
- Carrying Capacity: The maximum population size that the resources in an area can support.
- Limiting Factors: Anything that controls the growth and survival of a population.
Unit: Ecosystems

**Day 1:**

1. Begin by taking the students outside for an activity to demonstrate energy loss at each level of the food chain. The activity is taken from *Teaching Green: The Elementary Years* p. 208. (See attached) This activity will need the materials listed on the procedure as well as listed above.

2. Conclude by reading p.B28 and B29 about energy movement through an ecosystem, as well as p. B30-31 to connect how food webs/food pyramids affect you, as a human in an ecosystem.

3. Have students draw an energy pyramid in their science notebooks, using the creature cards from *Great Lakes in Our World*, or by choosing an organism in our ecosystem.

**Day 2:**

1. Population Growth: Read pg. B 34 and B35 in the textbook on population growth. Have the students then fill in the worksheet “Population Growth” (Cara) on the number of young per a litter for various animals. Then have them answer the questions on the bottom and the backside of the sheet (See attached).

2. Begin with the activity called “How many Bears Can Live in this Forest?” taken from *Project Wild* Activity Guide p. 134-137 (See Attached).

3. A discussion should follow regarding “Limiting Factors” and “Carrying Capacity”, have the students define these terms in their notebooks, p. B34-B35 in textbook. Examples of limiting factors can be pesticides, hunting, fishing licenses, DNR guidelines etc.

**Assessment:**

- Conclude by using the strips of Interaction scenarios, (See Attached). Hand out a scenario to each group of 4 students in your class. Explain that students should think about specific ways that the two scenarios on each strip can be connected in a number of ways. Have the students brainstorm with their groups how the two scenarios might be connected.

Provide the example below to the class:

**Air Pollution from an Industry and A moose in Canada**

**Explain the possible connection if no one is able to think of an interaction. The air pollution can travel to the long distances, which can cause acid rain falling into water sources or smog which can kill plant life, which the moose would consume. Or the air pollution could change the Climate Temperatures, which could cause the seasons to change slightly which affects food sources for the moose as well as shelter.**

**Extensions:**
Interactions Among Living Things

Fill in the blanks. [Reading Skill: Sequence of Events - questions 2, 6, 20]

What Is a Food Chain?
1. The path that energy takes from producers to consumers to decomposers is called a(n) _________________.
2. On a prairie, the food chains start with ________________, which produce food during _________________.

What Is a Food Web?
3. A food web shows the relationship between all ________________ in a community.
4. Organisms that use the Sun’s energy to make their own food are called ____________________.
5. Organisms that cannot make their own food are ____________________.
6. Food chains end with ________________, which break down dead matter.

How Are Populations Connected?
7. A change in one ________________ affects all the other organisms in that food chain.
8. ____________________ help scientists predict how communities will be affected by change.

How Do Populations Adapt to Competition for Food?
9. Florida anoles were threatened when a new, bigger species of anole somehow arrived from ________________.
10. The Florida anole found a new ________________ high up in the treetops.
What Is Symbiosis?

11. Symbiosis is the relationship between two kinds of ____________ over a period of time.

12. Sometimes both organisms ____________ from the relationship.

What Is Mutualism?

13. When both organisms benefit from the relationship, it is called ____________.

14. Yucca moths ____________ yucca flowers, which make seeds that sprout into ____________.

What Is Parasitism?

15. Parasitism is when one organism ____________ on or in another organism and may ____________ it.

16. A flea is a parasite that lives off the ____________ of a cat or a dog.

What Is Commensalism?

17. Commensalism is when one organism benefits from another without ____________ or ____________ it.

18. Orchids attach themselves to tree trunks to get ____________ without ____________ the trees.

How Does Energy Move in a Community?

19. Energy is ____________ as it passes from one organism to another in a food chain.

20. A(n) ____________ shows there is less food at the top than at the bottom.

How Do Food Webs Affect You?

21. The ocean turns red when a group of algae called ____________ bloom.

22. Poison from this algae can ____________ fish and make humans sick.
<table>
<thead>
<tr>
<th>Subject</th>
<th>Number of Young Per Litter</th>
<th>Litters per Year</th>
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<tbody>
<tr>
<td>MINK</td>
<td>5 to 6</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>OTTER</td>
<td>2 to 3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>MUSKRAT</td>
<td>6 to 8</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>DEER</td>
<td>1 to 3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>MOOSE</td>
<td>1 to 3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>ELK</td>
<td>1 to 3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>SQUIRRELS</td>
<td>1 to 6</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>RABBITS</td>
<td>4 to 7</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>MOUNTAIN LION</td>
<td>1 to 5</td>
<td>Cubs stay w/ mother 1-2 yrs.</td>
<td></td>
</tr>
<tr>
<td>BEARS</td>
<td>1 to 4</td>
<td>Cubs stay w/ mother 1-2 yrs.</td>
<td></td>
</tr>
<tr>
<td>MOUSE</td>
<td>1 to 12</td>
<td>12 (Can breed at 2 months)</td>
<td></td>
</tr>
<tr>
<td>SKUNK</td>
<td>4 to 10</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>FOX</td>
<td>4 to 10</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>WOLF</td>
<td>3 to 12</td>
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<table>
<thead>
<tr>
<th>Subject</th>
<th>Eggs-Average</th>
<th>Chicks hatched</th>
<th>Chicks by Fall</th>
<th>Nestings per season</th>
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<tbody>
<tr>
<td>PHEASANT</td>
<td>10</td>
<td>8 to 9</td>
<td>5 to 6</td>
<td>2 to 3</td>
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<tr>
<td>RUFFEDGROUSE</td>
<td>9 to 14</td>
<td>5 to 7</td>
<td>5 to 7</td>
<td>1</td>
</tr>
<tr>
<td>SHARP-TAILED GROUSE</td>
<td>12</td>
<td>4 to 6</td>
<td>4 to 6</td>
<td>1</td>
</tr>
</tbody>
</table>

If a certain area had one pair of each of these animals and if the conditions were right to raise the maximum number of young per litter, how many of each animal would there be at the end of one year? Put your answer in Column A.

1. Which are in higher numbers—herbivores or carnivores? Why?

2. If we would look at life spans, which two animals do you think would have the longest life span?

    .... The shortest?

3. About what percent of baby grouse will be living a few months after hatching?
4. Both mountain lions and fox feed on rabbits. We killed the last mountain lion in Wisconsin a hundred years ago. What effect did that have on the fox population?

Why?

5. We hear the phrase "balance in nature." These charts show one of those balances. Describe the balance that is shown.
Resource and energy budgets

In many developing countries, livestock is raised for export. Raising cattle and other livestock requires large amounts of grain, water, land, and other resources that could be used to ease chronic hunger if humans ate less meat. There is enough grain produced in the world to feed everyone, but much of it goes instead to feed livestock. Because energy is lost at each step of a food chain, eating meat is much less energy efficient than eating vegetables and grains. For example, it takes about 8 kilograms of wheat to produce 1 kilogram of beef; and while the kilogram of beef provides 174 grams of digestible protein, the wheat needed to produce it contains 800 grams of digestible protein. Water, too, is used much less efficiently in meat production than in grain production. At a conservative estimate, it takes about 3,700 liters (975 U.S. gallons) of water to produce one kilogram of beef, while it takes 120 liters (32 U.S. gallons) of water to produce one kilogram of wheat. For every liter of water used in production, wheat provides 36 times the calories and 18 times the protein that beef provides.

Energy chains

This activity demonstrates that energy is lost at each level of a food chain and that it takes more resources to support meat eating than to support a diet based on plants.

Materials: 4 buckets, 4 paper or foam cups of equal size, water, 100 candies in a cup

Location: outdoors

Time: 15-20 minutes

Procedure:

1. Fill two buckets with water.

2. Poke one hole in the bottom of two of the cups, and poke two holes in the bottom of the other two cups. The holes must be large enough to allow water in the cups to leak out in a steady stream, but not so large that it will drain from the cups in seconds.

3. Divide the class into two relay teams and have each team line up in front of one of the two full buckets. Put the empty buckets about 20 meters (22 yards) away.

4. Explain that the full buckets represent plants, and the water in them represents energy. Plants are able to convert sunlight to energy that is usable by animals. In this game, herbivores will take energy (water) from the plants and pass it to carnivores, simulating the way in which energy is transferred in a food chain.

5. Give a cup with one hole in it to the first student in each line, and explain that they represent herbivores. Ask the herbivores to stand next to the full buckets (the plants).

Cash crop surveys

Have students survey their own use of imported cash crops by looking at the ingredients of various food products, such as the chocolate in a pudding. Ask them to consider whether the imported cash crops they have identified in their foods are essential to a healthy diet.

Have students research cash crop exports and imports to learn about the flow of products between countries. To help them visualize these global interconnections, put a world map on the bulletin board. As the students find connection between countries, mark them on the map using tacks and string to create a web of interrelationships. Another way to demonstrate interrelationships is to make a flag for each country and post the flags around the room. As the students discover connections, link the flags with strings, creating an overhead web.

The slope of the land:

Slope also affects erosion. To demonstrate this, put soil into two trays. Prop up one tray to create a steep slope. Pour water on each tray and compare the degree of erosion in each. This demonstration of erosion can also be done in the schoolyard if it has a suitable site. When trees are cut down on mountainsides to supply firewood or lumber, or to create more land for farming, the resulting erosion can be very severe.

For more information on soil, visit the GLOBE program's "Soil and Agriculture" pages at NASA's soil science website <http://ltpwww.gsfc.nasa.gov/globe/index2.htm>.

Hunger and the global economy

Much of the land in developing countries is used to grow non-essential food crops, such as coffee, cocoa, bananas, sugar cane, spices, and tea, or crops that have other uses, such as cotton, rubber, and grain for livestock. These crops are exported to wealthier countries, hence the term "cash crops." In many cases, the money earned goes to wealthy landowners or is used to pay off the country's debt. Little money reaches the average farmer. And since the best land is used for cash crops, little food is grown to feed people locally. As a result, local food prices are high and most people cannot afford to buy it.

Economies that are dependent on a single cash crop are subject to severe disruption if demand for the crop decreases or if a natural disaster destroys the crop. In addition, cash crops can severely damage the environment. Many of the crops require large amounts of chemical fertilizers and pesticides that cause water pollution. And because the most productive land is used for cash crops, subsistence farmers have little choice but to overuse and deplete the already marginal lands that are left to them.

Resource and energy budgets

In many developing countries, livestock is raised for export. Raising cattle and other livestock requires large amounts of grain, water, land, and other resources that could be used to ease chronic hunger if humans ate less meat. There is enough grain produced in the world to feed everyone, but much of it goes instead to feed livestock. Because energy is lost at each step of a food chain, eating meat is much less energy efficient than eating vegetables and grains. For example, it takes about 8 kilograms of wheat to produce 1 kilogram of beef; and while the kilogram of beef provides 174 grams of digestible protein, the wheat needed to produce it contains 800 grams of digestible protein. Water, too, is used much less efficiently in meat production than in grain production. At a conservative estimate, it takes about 3,700 liters (975 U.S. gallons) of water to produce one kilogram of beef, while it takes 120 liters (32 U.S. gallons) of water to produce one kilogram of wheat. For every liter of water used in production, wheat provides 36 times the calories and 18 times the protein that beef provides.
6. Give a cup with two holes in it to the second student in each line. These players represent carnivores and go to stand midway between their group's full and empty buckets.

7. Explain the order of play: When you say "Go," each herbivore scoops a cupful of water from the full bucket, gives it to the carnivore, and pours it into the carnivore's cup. The herbivore then throws the herbivore cup back to the next student in line and stands in the carnivore's spot. Meanwhile, the carnivore relays the cup of water to the team's end (empty) bucket, pours the water in, and throws the carnivore cup back to the new carnivore in the middle. The next herbivore in line scoops up some water, relays it to the new carnivore, the carnivore takes it to the end bucket, and so on. Continue the cycle until the supply buckets are empty.

8. Gather the class around the two buckets of water. Ask the students to describe what happened to the water (energy). It is likely that most of it was lost.

9. Explain that in a food chain 90 percent of the energy is lost at each trophic level. To demonstrate this, show the class the cup containing 100 candies. Explain that the candies represent 100 units of energy that a plant has made from sunlight through photosynthesis.

10. Ask for a volunteer to be a herbivore. Give that student ten candies and throw the rest away. Ask "What percentage was lost?" (90 percent) Then ask for a volunteer to be a carnivore. Ask "If 90 percent of the energy is lost, how many of the herbivore's candies does the carnivore get?" (1 candy)

11. Discuss the implications: In this example, the carnivore needs a lot of plants and herbivores to support it. It took 100 units of the sun's energy to make 10 units of herbivore energy, whereas it would take 1,000 units of the sun's energy to make 10 units of carnivore energy. Humans are part of many food chains. By choosing to eat foods that are lower on these food chains we become more efficient users of resources.

**Food waste**

In developed countries a great deal of food and food resources (land, water, energy) are wasted. If your school has a composting program, have the students measure the volume and weight of the food waste in the lunchroom for a week and graph the results. Another way to get children to become aware of their own practices is to examine the resources that are involved in producing the food. Pick a popular food, such as pizza, and ask "What does it take to make a pizza?" (e.g., cheese). Then ask "What does it take to make cheese?" (cows, energy for transporting and processing milk). Ask more questions, such as "What do the cows need?" and so on. Create a large chart showing all the resources needed to make a pizza, or have the students make their own charts. This activity shows that all foods require many resources, and that when we waste food we also waste the resources that were needed to produce the food.
A late frost in June and
A bear giving birth to cubs

Using an electric blanket and
A coal miner's kid in Wyoming getting a new bike

A farmer plowing a field and
A dead carp in the Fox River
You flushing a toilet and
An eagle catching a fish

You buying a Big Mac and
An oak tree in Northern Wisconsin

Tilt of the earth and
A wolf pulling down a deer in deep snow
Unit: Ecosystems
Lesson Title: Lesson 10 - Endangered Species

Overview: This lesson will focus on how populations of various organisms in an ecosystem can affect one another, to the extent of a species becoming threatened or endangered. This lesson is a continuation of the previous lesson 8.

Length: 2-45 minute class periods

Standards/Benchmarks:
USDD Benchmarks

- F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.
- F.8.8 Identify how human activities affect an ecosystem in beneficial or harmful ways.
- F.8.9 Understand how people can develop solutions to lessen the effects of pollutants.

Wisconsin EE Standards:

- A.8.4 Use critical-thinking strategies to interpret and analyze gathered information
- B.8.8 Explain interactions among organisms or populations of organisms

Wisconsin Science Standards:

- F.8.8 Show through investigations how organisms both depend on and contribute to the balance or imbalance of populations and/or ecosystems, which in turn contribute to the total system of life on the planet
- F.8.9 Explain how some of the changes on the earth are contributing to changes in the balance of life and affecting the survival or population growth of certain species
- F.8.10 Project how current trends in human resource use and population growth will influence the natural environment, and show how current policies affect those trends.

Materials:


Vocabulary:

- Carrying Capacity: The maximum population size that the resources in an area can support.
- Limiting Factors: Anything that controls the growth and survival of a population.
- DDT: A colorless odorless water-insoluble insecticide C14H9Cl5 that is an aromatic organochlorine banned in the United States that tends to accumulate and persist in ecosystems and has toxic effects on many vertebrates
- Pesticide/insecticides: An agent used to destroy pests and insects.
- Endangered Species: A species that is in danger of becoming extinct.
- Extinct: A species that has completely died out.
- Threatened Species: A species that may become endangered.
Day 1:

1. Literature across the Curriculum:
   Read aloud to the class, Chapter 1 “A Fable for Tomorrow” from the book *Silent Spring* by Rachel Carson, a copy is in the ecosystem kit. The chapter presents a scenario of a fictional environment in which there is a lack of birds. It was written in the 1960’s as a way to alert the people of the United States about the harmful affects of the pesticide DDT. Rachel Carson was an author/poet, and is now considered an early visionary environmental protector.

2. This chapter provides a great introduction to the environmental issue concerning the use of pesticides, and their affect on organisms in an ecosystem. Next have the students read pg. B36-37 in the textbook as a class to gather more background on DDT and Eagle Populations.

3. Math Connection: Hand out graph paper to students, and using the data table on pg. B37, have students create two graphs using the data on diminishing eagle populations. Have them complete the questions provided on the page as discussion questions, to hypothesize the relationships between the amount of insecticide in eggs and the number of young hatched.

Day 2:

1. Define Endangered Species and Threatened Species in their science notebooks.
2. Experience the activity called “How can we help Endangered Species?” taken from *Economics and the Environment* pg. 38-44. Follow the procedure attached. You will need the overheads for this lesson Visual 13 and Visual 14.

Possibilities:

- Provide a list of endangered species in Wisconsin taken from WIDNR. Assign an endangered species per every 2 students. Have them go online to the Wisconsin DNR website link for kids called EEKI! http://dnr.wi.gov/org/caer/caer/ce/EEK/earth/endangered.htm. Have them work in partners on lab tops or in the computer lab to garner some basic info about their species to create a Gravestone that could be displayed on a bulletin board “Graveyard of Wisconsin Endangered Species” or “Gone Missing in Wisconsin” and presented to the rest of the class as way to learn about the endangered/threatened species in Wisconsin.

Possible Guidelines for the gravestone or poster:

- Name of Species
- Type of Species: Producer or Consumer (Herbivore, Carnivore, Ominivore)
- Origin
- Habitat
- Food Sources
- Predators
- Reason for Endangered/threatened listing
- Include a picture of the species

Extensions:

- Extension Lesson: Economics Standard Link “Why are there so Few Whales and so many Chickens?” (See Attached p. 63-67)
Threatened and Endangered Species

- Bald Eagle
- Barn Owl
- Blanchard's Cricket Frog
- Blanding's Turtle
- Dune Thistle
- Hine's Emerald Dragonfly
- Karner Blue Butterfly
- Massasauga Rattlesnake
- Northern Ribbon Snake
- Ornate Box Turtle
- Osprey
- Peregrine Falcon
- Pine Marten
- Prairie White-Fringed Orchid
- Queen Snake
- Slender Glass Lizard
- Timber Wolf
  - Wolves from the Air-Picture Gallery 2001
- Trumpeter Swan
- Western Ribbon Snake
- Whooping Crane

Unit: Ecosystems

Lesson Title: Lesson 11- Invasive (non-native, exotic) Species

Overview: This lesson will focus on introducing invasive species of Northeast Wisconsin to students, as a continuation of the study of how different organisms can affect one another in an ecosystem.

Length: 3-45 minute class periods

Standards/Benchmarks:

USDD Benchmarks
- F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.
- F.8.8 Identify how human activities affect an ecosystem in beneficial or harmful ways.
- F.8.9 Understand how people can develop solutions to lessen the effects of pollutants.

Wisconsin EE Standards:
- B.8.5 Give examples of human impact on various ecosystems*
- B.8.8 Explain interactions among organisms or populations of organisms
- B.8.10 Explain and cite examples of how humans shape the environment

Wisconsin Science Standards:
- F.8.8 Show through investigations how organisms both depend on and contribute to the balance or imbalance of populations and/or ecosystems, which in turn contribute to the total system of life on the planet

Materials:
- 4 Decks of playing cards
- Creature Cards taken from the Great Lakes in My World Curriculum Guide

Vocabulary:
- Invasive Species: Plant or animal that enters an ecosystem to which it is not native and competes with one or more native species for food, shelter and or reproductive opportunities.
WHY ARE THERE SO FEW WHALES AND SO MANY CHICKENS?

BACKGROUND
In the world today, chickens are plentiful, but many people worry about the whale population. Many students are involved in “save the whales” campaigns. Their activities might include adopting a whale, participating in whale watches, or buying merchandise to support “save the whales” organizations. However, few students participate in campaigns to save pigs, cows, or chickens, even though those animals are slaughtered in large numbers every day.

ECOMYSTERY
Why do we have so few whales and so many chickens?

ECONOMIC REASONING
In order to solve this mystery, students need to know about “the tragedy of the commons.” In eighteenth century England, towns reserved some land as common land that would be available for everyone to use without charge. (This policy was adopted by some colonial cities in the eastern United States; the Boston Common is a well-known example.) Because everyone could use the common land without charge, shepherds in England used common land rather than their own land for grazing. There was no problem at first, as long as only a few people used the commons; but when many did, they overgrazed the land. The grass died.

The key to understanding “the tragedy of the commons” is to remember that people are more likely to take better care of things they own and value. Private ownership creates rewards that encourage wise use of property and conservation of resources for use in the future. The wise use of property increases its future value.

Publicly owned land creates incentives for overuse. When everyone owns land collectively, people who actually use the land share the costs of their use with everybody else—including those who don’t use it. For example, people in England placed additional animals on the common land even though the livestock were scrawny and unhealthy and the common overgrazed.

Pigs, cows, and chickens are privately owned. If farmers killed all their livestock, they would not have any pigs, cows, and chickens to sell in the future. But whales roaming the oceans have no owners. Whalers have no reason not to kill whales now, before other people do; to hold back now is to risk losing the opportunity to harvest and sell a whale that somebody else will kill if a whaler doesn’t. In effect, whales are like the common land—anyone who wants to do so can use them.

ECONOMIC CONCEPTS
Benefits
Incentives
Opportunity Cost
Scarcity

OBJECTIVES
1. Students use economic reasoning to explain why whales are an endangered species while pigs, cows, and chickens are plentiful.

2. Students explain why people generally take better care of things they own and value.

3. Students explain how private ownership provides incentives to manage resources wisely.

TIME
One class period

MATERIALS
♦ Visuals 20 and 21
♦ Paper clips
♦ Colored paper squares (one quarter of an 8.5 x 11 inch sheet of paper, two squares per student)
♦ Bag of small candies

PROCEDURE
A. Explain that the purpose of this lesson is to learn why some resources are overused while
others are protected and preserved. The lesson helps demonstrate the idea that people generally take better care of things they own and value.

B. To begin the demonstration, throw several paper clips on the floor.

C. Tell students that, after you say “Go,” you will give them a piece of candy for every paper clip they give you. (Even though the simulation works best if you have no rules, you may want to tell them that they cannot dive for the paper clips or push and shove too much. We do not want any endangered students.)

D. Say “Go,” telling the students that they are free to pick up the paper clips and trade them for candy. Students will probably rush to grab the paper clips and to trade all the clips they retrieve for candy.

E. Ask students why they didn’t leave some of the paper clips on the floor or save some for later. (They will probably say that if they didn’t grab them other students would.)

F. Now give each student two squares of colored paper. They can trade these for candy. But for each day they keep the two paper squares, they will receive another square, and each square is worth a piece of candy.

G. Ask students how many of them want to trade their paper squares for candy. (Probably some will trade immediately, but others will want to get more candy later.)

H. Ask students why they made the decision to trade their paper squares now or later. Accept a variety of answers.

I. Explain that the paper clips are like whales and the paper squares are like chickens. Display Visual 20. Ask students to reflect on their experience in the simulation to solve the mystery.

J. If students have trouble solving the mystery, explain that the chickens are privately owned while whales just roam the oceans. Assigning and enforcing property rights creates incentives to conserve resources. This is because the owner has strong incentives to maintain and improve the resource for use in the future. Commonly owned property may be overused and not conserved. Whalers felt that if they did not kill a whale, someone else would. The whales became victims of economic incentives.

K. Display Visual 21. Prompt students to discuss the answers.

1. Most students would take better care of their own property than the school’s property. In the discussion, you may want to refer to litter and other damage to your school’s property.

2. The key to question 2 is that students own their property and have an incentive to take good care of it.

3. Question 3 is more difficult. Whales in the ocean cannot be restricted to one location, so it is difficult to establish ownership rights. John Majewski of the University of Texas has proposed attaching transmitting devices to whales. He thinks this would not be hard to do. These devices would give whales radio signal “brands.” Ownership rights to whales could then be purchased by whalers who would want their private whale population to be protected and to grow. Under this system, existing laws that now protect property rights on the seas would also protect whales. “Whale rustlers” would become pirates who could be arrested and fined.

CLOSURE
Ask students to identify something they own in which they have much pride. Why is this?

ASSESSMENT
Multiple Choice
1. Which of the following programs would be most effective in conserving whales and fish for future generations?
   a. The government should own or control all waterways.
LESSON NINE

b. People should be free to fish as often as they like so they get tired of it.
*c. Allow people to own certain lakes and waterways.
d. Set up government rules to prevent people from fishing on most waterways and oceans.

2. Which of the following programs would best preserve public lands for future generations?
*a. Allow environmentalists the right to lease or buy the land in order to conserve it.
b. Pass a law that prevents farmers from renting the land for more than a year.
c. Rent the land at a low price so farmers can afford to fix it up.
d. Require farmers to sell any privately owned land to the government if they are not farming it.

Essay
Which of these actions would be most effective in preventing elephants from becoming extinct? Explain your conclusion.
a. Pass a law that bans the sale of ivory and makes it a crime to shoot elephants for any reason.
b. Create privately owned game preserves that charge people to view elephants in their natural environment.
(Choice a. looks good at first glance, but this policy may have harmful unintended consequences. The ban on ivory decreases the ivory supply and therefore raises the price of ivory. This creates a powerful incentive to kill elephants in order to receive the benefits of large illegal profits. Poachers will kill elephants in order to sell ivory for high prices on black markets. Choice b. better follows the principles of ecodetection. It creates incentives to preserve the elephants. By keeping the elephants alive, profits can be made. However, the local people must share in these game-preserve profits if they are to see them as incentives not to poach.)

Journal
Ask an adult what improvements they made over the past few years in their house or apartment. Why did they make these improvements? Did renting or owning make a difference as they made their decisions? Record their answers in your journal.
Why do we have so few whales and so many chickens?
1. Do you take better care of your school’s property or your own property? Why?

2. Have you ever fixed up or improved something you owned? Why were you willing to do this?

3. What are some ideas for how we could create private ownership for whales to help prevent them from becoming extinct?
Unit: Ecosystems

Procedure:

Day 1:
1. Define Invasive Species on the board (see above) for definition. Brainstorm ways invasive species can affect an ecosystem.
2. Students will then play a game to demonstrate how an invasive species affects an ecosystem and its organisms. See attached lesson What's New? (Explore 11) taken from the Great Lakes in My World Curriculum Guide.
3. Read the article about Sea Lamprey as a class, taken from Exploring Non-Fiction: Alien Invasion.
4. Hand out the blank chart with a variety of different invasive species in the Great Lakes Watershed that also invade the Fox River. In small groups have the students choose a species and do a bit of research to fill in the attached handouts.
5. After plenty of time is given to do some basic research, groups will prepare a quick 2-3 minute presentation of their invasive species, using the Preserved Species in the Ecosystems kit, as real life examples. As each group presents, the rest of the class should be filling in their blank charts. Info: Wisconsin DNR http://dnr.wi.gov/org/caer/ce/eek/earth/aliens.htm

Day 2: Prep for Field Trip to Legion Park to Meet the City Forester
1. Students will work in the classroom to use a dichotomous key to distinguish classmates by characteristics such as eye color, hair color, freckles, earlobes etc. (See attached).
2. Students will then prepare to walk to Legion Park, with a clip board in hand, a pencil a dichotomous key and a tree id sheet (see attached).

Day 3:
1. As we walk as a class, students will need to stop at in the least 3 trees along the way to identify them using the dichotomous key. They will fill them in on their worksheet/chart.
2. Once we arrive at the park we will have the pleasure of hearing from a gentleman from the Urban Forestry Department of the City of De Pere. He will discuss with the students about his job, what schooling he has, what his duties are, and then proceed to discuss the gypsy moth problem in Legion Park and what they do to control it. Students will be able to ask questions about the moth.
3. Students will then be able to check out the cloths that are wrapped on the trees to trap the moths. They will use their hand lenses to examine the moth, and draw a sketch of the body and determine what stage of life it is in.
4. The rest of the time students will need to explore the trees in the park and use their dichotomous keys to identify the species. (The trees will be marked ahead of time with numbers so that the students can check if they have correctly identified them.
5. Finally, the class will come together and discuss tree species that were discovered, and I will list the biodiversity on a poster paper. This will lead in to a brief discussion about why biodiversity is important, especially when invasive species come to the area.
6. The last activity will be as a class to create a gypsy moth “ID Card” as an example for the students. It will include:
   Side 1: Name, species, origin, date of arrival, spread, destruction, elimination methods.
   Side 2: Stages of the Life for the Gypsy Moth (Drawings)

<table>
<thead>
<tr>
<th>Eggs</th>
<th>Caterpillars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocoon</td>
<td>Adult Moth</td>
</tr>
</tbody>
</table>

Assessment:
1. Students will again be given pictures of trees that we have identified on our walk to Legion Park and at the park itself, and will need to identify them appropriately.
2. Students will create a “wanted poster” of a Wisconsin Invasive Species using the EEK! Webpage on the DNR website. See Attached List and Handout of Instructions

Extensions:
Invasive Species in Wisconsin

http://dnr.wi.gov/org/caer/ce/eek/earth/aliens.htm

Plants

- Common Buckthorn (Leaves EEKI)
- Eurasian Water-milfoil
- Garlic Mustard
- Japanese Stilt Grass (Leaves EEKI)
- Japanese Hedge Parsley (Leaves EEKI)
- Leafy Spurge
- Multiflora Rose (Leaves EEKI)
- Purple Loosestrife
- Spotted Knapweed
- Tartarian Honeysuckle (Leaves EEKI)
- Wild Parsnip

Learn more about Invasive Species in Wisconsin (Leaves EEKI)

Alien Animals

- Asian Long-horn Beetle (Leaves EEKI)
- Earthworm (Leaves EEKI)
- Emerald Ash Borer
- Feral Pig (Leaves EEKI)
- Gypsy Moth
- Hemlock Wooly Adelgid (Leaves EEKI)
- Multicolored Asian Lady Beetle
- Quagga Mussel
- Round Goby
- Rusty Crayfish
- Sea Lamprey
- Spiny Water Flea
- Zebra Mussel
summary
Students play a game that demonstrates the impact of suddenly introducing a new species to an ecosystem.

objectives
- Define invasive species.
- Explain the impact of invasive species on the food web.

prerequisite
Web of Life or Tangled Web

vocabulary
*Invasive species*: plant or animal that enters an ecosystem to which it is not native and competes with one or more native species for food, shelter and/or reproductive opportunities

setting
INDOORS

materials
- Four decks of playing cards
- Creature Cards
- Journals
- Pencils
Invasive species arrive, often accidentally, from their native ecosystem to a new ecosystem. When a new species is introduced into an ecosystem, the balance is altered and competition is high until a new balance is achieved. If the new or "introduced" species is successful, one or more native species populations can suffer, altering the ecosystem. For example, the round goby was introduced into the St. Claire River in 1990 (probably in ship ballast water). This aggressive fish competes with native fish for prime spawning sites, causing problems for mottled sculpin, logperch and darters. The introduction of the goby has changed the balance of the ecosystem, as the native species mentioned are bottom dwellers, an important part of a complex food web. This poses threats to a number of species in the food web, as they are interdependent. On an economic level, it poses a threat to the fishing industry that depends on the abundance of certain fish.

Other non-native species introduced into the Great Lakes are: rusty crayfish, spiny water flea, common carp, Eurasian ruffe, sea lamprey, zebra mussel, Eurasian water milfoil and quagga mussel.

**procedure**

1. Introduce the concept of invasive species and explain it. Tell the students they'll play a game to illustrate it. Break the class into four small groups. Pass out a deck of cards to each group. Tell the groups that they will each play a different card game and they should not share what they are doing with the other group. If it helps, one group may be located in the hallway or a different room.

2. Two groups will play Old Maid and two groups will play Go Fish.

3. **Old Maid Rules:**
   - Cards are passed out to players until the deck is gone. One joker is in the deck.
   - The joker is the "old maid." Players do not reveal their hands to each other.
   - The object of the game is to run out of cards and not end up with the "old maid."
   - Players take turns taking one card from the hand of another player (any player).
   - If a player has a match of numbers or faces in his/her hand, he/she should put down the match, face up.
   - Play continues until all but one run out of cards, and one player is left with the "old maid."

4. **Go Fish rules:**
   - Seven cards are passed out to each player. The remainder of the deck is placed in the middle, face down.
   - The object of the game is to get the most matches.
   - Players take turns asking another player (any player) for specific number or face cards in order to find matches.
   - For instance, a player asks any other player, "Do you have a queen?"
   - If the player has the card, she/he turns it over to the asker. If not, she/he says "Go fish," and the asker takes one card from the remaining deck.
   - Whenever a player has a match, she/he should put it down.
   - Play continues until everyone runs out of cards, and then players count their matches.

5. Once the groups understand the rules, select two students from each group to trade places with students from a group playing a different game. These transferring students should go into the new group playing by the rules of their "home" game, without knowing the rules of the new game. If a student knows what the other game is, she/he should pretend not to know the rules.

6. The groups should be instructed to go on playing their games and not change the rules to accommodate the newcomers. With the newcomers, the games will change. These students are playing by different rules, changing the dynamic of the group. Some of the players' situations may change or suffer because of the newcomers.

7. Stop the game about three minutes after the switch. Discuss as a class what the playing was like before the switch. Were the situations calm and the rules easy to understand? Then discuss what happened when the newcomers entered the group. The class should be able to understand that the dynamics changed. Explain that this is what happens when a species from one ecosystem is introduced into another—the species reproduces and causes change in the ecosystem. It takes a long time before the ecosystem reaches a balance again. Make sure students understand that invasive species are not "bad." They have a home in another ecosystem, which means they are used to living by different rules.
UNIT 1 Lakes

wrap-up

1. Show the class a map of the United States, and point out where the Great Lakes connect with rivers and canals that connect with the ocean.

2. Show how ships can come into the Great Lakes from the ocean with new organisms such as zebra mussels attached. Show how organisms such as carp can swim up the Mississippi River and other rivers into the Great Lakes.

3. Show students the Creature Cards of invasive species. Ask students where they think these species are originally from.

4. Ask students what they think about a new species entering the lake system. What do they think happens to the food web?

5. In their journals, students write about what happened during the game. Then, they should work in groups to investigate an invasive species from the Creature Cards. Have students think about what type of impact it has on the lake food web. Does it eat species that do not have a natural predator (i.e., another invasive species)? Does it eat something that is a food source for another species? Does it occupy the same habitat as another species? Students can find this information by looking at the Creature Cards. Then students should write in their journal pages about how the food web might change because of the introduction of this species. For a more detailed invasive species activity, see Invasive Issues.

assessment

Rubric on page 86

We value your thoughts and feedback on Great Lakes in My World. Please let us know about any oversights, errors or omissions you find, or if there are things you or your students particularly like.

Send your comments to: education@greatlakes.org
11 | What's New?

[1] Describe the game. How was it different after the switch?

<table>
<thead>
<tr>
<th>Before there was a new player</th>
<th>After the new player arrived</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[2] Which invasive species did you choose from the Creature Cards?

[3] In what way does this species interfere with a native species or cause problems for humans?

- It eats food that another species eats.
- It uses the same habitat space.
- Other:

[4] Name of native species impacted by the invasive species:

[5] List the names of at least two other species that are connected to the native organism you listed in #4 (predators, prey, etc.):
[6] Write two sentences about how the food web might change because of the introduction of the invasive species.

Can we stop nature’s most harmful visitors from entering the U.S.?

By Kathryn R. Hoffman

In the summer of 2002, the quiet town of Crofton, Maryland, was invaded by aliens. Townspeople told fearful stories of hungry predators that would eat anything they could swallow. Soon, the whole country was on the alert.

But these aliens aren’t from outer space. They were brought here by humans! This creepy tale is about a fish called the northern snakehead. It is from Southeast Asia, where it is seen as a harmless swamp fish. But in the U.S., the fish is an invasive, or alien, species. It is part of a growing threat to American ecosystems. Maryland wildlife officials had to poison the lake where the snakeheads lived before the fish could do serious damage.

They Come by Air and Sea

Most foreign plant and animal species travel into the country with humans. Some non-native species, such as a plant called kudzu, were brought here on purpose—for people’s gardens. Most others slip in accidentally with cargo on boats or planes.

Some of these non-native species have become invasive. This means that their introduction has caused environmental, economic, or health problems in our country. For example, kudzu vines kill trees and bushes.

Many foreign species have no natural enemies in their new environment. This allows them to spread rapidly and threaten the survival of native species. “In eastern Africa, the (invasive) Nile perch has caused the extinction of 300 species of fish,” says Guy McPherson. She is an ecologist at the University of Arizona. Scientists feared that the snakehead would have a similar effect on U.S. waterways.

A Balancing Act

Plants and animals do have a special place in their original environments. “Native species have a role in the ecosystem that they evolved into,” says researcher Faith Campbell. “There’s a balance.”

The U.S. and other countries around the world are trying to keep this balance. Most wildlife officials agree that we may not be able to stop the invasions. But we can work to protect healthy native species from harmful foreign ones. Says Campbell: “We have a responsibility to take care of the environment where we live.”

AMERICA’S MOST UNWANTED

Researchers say that humans have brought about 50,000 foreign species into the United States. Here is a look at some of our uninvited guests.

ZEBRA MUSSEL This invader from Eastern Europe has caused problems in the Great Lakes for years. Now, they are threatening waterways in Virginia.

NUTRIA This rodent was brought here from South America for the fur trade. By digging and gnawing at grasses, it has ruined thousands of acres of marshland in Louisiana and Maryland.

ASIAN LONG-HORNED BEETLE These bugs came to the U.S. from China—where they’re also a problem. They’ve killed thousands of trees.

CARP The Mississippi River is teeming with several kinds of carp from Asia. They compete with native fish for food and threaten the fishing industry.
**Before Reading**

1. What is an ecosystem?

2. What do you think might happen when a foreign species is introduced into an ecosystem?

3. What do you know about a plant called kudzu?

**During Reading**

1. Why is the northern snakehead a threat in a Maryland lake but not in its home in Southeast Asia?

2. What problems do officials have getting rid of foreign species after they have been introduced into a new environment?

3. What would have happened if officials had not poisoned the lake in Maryland?

**After Reading**

1. Why do you think invasion by non-native species is a bigger problem now than in the past?

2. What can be done to prevent harmful species from getting into the United States?

3. What important lessons can people learn from this article?

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**Skill Focus**

**Drawing Conclusions**

The article “Alien Invasion” says that Maryland wildlife officials had to poison a Maryland lake to get rid of an alien fish. Why did they take such a drastic step? How did the officials feel about this decision?

The article does not answer these questions. But you can answer them. You can draw conclusions based on the information that is given.

Why did officials have to poison an entire lake to get rid of one predator? In the second section, the author explains that many foreign species do not have natural enemies in a new environment. You can conclude that the northern snakehead fish was killing many fish. There were probably no fish that could or would prey on the snakehead.

How did the officials feel about this decision? They probably debated and worried about it. In poisoning the lake, they no doubt killed many harmless organisms. The article does not say this. But you can draw this conclusion based on what the article says and what you already know.

Draw conclusions about what you read. Read between the lines. Think about facts you already know. You can figure out more than the author tells you directly.

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**Writer's World**

1. Find out more about one of the “uninvited guests” described in the article. Write a news story about the pest’s history and how it threatens other species.

2. “We have a responsibility to take care of the environment where we live.” Do you think most Americans take this responsibility seriously? Write an editorial stating and supporting your opinion.

3. Research more about the northern snakeheads in Maryland. Find out whether officials have completely solved the problem or whether the snakehead is still a threat. Write a summary of your findings.
Sea Lamprey
*Petromyzon marinus*

- **Length:** 12 to 20 inches
- **Weight:** 8 to 13 ounces
- **Coloring:** grey-blue back, metallic violet on sides, shading to silver-white underneath
- **Common Names:** great sea lamprey, lake lamprey, lamprey, lamprey eel
- **Found in Lakes:** Michigan, Huron, Ontario, Erie, and Superior

In their natural habitat, sea lamprey -- like salmon and alewifes -- are ocean fish that spawn in fresh water. But some sea lamprey have always inhabited Lake Ontario and the St. Lawrence River, which are open to the Atlantic Ocean. In 1921, lampreys appeared in Lake Erie for the first time, arriving via the Welland Canal. From there, they rapidly colonized all of the upper Great Lakes, with especially large infestations developing in Lakes Michigan and Huron.

The sea lamprey is an aggressive parasite -- equipped with a tooth-filled mouth that flares open at the end of its eel-like body.

When attacking, the lamprey fastens onto its prey and rasps out a hole with its rough tongue.

An anticoagulant in the lamprey's saliva keeps the wound open for hours or weeks, until the lamprey is satiated or the host fish dies.

In 1958, scientists finally found TFM -- a chemical that selectively kills sea lamprey larvae in their spawning streams -- and brought the lamprey under control. Lamprey numbers in Lake Michigan are currently only about 10 percent of their peak numbers in the 1950s. However, some biologists are concerned that these surviving populations might develop a resistance to the
Round Whitefish

Ruffe

Sea Lamprey

Smallmouth Bass

Walleye

White Perch

White Sucker

Yellow Perch

lampricide or, just as worrisome, an ability to spawn on the deltas at stream mouths -- deeper waters not suitable for lampricide treatment.

A more positive approach might be to harvest and market the lampreys. For centuries, river lampreys have been considered a delicacy in Europe -- King Henry I of England, in a fit of royal gluttony, is said to have died from a "surfeit of lamprey." But the unappetizing appearance of the eel-like fish and their unpalatable state when caught on their spawning runs has so far undermined their popularity as a food fish in this country.
13 | Invasive Issues

[1] Species name: .................................................................

[2] Species is from: .............................................................


[4] How was it introduced? ................................................


[7] Describe its impact on the food web. ..............................

[8] Draw a diagram of the lake food web including the invasive species. Describe how the native species are impacted by the invasive species.
13 | Invasive Issues

Brainstorm a list of potential solutions to the damage your species has had on the lake food web. This may include methods of preventing more from entering the Great Lakes and/or methods of reducing numbers already in the lakes. Narrow down your list to one solution - circle this solution.

1. 

2. 

3. 

Write!
On a separate sheet of paper, write a composition explaining the impact of the invasive species you have chosen, and a possible solution to the problem.
### Invasive Issues

<table>
<thead>
<tr>
<th>SPECIES NAME</th>
<th>From the Great Lakes</th>
<th>Introduced or Occupied</th>
<th>Habit if Habitat (shelter or space occupied)</th>
<th>Food Source</th>
<th>Impact on Lake Food Web</th>
<th>Year it Originally arrived in the Great Lakes</th>
<th>How it was Introduced or Occupied</th>
<th>How it was Originally Introduced or Occupied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zebra Mussel</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eurasian Water</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Eurasian Water</td>
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<td></td>
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<tr>
<td>Sea Lamprey</td>
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<td></td>
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<tr>
<td>Eurasian Puffer</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Bighead or Silver Carp</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Spiny Water Flea</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rusty Crayfish</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round Goby</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

During the presentations, fill in the rest of the chart.

Fill in the row on the chart for the species your group chose.
<table>
<thead>
<tr>
<th>Name</th>
<th>Latin Name</th>
<th>Origin</th>
<th>When Arrived in Great Lakes</th>
<th>How Arrived in Great Lakes</th>
</tr>
</thead>
<tbody>
<tr>
<td>alewife</td>
<td><em>Alosa pseudoharengus</em></td>
<td>Atlantic coast</td>
<td>Before 1931</td>
<td>Canals and the St. Lawrence River</td>
</tr>
<tr>
<td>bighead and silver carp*</td>
<td><em>Hypophthalmichthys nobilis</em> and <em>Hypophthalmichthys molitrix</em></td>
<td>Originally from China, now in Mississippi River</td>
<td>Not yet arrived; currently in upper Illinois River less than 55 miles from Lake Michigan; a permanent electric fish barrier is being constructed to prevent their advance towards Lake Michigan</td>
<td>Escaped into the Mississippi River from aquaculture facilities in the early 1990s when the facilities were flooded</td>
</tr>
<tr>
<td>Eurasian ruffe*</td>
<td><em>Gymnocephalus cernuus</em></td>
<td>Northern Europe- Black and Caspian Seas</td>
<td>1980s</td>
<td>Arrived in ballast water from a ship</td>
</tr>
<tr>
<td>Eurasian water milfoil*</td>
<td><em>Myriophyllum spicatum</em></td>
<td>Europe, Asia and North Africa</td>
<td>1940s</td>
<td>Introduced as an aquarium plant</td>
</tr>
<tr>
<td>purple loosertrife*</td>
<td><em>Lythrum salicaria</em></td>
<td>Northern Europe</td>
<td>Early 1900s</td>
<td>Intentionally imported for its beautiful flowers</td>
</tr>
<tr>
<td>quagga mussel*</td>
<td><em>Dreissena bugensis</em></td>
<td>Eurasia</td>
<td>1989</td>
<td>Ballast water</td>
</tr>
<tr>
<td>round goby</td>
<td><em>Neogobius melanostomus</em></td>
<td>Black Sea</td>
<td>1986-1988</td>
<td>Arrived in a ship's ballast water brought into St. Clair River or Lake St. Clair</td>
</tr>
<tr>
<td>rusty crayfish</td>
<td><em>Orconectes rusticus</em></td>
<td>Ohio River Basin</td>
<td>1960s</td>
<td>Used as bait by fishermen and released by science classes who had them as pets</td>
</tr>
<tr>
<td>sea lamprey</td>
<td><em>Petromyzon marinus</em></td>
<td>Atlantic Ocean, St. Lawrence and Hudson Rivers and possibly Lake Ontario</td>
<td>Arrived in 1830s, established by 1938</td>
<td>Through the Welland Canal</td>
</tr>
<tr>
<td>spiny water flea</td>
<td><em>Bythotrephes cedrstromi</em></td>
<td>Northern Europe</td>
<td>Lake Huron 1984, in all Great Lakes by 1987</td>
<td>Arrived in ballast water from a ship</td>
</tr>
<tr>
<td>zebra mussel</td>
<td><em>Dreissena polymorpha</em></td>
<td>Caspian Sea region of Poland, Bulgaria and Russia</td>
<td>About 1985</td>
<td>Arrived in ballast water from a ship</td>
</tr>
<tr>
<td>white perch*</td>
<td><em>Morone americana</em></td>
<td>Atlantic coast</td>
<td>1930s-1950s</td>
<td>Canals</td>
</tr>
</tbody>
</table>

* = not a Creature Card
<table>
<thead>
<tr>
<th>Habitat</th>
<th>Food Source</th>
<th>Impact on Food Web</th>
<th>Other Impact</th>
<th>Notes</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lakes and oceans</td>
<td>Phytoplankton, zooplankton, and small crustaceans</td>
<td>Competes for food</td>
<td>Large numbers die off, can clog water intake pipes and contaminate beaches</td>
<td>Thrived when sea lamprey ate the fish that prey upon it</td>
<td>alewife</td>
</tr>
<tr>
<td>Surface layers of open water</td>
<td>Plankton</td>
<td>Would likely compete for food with native fish; are large and consume large quantities of food</td>
<td>Have the potential of destroying the $1 billion commercial and recreational fishing industry on the Great Lakes</td>
<td>These Asian carp species are bothered by boats and leap several feet out of the water, injuring boaters</td>
<td>bighead and silver carp*</td>
</tr>
<tr>
<td>Fresh and brackish waters, usually near river mouths</td>
<td>Highly variable diet including mollusks, insect larvae, small fish, and crustaceans</td>
<td>Aggressive competitor for food</td>
<td>Reproduces quickly; its not eaten because of spiny fins; has a variable diet</td>
<td>Tolerates varying water conditions</td>
<td>Eurasian ruffe*</td>
</tr>
<tr>
<td>Freshwater lakes up to 33m/98ft</td>
<td>Plankton</td>
<td>Compete for food</td>
<td>See zebra mussels</td>
<td>Reproduces quickly; can tolerate a wider temperature range than zebra mussels, live at greater depths, and on a wider variety of substrates</td>
<td>quagga mussel*</td>
</tr>
<tr>
<td>Lake bottom; found in all Great Lakes and some nearby lakes</td>
<td>Small fish, zebra mussels, fish eggs</td>
<td>Compete with native sculpin for resources; reduces top predators by consuming their eggs</td>
<td>Reproduces quickly; is more likely to find prey than to become prey</td>
<td>reound goby</td>
<td></td>
</tr>
<tr>
<td>Lakes, ponds, and streams in areas where there is debris on the bottom</td>
<td>Aquatic plants and insects, fish eggs, small fish</td>
<td>Displaces native crayfish; reduce the number and types of aquatic vegetation in invertebrates.</td>
<td>海</td>
<td>rusty crayfish</td>
<td></td>
</tr>
<tr>
<td>Freshwater lakes and oceans</td>
<td>Lake trout</td>
<td>Upsets the ecosystem balance by removing top predators</td>
<td>Destroys fish by sucking blood and tissues</td>
<td>Had great impact on the commercial fishing industry of the 1950s</td>
<td>sea lamprey</td>
</tr>
<tr>
<td>Throughout Great Lakes and some inland lakes</td>
<td>Plankton</td>
<td>Competes with small fish for food, but its spiny tail prevents it from being eaten</td>
<td></td>
<td>spiny water flea</td>
<td></td>
</tr>
<tr>
<td>Freshwater; native to the Caspian and Black Seas; now in all Great Lakes and some inland lakes; depths of 2-7m/ 6-23 ft</td>
<td>Plankton</td>
<td>Competes for food by filtering large amounts of plankton, which has reduced this population</td>
<td>Accumulates on objects, such as boat hulls, and dogs water pipes</td>
<td>zebra mussel</td>
<td></td>
</tr>
<tr>
<td>Marine; spawn in coastal streams; now found in freshwater lakes</td>
<td>Eggs of walleye and white bass</td>
<td>Competes with yellow perch and other fish in shallow water; consumes eggs of other fish</td>
<td>Reduced number of walleye impacted fishing industry</td>
<td>white perch*</td>
<td></td>
</tr>
</tbody>
</table>
Tree Identification-Legion Park, De Pere, Wisconsin

<table>
<thead>
<tr>
<th>Coniferous or Deciduous</th>
<th>Bark Description</th>
<th>Leaf Description</th>
<th>Leaf Sketch</th>
<th>Name of Tree Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<td>6.</td>
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<td>7.</td>
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</tr>
</tbody>
</table>
Gypsy Moth Investigation

Drawing

Which Stage is the gypsy moth you found in?

Drawing

Which Stage is the gypsy moth you found in?

The gypsy moth has four distinct stages in life: egg, larva, pupa, and adult.
Legion Park: Field Experience

Name and description of resource: Legion Park, De Pere Department of Parks and Forestry. The oak trees in the park are major concern for gypsy moth infestation. The city places skirts around the trees, and traps and kills the invasive species, to control the infestation. The City of De Pere Urban Forester will meet us at the park to explain the trapping and control methods for eliminating the gypsy moth. The students will conduct a Tree Identification activity, and they will examine the cloths around the trees.

Contact information
- Name: Don Melichar
- Affiliation: City of De Pere: Urban Forester
- Address: 925 S. Sixth St. De Pere, WI 54115
- Telephone # and best time to call: 920-339-4065 Hours: 7:30 - 4 M-F
- FAX #: 920-339-4071
- E-mail address: dpparks@mail.de-pere.org

Driving directions/time from school:
5 min=Driving  15 min= Walking
Take a Right out of the parking lot on Merril St., Straight for 5 blocks.
Take a Left on Erie St., Take first Right on Chicago St
Take second Left on Webster Ave., Park will be on left.
Take first left on Charles St. and park in the angled parking lot.

Best time to visit:
Spring, M-F, 8-3

Suggested concepts/topics:
Tree Identification, Gypsy Moth Id.

Best suited to the following student abilities, interests, and maturity:
These activities are best suited for any student, but primarily those students in the intermediate to middle school ages. Students who are particularly interested in hands on activities, and being outdoors.

Logistics & limitations:
- Accessibility  Students with physical disabilities may need accommodations for access to the park and on the grass.
- Costs  None
- Meals/eating  Students could pack a bag lunch if activities will last longer than a few hours.
- Restrooms  The park has bathroom facilities, and if they are not open there are port-o-potties.
- Attire  Students should dress for the weather.
- Group size  1 to 2 classes, 25-50 students
- Legal/consent form required  -Parent Permission to Walk to the Site
- Reservation required; advance time  -Time arranged for the Forester to speak with the class.
- Chaperones  - A few parent chaperones to supervise the walk and the park activities.

Focus for City/Urban Forester
- Explain Job, Assist with Tree ID, Present on Invasives in the De Pere Area
Lesson Title: Lesson 12- Local Environmental Issues

Overview: This lesson will focus on local Environmental Issues—Case Studies.
- Urban Development (Waukesha Water Issue)
- Habitat Destruction (Hawks and Deer in Local yards)
- Hunting (Population Control/CWD Case Study)

Length: 2-45 minute class periods

Background: When doing an issue analysis, students must identify the following to begin to assess their understanding.
Define the Issue
Identify the Stakeholders
List Options for solutions to the issue
Express their own personal attitude or feeling about the issue.

Standards/Benchmarks:

USDD Benchmarks
- F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.
- F.8.8 Identify how human activities affect an ecosystem in beneficial or harmful ways.
- F.8.9 Understand how people can develop solutions to lessen the effects of pollutants.

Wisconsin Science Standards:
- A.8.4 Collect evidence to show that models developed as explanations for events were (and are) based on the evidence available to scientists at the time
- F.8.8 Show through investigations how organisms both depend on and contribute to the balance or imbalance of populations and/or ecosystems, which in turn contribute to the total system of life on the planet
- E.8.6 Describe through investigations the use of the earth's resources by humans in both past and current cultures, particularly how changes in the resources used for the past 100 years are the basis for efforts to conserve and recycle renewable and non-renewable resources.

Materials:
- http://www.greatlakesdirectory.org/zarticles/113corm.htm
- “Open Season” http://www.youtube.com/watch?v=2rg6oghvwjo

- Issue Analysis Graphic Organizer (See Attached)
Unit: Ecosystems

**Vocabulary:**
- Stakeholders: People involved in an issue and many times affected by the issue at hand.
- CWD: Chronic Wasting Disease

**Procedure:**

1. Show clip from the movie “Open Season”. [http://www.youtube.com/watch?v=2rg6oghywwjo](http://www.youtube.com/watch?v=2rg6oghywwjo)
   - This is a discussion starter about hunting in Wisconsin. Ask the students to brainstorm what they know about hunting, and what they know already about hunting season here in Wisconsin.

2. Read the overview of Wisconsin Deer Hunting from the DNR, as a class. Thoughts to discuss...
   - Why is deer season in the Fall? Why do we hunt? Where are we allowed to hunt? Who is allowed to hunt?

3. Hand out the map of the deer control map. Examine the map with the students, and ask them to point out the various categories on the map, by using the key. Explain that the hunt in Wisconsin is controlled for a variety of reasons. Have the students try to generate their thoughts as to why the DNR controls the hunt and the deer population.

4. Define Stakeholder on the board, as someone who has strong interest in the issue at hand. Have the students determine who the “stakeholders” in the hunting issue in Wisconsin. Then be ask the students to list the stakeholders for this particular issue in their notebooks as well as a brief description about why each one of the stakeholder’s would care about the issue of hunting.
   **Ex. Stakeholders**
   - DNR Officials, and rangers
   - Deer
   - Hunters
   - Tourist Industry-Hotels, restaurants
   - Stores-Such as...Gander Mountain or Sportsman’s Warehouse or Fleet Farm.

5. Next, divide the class in two parts and hand out the articles attached about other environmental issues in Wisconsin. One has to do with Water issues in Waukesha, and the other is about Comorants. If you have other articles or stories that you would like the students to study feel free. Have the students read the article with a small group and...
   - Define the Issue
   - Identify the Stakeholders
   - List Options for solutions to the issue
   - Express their own personal attitude or feeling about the issue.
   *Use the attached sheet as a graphic organizer for the students to fill out.

6. Explain that we are going to be focusing on an issue closer to home that is right out of our school doors in the next lesson.

**Assessment:**

**Extensions:** Economics Standard Link: “How Clean is Clean Enough?”
<table>
<thead>
<tr>
<th>Environmental Issue:</th>
<th>Stakeholders:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Options for Solving the Problem:</td>
<td>Attitude or Feeling about the Issue:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental Issue:</th>
<th>Stakeholders:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Options for Solving the Problem:</td>
<td>Attitude or Feeling about the Issue:</td>
</tr>
</tbody>
</table>
Deer Hunting in Wisconsin  http://www.dnr.state.wi.us/org/land/wildlife/hunt/deer/

Wisconsin is recognized as one of the premier deer hunting states in the nation as Wisconsin is home to a thriving deer herd. Wildlife habitat changes during the past century due to farming, logging, and urban expansion have led to the evolution of new method for managing our deer populations in an attempt to control their numbers under a wide array of habitats and social conditions.

Wildlife biologists in Wisconsin have developed population models for deer. The model depends on information gathered primarily from the hunters themselves. Such information includes the actual number of deer harvested annually, and the sex and age of each animal. When applied to a specific geographical "unit," it is possible for biologists to accurately estimate the number of deer living in that unit. They can then estimate the numbers that may be harvested to keep populations at healthy levels that are socially acceptable to both hunters and nonhunters alike. For more information, please feel free to read "Wisconsin's Deer Management Program: [PDF 1.72MB], The Issues Involved in the Decision-Making."

2008 Deer Hunting Season Report

The 9-day gun season ran November 22-30, 2008. Overall, deer hunting license sales are stable for the year. Today's tough economy didn't keep hunters from travelling to Wisconsin to hunt. 2008 was the third safest hunting season. Preliminary harvest numbers indicate that in parts of the state the deer harvest was significantly down. View detailed reports [PDF 293KB].
Great Lakes Article:

Cormorant controls encouraged

Order would let states use lethal force

By Peter Rebhahn
Green Bay Press Gazette
January 13, 2001

Double-crested cormorant

- **Length:** 27 inches

- **Wingspan:** 50 inches

- **Weight:** Adults weigh 4 to 5 pounds

- **Background:** One of six cormorant species nationwide and 38 worldwide. They nest along the coast from southwest Alaska to Mexico, and on lakes from north-central Canada to the Gulf of Mexico.

- **Description:** Both sexes' dark plumage bears a greenish gloss. Slender, hooked bills, with webbed feet set well back on their body, orange facial skin and an orange throat pouch. Juveniles have gray or tan plumage.

- **Breeding habitat:** Breed in colonies ranging from several pairs to thousands. They build their nests of twigs and branches beginning in April. Adults are ready to breed at age 3 or 4. Eggs are laid in mid- to late April and hatch about 25 days later. A typical nest has two or
ASHWAUBENON — The thousands of double-crested cormorants that called the bay of Green Bay home last summer are living it up now in the warmth and sunshine of the southern U.S. coast.

It’s a good thing for the cormorants, too, because Monday night wasn’t a good time to be a cormorant in Green Bay.

“A cormorant is nothing but a flying rat,” said Green Bay resident Ken Murray. "Some way, they have to be controlled.”

Murray was one of about a dozen people who aired similar views at a meeting on a U.S. Fish and Wildlife Service plan to manage cormorant populations nationwide. All but one asked for tough population controls. The meeting here was the first of 10 listening sessions scheduled from Portland, Ore. to Burlington, Vt., in coming weeks. About 65 people attended Monday’s meeting.

Fish and Wildlife has proposed a management plan whose centerpiece is a “Public Resource Depredation Order.”

The order would let states, tribes and federal agencies use lethal force to control the birds, which are protected under the Migratory Bird Treaty Act. Management of migratory birds falls under the aegis of Fish and Wildlife, not state agencies such as Wisconsin's Department of Natural Resources.

Double-crested cormorants are native to North America but not the Great Lakes. They moved into the Great Lakes basin in the early 1900s, then nearly vanished in the 1960s when the pesticide DDT cut nesting success to near zero. Fish and Wildlife biologists estimate cormorant nests increased an average of 29 percent every year in the 1970s and 1980s. Recent estimates peg the U.S. and Canadian population at 2 million birds.

Cormorants eat fish. Growing numbers of the birds have sparked calls for population controls from sport and commercial fishermen in Great Lake states. Many fishermen believe cormorants are a factor in the steep decline of yellow perch in the bay of Green Bay, though studies so far don’t support the claim.

Fish and Wildlife considered six management plans before recommending a middle-of-the-road course. The simplest plan called for no change in current management. The most extreme would have created a hunting season on the birds.

No one who spoke at Monday’s meeting said they liked the idea of a
“We’re not asking for a hunting season because you can’t use the resource,” said Pete Petrouske, a member of the Brown County Conservation Alliance and a backer of population control.

Suamico commercial fisherman Tom Peters told federal regulators they’d made a mess of things.

“If there were experts in this, we wouldn’t have this problem now,” he said. “The only experts we need are experts out there with shotguns to control them.”

Rick Johnson, a commercial fisherman from Gills Rock, at the tip of northern Door County, said the birds had created an economic hardship for fishermen.

“I feel strongly that Wisconsin needs control for cormorants,” said Johnson, president of the Northeast Wisconsin Commercial Fishermen Association.

Blames exotic species

Just one person, Green Bay resident Mark Tweedale, spoke against population controls.

Tweedale said studies suggest that exotic species, not cormorants, are to blame for the decline of yellow perch in the bay.

Tweedale has lived on the Green Bay shoreline for 27 years. Overall, he said, the bay's fishery is healthy. He compared the “majesty” of big flocks of cormorants foraging for fish with similar sites from the Florida Everglades.

“I say leave well enough alone, but I think I’m probably a lone wolf here,” Tweedale said.

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Great Lakes Article:

Waukesha offers to be water test case
City hopes to win approval for diversion from Great Lakes
By Darryl Enriquez and Lee Berquist
Milwaukee Journal Sentinel
Published December 2nd, 2004

Waukesha - With a daily need of 20 million gallons of fresh water, Waukesha officials intend to ask Gov. Jim Doyle early next year for his help in making this community of 66,000 a test case for diverting Great Lakes water, the city's water manager said Wednesday.

Troubled with declining groundwater supplies and unacceptable levels of cancer-causing radium in its drinking water, the city is on the hunt for new water sources to serve its growing population and established industries.

Lake Michigan is only about 20 miles east of Waukesha, but the historical reluctance of regulators of Great Lakes resources to divert water to communities outside lake drainage areas makes the city's pursuit a dicey one.

Waukesha is west of the subcontinental divide, which puts it outside the Great Lakes drainage basin. The boundary generally follows Sunny Slope Road in Waukesha County.

But new rules for water diversion called Annex 2001 are coming together, and they could provide a chance for communities such as Waukesha to get Great Lakes water.

Dan Duchniak, Waukesha Water Utility general manager, said he wants Waukesha to be the "pilot community" in which Great Lakes regulators apply policies being considered by Annex 2001.

"I want them to use us as a test case for the process, and we'll see what happens," Duchniak said.

Doyle is co-chairman and one of eight governors from states within the Great Lakes Basin that make up the Council of Great Lakes Governors.

Waukesha's request would go to Doyle, who could then send it to the council to be reviewed by governors of other Great Lakes states, an official with the state Department of Natural Resources said Wednesday.

Because Waukesha has been making its case for more than a year, the city is viewed as the leading candidate for a test case on whether a community outside the Great Lakes Basin can tap into the lakes as a source of water. Only two other out-of-basin communities have been successful in getting
water from the lakes in recent decades: Pleasant Prairie in Kenosha County and Akron, Ohio.

The basin is key because in 1986, Congress passed the Water Resources Development Act, which required the governors of Wisconsin, Minnesota, Illinois, Michigan, Indiana, Ohio, Pennsylvania and New York to unanimously approve any water diversions outside the boundary.

New rules considered
The proposed governors' agreement includes these highlights:

Authority over the Great Lakes would remain in the states and the two Canadian provinces that border the lakes.

Inside the basin, Great Lakes governors would have to review any new request to use 5 million gallons a day or more that will not be returned to the lake. This would also apply to any existing user that wanted to increase water use by that much.

Outside the basin, Great Lakes governors would have to review any request for 1 million gallons a day. All eight governors would have to agree to the water use.

Anyone asking for water outside the basin would have to demonstrate that they needed the water and couldn't find it elsewhere. They also must agree to return the water after treatment and fund water restoration projects.

When it makes an application to tap Lake Michigan, Waukesha's plan does not call for returning water directly back to the lake.

The city would continue to discharge the water into the Fox River, rather than running it through its sewage treatment plant and piping back to Lake Michigan.

The Fox River lies outside the Great Lakes basin, and river water flows into the Mississippi River.

Waukesha plans to argue that it will return Lake Michigan water another way: Reducing the pumping of groundwater in Waukesha would allow groundwater to change direction and flow back to the lake and replenish Lake Michigan, Duchniak said.

Also, he said that the Fox River ecosystem depends on Waukesha's millions of gallons of treated wastewater to keep flowing into the river.
LESSON FIVE

HOW CLEAN IS CLEAN ENOUGH?

BACKGROUND
Cleanliness has become a major environmental controversy. People tend to agree that we should have clean air and water, but they often disagree about how clean is clean enough. Does clean water mean no acidity in the water when a lake has natural acidity because of its geological location? Does clean air mean no emissions from automobiles? Or does clean air mean emissions are okay as long as winds blow the emissions elsewhere? Economists who have studied this issue suggest an approach that focuses attention on the costs as well as the benefits of cleaning up the environment.

ECOMYSTERY
Can the air and water become too clean?

ECONOMIC REASONING
In a world with scarce resources, efficient use of those resources is an important goal. Inefficiency is a waste of resources that could be used for other desired outcomes. The goal of efficiency suggests that cleaning the environment should continue as long as the benefits we gain from additional cleanliness are greater than the costs we pay to produce additional cleanliness.

Any time we set out to do a big cleanup job, the first stages of our work will be more efficient than the later ones, because a few cleanup resources can yield large benefits. For example, cleaning up a lake by restricting the flow of sewage from one factory is easy to accomplish and can dramatically improve the lake’s water quality. But replacing all septic tanks near the lake with a community sewage system would cost much more—and the extra expenditure would be less efficient. To make the lake water 100% clean by installing a filtering system to clean the runoff water from every rainfall would be extremely expensive and would yield few obvious benefits to most people who care about the lake.

Balancing additional costs against additional benefits is a helpful criterion to use when attempting to resolve issues of cleaning the environment.

ECONOMIC CONCEPTS
- Efficiency
- Costs
- Benefits

OBJECTIVES
1. After participating in a cleaning demonstration, students establish criteria for evaluating environmental cleanup proposals.
2. Students use cost-benefit criteria to evaluate proposals to clean the environment.
3. Students explain why acceptable levels of environmental quality differ from situation to situation.

TIME
One class period

MATERIALS
- Visuals 11 and 12
- Dirty rug squares: You will need at least one rug square for the instructional activity described in Procedure D. If you choose the small group method described in Procedure D, you will need one rug square for each group. Rug samples are usually available without cost from carpet sellers. Get the largest available pieces so that students will have plenty of rug area to clean. Do things to make the rug pieces very dirty. Grind in lots of dust, coffee grounds, sand, toast crumbs, and dried, crusted milk residue. Pour coffee and grape juice on the rug to stain it. Then litter the rugs with small scraps of paper, leaves, paper cups, and so on.
- Hand-held vacuum cleaners or whisk brooms, trash bag.

PROCEDURE
A. Explain that cleaning the air and water is an important environmental issue. But why should it be an issue? Doesn’t everybody want clean air and water? Today we are going to conduct a classroom experiment to see if
we can understand one reason why this issue has become controversial.

B. Display Visual 11. Ask: Which statement would you agree with?
(Most students will favor statement 1. Poll the students informally; do not try to influence their decisions. Encourage the students to justify their preference. Their explanations may help to generate controversy.)

C. Display Visual 12. Invite students to speculate on reasons why the air can or can not be too clean.

D. Conduct an experiment with the class.
Explain that the experiment will help students understand problems related to cleaning the air and will suggest practical ways to deal with air pollution. This experiment can be conducted in one of two ways, depending on how much students are involved.

1. Demonstration Method Organize a demonstration in which 3 to 5 students participate directly and the remaining students look on. This procedure reduces management tasks for the teacher.

2. Small Group Method Divide the class into small groups; each group will perform the experiment and compare results. This procedure engages more students directly in the activity but requires more set-up and management by the teacher.

The directions are written to assist the teacher with either procedure.

E1. Demonstration Method: Choose 3 to 5 students to clean a single dirty rug (see materials section for suggestions on how to prepare the dirty rug). Arrange the classroom desks so that the demonstration group is in the center of the room, surrounded by the observing students. Follow the remaining procedures as described in E2.

E2. Small Group Method: Divide the class into groups of 3 to 5 students. Give members of each group a dirty rug square, a trash bag, and a hand-held vacuum cleaner or whisk broom. Tell them they will have 30 seconds to clean the rug square. The rug cannot be moved. It must stay on the floor in the position in which they found it. All trash must be placed in the trash bag. One person should write a description of how much cleaning is accomplished in 30 seconds. The group that gets its rug clean first gets an extra five points on their next quiz.

F. Begin round 1. Give the group(s) 30 seconds to clean the rugs. Ask the recorder to describe what cleaning took place. Record the information on the chalkboard for each group. (Group members probably picked up the easiest litter to gather and quickly vacuumed or brushed the rug.)

G. Ask the students if they think their rug is clean.
(Most will say no. They didn’t have enough time.)

H. Begin round 2. Give the students another 30 seconds to clean their rug. Again, ask the recorder to describe the cleaning that takes place. Record the information on the chalkboard for each group. (They probably will clean up the next-easiest material to collect from the rug.)

I. Ask students if they think their rug is clean.
(Some may think it is. If so, ask if they think other people will think the rug is clean. Most will still think it is not clean.)

J. Begin round 3. Give the students another 30 seconds to clean the rug. Again, ask the recorder to describe the cleaning. Record the information on the chalkboard for each group. (It should be getting harder to clean up the rug any more—to get it very much cleaner.)

K. Ask students if their rug is clean.
(More will say “yes” at this point. They are probably tiring of the experiment by now. If not, conduct more rounds until they do think the rug is clean.)

L. Explain that you do not think the rug is clean.
You think that they should continue to clean
the rug in order to earn the extra points on the next quiz. Students may protest and question your evaluation. Prove that the rug is not clean by picking it up and hitting it sharply with your hand or a ruler. Dust will fly out of the rug. Ask: Why did you think the rug was clean when dust is still in the rug? Record the students' replies on the chalkboard. (Some of their comments should include “it’s too hard to clean the whole rug” or “it’s clean enough to suit us” or “we don’t have the right equipment to clean all the dust and stains from the rug.”)

M. Display Visual 11 again. Which statement most resembles the students' protests about cleaning the rug?
(Statement 2—the one many students disagreed with at the beginning of the lesson.)

N. Ask:
1. When was cleaning the rug easiest?
   (In the first rounds.)
2. When did you see great improvements in cleanliness?
   (In the first rounds)
3. When it was most difficult to get the rug cleaner?
   (Cleaning was most difficult in the last round, when all the obvious litter and easy-to-extract material had been removed.)
4. Is it possible to get the rug still cleaner? How?
   (Yes. With cleaning fluids, soap, brushes and hard scrubbing it will be possible to get the rugs cleaner.)
5. Can something be too clean?
   (It depends. We need to ask, “too clean for what?” For some purposes, more cleaning of the rugs would not be worthwhile. We could use them right now, for example, for padding in the back of a pickup truck. If that’s what we want to do with the rugs, we wouldn’t gain any benefit by spending more time and money to do additional cleaning. More cleaning would be inefficient.)

O. Explain this criterion for use when evaluating how clean is clean enough: Something is “clean enough” when the benefits of additional cleaning are less than the costs of additional cleaning. Encourage the students to recognize that this is the criterion they used when they participated in or watched the rug-cleaning experiment. They discovered from the experiment that, at a certain point, the costs of further cleaning far outweighed the benefits.

P. Display The Principles of EcoDetection. Ask: What principle of ecodetection best explains why people analyze additional benefits and costs? (People’s choices are influenced by rewards. In the rug example, students saw that when additional costs offset additional benefits or rewards, people will not support additional cleanup.

Q. Ask students to apply this lesson on rug cleaning to cleaning the air and water. How clean should air and water get?
   (Encourage students to recognize that obtaining 100% clean air and water would require very high costs. The potential costs of air and water cleanup need to be weighed against the potential benefits of cleanup. That cleanup costs should be less than the cleanup benefits is a useful criterion to aim for.)

CLOSURE
Ask students to apply the cost-benefits criterion to other environmental problems, such as the environmental quality of their rooms at home. Ask: Why do most parents disagree with teenagers on how clean teenagers’ bedroom areas should be?
(Teenagers and parents disagree on the criterion to be used in deciding how clean is clean enough. They argue about whether the extra work necessary to make the room cleaner is worth the benefit received.)

ASSESSMENT
Multiple Choice
1. Which of the following statements is false?
   a. Cleaning up the environment requires people to decide how to use resources.
b. Cleaning up all pollution is very expensive.
c. Some pollution may not be worth cleaning up.
d. Resources used to clean up pollution cannot be used for other purposes.
e. Cost is not an important consideration when cleaning up the environment.

2. When lake pollution is reduced, which part is most difficult to clean up?
a. The first 10% of the dirty material.
b. The pollution which that floats in large chunks on top of the water.
c. The sewage flowing in from one large pipe.
d. The last 10% of pollution left after 90% of the pollution has been eliminated.

Essay
1. Imagine that your family has given you a choice of cleanup tasks. You can clean up your room 100%. Your family will check it before you are done to be sure it is 100% clean. Or you can clean up two rooms, but if you choose to clean two rooms it will be enough to get them 50% clean. Someone else will finish cleaning the rooms after you have done your part. Which option should you choose if you want to do the least work? Explain how this choice relates to cleaning lakes and rivers.

2. Read the following statement. Decide whether the writer’s conclusion is accurate. Give examples to support your conclusion.

“There is no reason why we can’t get our air and water really clean—100%. There is no excuse for a dirty environment, just as there is no excuse for driving a dirty car, cooking in a dirty kitchen, sleeping in a dirty bedroom, or wearing dirty clothes.”

(The writer exaggerates the point. None of the

examples is accurate. No one’s car, kitchen, bedroom, or clothes meet the highest possible cleanliness standards. Individuals keep those items clean enough to satisfy themselves. Air and water also can be kept clean enough. They do not have to be kept to the highest possible standards.)

Journal
Over a period of several days, write an entry in your journal to record every time you notice dirt on something of yours. It might be a spot of tomato sauce on your shirt, a big spot on your parents’ car windshield, some dust or water spots on your bicycle fender, a candy wrapper on your front lawn, and so on. When you have made several entries, look back over the list and think about what action you took to clean up these spots and blotches. Did you clean every one of them up? Did you do the cleaning right away, or did you wait a while? How clean did you try to get each item? Write a paragraph in which you answer these questions. In your paragraph, comment on the costs and benefits that influenced you.
Statement 1
Spanaway Lake is a disaster. It used to be a beautiful, pristine lake where you could drink the water safely. Now it is dirty from overuse, soil runoff, and overflow from septic tanks. The County Council should clean the lake completely—100% clean. The technology and know-how are available. There is no excuse for not doing the job right.

Statement 2
Cleaning the lake completely is environmental overkill. We don’t need it to be perfectly clean. We can clean up most of the problem for one-third the cost and effort it would take to get it “completely” clean. The County Council should not overspend for the environment.
Can the air and water become too clean?
Unit: Ecosystems

Lesson Title: Lesson 13 - History and Future of the Fox River, the Environmental Issues

Overview: This lesson will focus on the local Environmental Issue of the PCB Contamination in the Fox River Water Ecosystem in De Pere, WI.

Length: 3-45 minute class periods

Vocabulary:
- PCB's: Polychlorinated Biphenyls
- Vitrification: The process of heating chemicals to a such a high temperature that it turns to glass.
- Dredging: Digging up of material and re-depositing it elsewhere.
- Capping: Covering or containing materials so that they can no longer pollute.
- DNR: Department of Natural Resources

Background: The Fox River has long since been used as a primary water source in Northeast Wisconsin for transportation, industry, municipalities and recreation. Throughout the history of the river there has been a series of contamination issues as a result of the use of the river, primarily due to the paper industry along the river and the contamination of Polychlorinated Biphenyls (PCBs).

Objectives: Students will...
- Examine a timeline of the Fox River History and Contamination.
- Read 3 abstracts outlining the Clean-up alternatives for the PCB contamination.
- Complete a chart comparing the 4 clean-up alternatives, vitrification, dredging and disposal, capping the contaminated sediment or leaving it alone.
- Predict the future of the river and the clean-up that will take place on the timeline.
- Compose an editorial article stating their opinion and summary of the PCB contamination.

Standards/Benchmarks:
USDD Benchmarks
- F.8.8 Understand that organisms in ecosystems have dependent and independent relationships. Growth, death and decay of organisms, cooperation and competition among species, contributing to population, how organisms depend on one another to satisfy growth and survival needs.
- F. 8.8 Identify how human activities affect an ecosystem in beneficial or harmful ways.
- F.8.9 Understand how people can develop solutions to lessen the effects of pollutants.

Wisconsin EE Standards:
- A.8.4 Use critical-thinking strategies to interpret and analyze gathered information
- B.8.5 Give examples of human impact on various ecosystems*
- B.8.10 Explain and cite examples of how humans shape the environment
- B.8.17 Explain how human resource use can impact the environment; e.g., erosion, burning fossil fuels
- B.8.21 Identify and analyze individual, local, regional, national, and global effects of pollution* on plant, animal, and human health
Unit: Ecosystems

- B.8.23 Identify governmental and private agencies responsible for environmental protection and natural resource management
- B.8.24 Create a timeline of Wisconsin history in resource management
- C.8.3 Use questioning and analysis skills to determine beliefs, attitudes, and values held by people involved in an environmental issue
- D.8.1 Identify options for addressing an environmental issue and evaluate the consequences of each option

Materials:
- Poster Paper
- Cause/Effect Chart (Attached)
- Timeline of the History of the Fox River (Attached)
- Markers

Procedure:
1. Examine a timeline of the Fox River’s history until present day.
2. What are PCB’s? Read a summary from the website www.foxriverwatch.com
3. As a class complete a Cause and Effect Chart of PCB contamination, using information that was taken from the reading.
4. Split into small groups and hand out a summary of the 4 clean-up alternatives from the DNR website on PCB Clean-up (see references). After reading about PCB clean up alternative assigned to their group, students will create a poster with a chart of the positives and negatives to the alternative they were assigned.
5. Students will present their alternative and the positives and negatives. As a class we will discuss the process of each alternative and I will add in the economic impact of the alternative.
6. After being exposed to the alternatives, students must pretend they are the “Director of the DNR” and they must make the final decision after considering all of the options.
7. Students will add their decision to the timeline as a prediction of the future life of the Fox River, and the predicted affects on the communities surrounding the river.

Assessment:
- Students will write an editorial article to the local newspaper stating their opinion about the state of the Fox River and the PCB clean up alternative they think is the best. They must include a brief summary of how the contamination occurred, what are the effects of the contamination, and why we should care. Then they must present their opinion about the clean-up and the reasons behind their choice.

Extensions:
- Fox River Walking Field Trip
  1. Brainstorm as a class a variety of known wildlife native to the Fox River. Students should create a T-Chart in their Science notebooks with the labels of invertebrates and vertebrates. As the students brainstorm, have them categorize the organisms.
  2. After the brainstorm is complete students will be given charts of possible invertebrates in the river as well as DNR Wild Cards of fish native to the river, and Creature Cards from Activity Book Great Lakes in My World. Then as a class we will add to our lists.
Unit: Ecosystems

3. The class will then begin a walking field trip to the Fox River at the boat landing across from our school upstream from the De Pere Dam. Students will be recording observations of wildlife and plants on the next page in their notebook as they explore the shores of the river.

4. Students will use containers to collect water samples from the river and will cover them in a water tight container to be tested later.

5. Students will then use nets to collect invertebrates along the shores of the river, and examine using hand lenses, and their charts of macro invertebrates in a river ecosystem. Students will need to record the numbers of macro invertebrates found in their samples, and identify what invertebrates were found.

6. Students will clean-up and collect their materials.

References:


summary

Students learn about bioaccumulation and its harmful effect on the food chain through the example of mercury in the aquatic ecosystem.

objectives

- Explain bioaccumulation.
- Trace mercury's path to the lake and through the food web.
- Create a concept map relating to mercury issues in the Great Lakes.
- List ways to help solve problems related to mercury bioaccumulation and biomagnification.

prerequisite

A Tangled Web, Great Lakes Relay

vocabulary

Bioaccumulation: the building up of a chemical in the tissues of an organism
Biomagnification: the large increase in the concentration of a chemical in an organism at the top trophic level of a food chain
Mercury: a silvery-white poisonous metallic element (Hg), liquid at room temperature and used in thermometers, barometers and batteries, and in the preparation of chemical pesticides
Primary consumer: an animal that gets its energy from plants (producers); an herbivore
Secondary consumer: a consumer that gets its energy from other consumers; a carnivore
Tertiary consumer: an animal that feeds on secondary consumers in a food chain, usually the top predators in an ecosystem or food chain
Predator: an animal that lives by killing and eating other animals

materials

- 10 very small clear containers (1-2 oz.)
- Five small clear containers (4-5 oz.)
- Three medium clear containers (8 oz.)
- One large clear container
- One small jar of glitter
- Water

settings

INDOORS
UNIT 1 Lakes

background

When an unnecessary or unhealthy chemical bioaccumulates in a living creature, it can cause health problems. It can also be transferred to the animal that eats this organism.

There are several toxic chemicals that biomagnify in the Great Lakes food chains. They include dioxin, polychlorinated biphenyls (PCBs), DDT and mercury. This activity focuses on mercury, as it continues to be a pressing issue in the Great Lakes watershed.

Mercury is a naturally occurring element. It becomes present in the environment through volcanoes and the weathering of rocks. However, most mercury in the environment is released into the atmosphere as a by-product of coal-fired power plants. Once in the air, it can attach to precipitation (rain, snow, sleet) and enter waterways via the water cycle.

Once in waterways, mercury transforms into methylmercury and is taken into the food chain by microorganisms. Methylmercury is a neurotoxin that can bioaccumulate. It can cause harm to organisms as it moves up the food chain, increasing in concentration with each contaminated organism ingested. Unlike other toxins (DDT, dioxin and PCB) which accumulate in fatty tissues of organisms, mercury also accumulates in muscle tissues. This means that there is no simple way to remove the mercury from the edible parts of the fish or other organisms. The longer an organism lives, the more contaminated food it eats, and the more toxins it accumulates. The increase of toxins found at the higher levels of the food chain is called biomagnification.* Mercury is a neurotoxin which damages or destroys nerve tissue.

Note: Although the concept of bioaccumulation is demonstrated by this activity, the amounts of the substance representing mercury are not intended to be true representations. For accurate measurements and amounts, see the activity: It Adds Up and Up.

Students are asked to make a concept map in this activity. A concept map is a type of a diagram for exploring knowledge and gathering and sharing information. A concept map consists of cells or circles that contain a concept, item or question and links. The links are labeled and show direction with an arrow. The labeled links explain the relationship between the cells. The arrow describes the direction of the relationship and reads like a sentence.

procedure

1. Ask students to make a food chain based on what they have eaten during the day. When discussing the food chains, ask students how they can tell if what they ate was raised or grown in a healthy way. If it has a special label (e.g., organic, hormone free) or was grown/raised by themselves or someone they know. Otherwise, it is difficult to know what an animal or plant has ingested.

2. Tell students you will be talking about mercury, a substance that is not able to be seen in the Great Lakes but is definitely present and can be unhealthy for living creatures. It is passed along a Great Lakes food web, from plant to animal to animal. First, how does it get into the lake? Ask students to list the different ways we get power to our homes. Focus on coal-fired power plants, which generate electricity. That is the major source of mercury in the environment. As you explain the path of mercury into the Great Lakes, have students create diagrams.

3. Explain the concept of bioaccumulation and how it affects a food web. Have students define bioaccumulation in the journal pages.

4. Point out the containers (each filled 1/3 full with water) and tell students these represent organisms in the food web. Show students the glitter and explain that it represents the mercury. Have the students decide (in small groups if time) on a plan that uses the containers and the mercury to demonstrate bioaccumulation. If students do not do it on their own, discuss how the containers can represent organisms in the food web (suggested names included). Guide them to come up with names for the 10 very small (1-2 oz.) containers (green algae), names for the five primary consumer jars (4-5 oz.) (diporeia), names for the three secondary consumer jars (8 oz.) (chub), and a name for the top predator jar (lake trout). If students come up with a different system, discuss it and use their idea, if it is accurate.

5. Demonstrate the food chain and bioaccumulation in action by putting a pinch of glitter in the very small containers, small containers, and medium containers. Pour the contents of the very small containers into the five small containers. This represents producers being eaten by the consumers. Continue with the other containers, as each “organism” is “eaten.” Some of the glitter may stay in the containers as you pour, which is fine as it can represent the mercury that is not accumulated, or is excreted by the animal.

6. Discuss what happened. Where did most of the glitter end up? What does this mean in a food chain? When a lot of the glitter/mercury ends up in the top predators, it can be described as “biomagnification.”

7. Have students diagram what they saw in the activity by creating a food web that shows mercury being passed along to each organism.
UNIT 1 Lakes

wrap-up

1. Have the students create a concept map using vocabulary from the activity: bioaccumulate, micro-organism, primary consumer, secondary consumer, top predator, biomagnify, mercury, coal-fired power plant.

2. Have students share their diagrams with each other.

3. Create a list of ways to help solve the problem of mercury in the environment. The list might include:
   - Don’t buy products with mercury in them.
   - Use less electricity, so less coal has to be burned (turn off the lights!).
   - Educate others about the issue.
   - Encourage alternative energy sources.
   - Write letters requesting stronger emissions controls on power plants.
   - Support public leaders who will back strong emissions controls.

sources

This activity has been adapted with permission from Mercury in Schools:
http://www.mercuryinschools.uwex.edu/flash_content/curriculum/hg_in_env.htm

Mercury Contamination of Aquatic Ecosystems
wi.water.usgs.gov/pubs/FS-216-95/

Food Watch
http://www.foodwatch.ca/

assessment

Rubric on page 87

We value your thoughts and feedback on Great Lakes in My World. Please let us know about any oversights, errors or omissions you find, or if there are things you or your students particularly like.

Send your comments to: education@greatlakes.org
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History of the Fox River Contamination

Native Americans lived and utilized the Fox River for fish, transportation, and wildlife.

7000 BC

Jean Nicolet landed on the shores of the river in search of a new route to the Orient.

1634 AD

Fur Trading business peaked along the river after the arrival of the French. It was the area's largest business.

1834 AD

European Immigrants moved to the area, which started communities along the Fox River.

1848 AD

Agricultural Business was established, and led to the use of steamboats along the Fox River.

1880 AD

Lake Herring catch peaked and never regained its former abundance. Wallaye also was depleted.

1905 AD

Wisconsin State Board of Health Reported Raw Sewage, oil slicks, wastes from canning factories and paper mills. Dead Fish floated along the river's surface.

1927 AD

Severe oxygen depletion caused by paper mills declined the fish population in large numbers.

1930 AD

Bay G Boa
Unit: Ecosystems

1954 AD: NCR Corporation and Appleton Paper Company began dumping PCBs into the Fox River, as a by-product of their joint production of PCB-coated carbonless copy paper.


1972 AD: Congress passed the Toxic Substances Control Act which outlawed the manufacture, sale, and distribution of PCBs except in "totally enclosed" systems, within 3 years. It was the only chemical Congress itself has ever banned.

1976 AD: The federal Clean Water Act was passed, mandating improvements in wastewater treatment plants.

1976 AD: DNR released a major report on PCB contamination on the Fox River. Fish consumption advisories were issued for the first time, warning anglers to not eat certain fish.

1980 AD: Visually, the River improved dramatically; wastewater treatment plants were upgraded.
started the Final Action Plan (FAP) for cleaning up the River and Bay, with input from millions of citizens, business, industry, and others.

Many discussions and agreements have been made among politicians, and government agencies re: PCBs.

The government agencies announced the release of the final proposed River cleanup plan, which provided alternatives.

2001 AD

Capping vs. dredging debate continues, regardless of PCBs.

2007 AD

Future?

Possible

Preferable
What are PCBs?
Polychlorinated biphenyls (PCBs) are a group of 209 synthetic chemical compounds which are colorless and odorless. From 1929 to 1977 PCBs were manufactured in the United States and widely used in electrical equipment and other industrial uses. Due to the harm PCBs cause to humans and wildlife, their manufacture was banned in 1977.

How are people exposed to PCBs?
PCBs are found primarily in lake and river bottom sediments and fatty tissues in fish. Eating contaminated fish remains the major route of exposure to PCBs. Other sources of exposure remain very small.

How do PCBs affect human health?
PCBs are stored in the fat of animals and humans. PCBs and other contaminants can accumulate in the body over time. It may take months or years of regularly eating contaminated fish to build up amounts that are a health concern. However, PCBs may eventually affect your health or that of your children.

Pregnant women and young children: Mothers who eat highly contaminated fish before birth may have children who have slower mental development and difficulty learning. A pregnant woman can pass these chemicals to her unborn child and to the new baby through breast milk. However, the significant benefits of breastfeeding far outweigh the associated risks. Young children may also experience developmental health effects.

Adults: Adults should also remain concerned about PCBs because they may cause liver and immune system problems, including cancer.

How can I reduce my health risks to PCBs?
Most exposure to PCBs comes from eating contaminated fish. The best way to reduce the health risks is to eat only the safest fish. Some examples include:

- Choose smaller and younger fish. Generally, panfish and fish just over the legal size will have fewer PCBs.
- Choose lean fish. Panfish, brook trout and brown trout that live in streams and rivers tend to be low in fat. Small walleye, northern pike and bass, especially those that are just legal size, also tend to have fewer chemicals.
Fish from these waters contain chemicals. Eating too much may be harmful, especially for women and children. Follow the safe fish eating guidelines below.

Los peces de estas aguas están contaminados. Su consumo puede ser malo para la salud, especialmente las mujeres y niños. Para protegerse y proteger a su familia, siga las recomendaciones siguientes.

This information is based on the Wisconsin Departments of Health & Family Services and Natural Resources joint fish consumption advisories. For more information or to obtain a fish advisory booklet, please contact your local health department.


GREEN BAY SOUTH OF MARINETTE

Printed by the Division of Public Health, Wisconsin Department of Health and Family Services, with funds from the Agency for Toxic Substances and Disease Registry, Public Health Services, USDHHS. PPH 45064 (Rev. 5/14/04)
• Release predator fish that are very large, like walleye, northern pike, muskie, and lake trout. These fish tend to have more PCBs. Bass have different advisories. Carp and catfish also tend to accumulate more chemicals. Any size of carp caught in the Lower Fox River should not be eaten.

• Advise women of childbearing age, pregnant women, nursing mothers and young children to select their catch or meals carefully (follow the Wisconsin Fish Consumption Advisory, Internet links can be found below).

• Trim the skin and fatty areas off the fish where contaminates accumulate (see filleting recommendations below).

How can a fish be safely filleted?
Properly trimming fish can reduce the concentration of PCBs and other chemicals. However other chemicals such as methyl mercury, are stored throughout the fish and cannot be filleted. Trim the fatty areas of the fish before cooking. Cook the fish in ways that allow fat (and the unwanted chemicals) to drip away. About half of the PCBs can be removed by trimming away the fatty parts of the fish. Filleting and PCBs: Fillet along the belly, the top of the back, and the dark meat along the skin side of the fish. Remove the skin before cooking. This allows fats to drain off.

Cook so fat drips away. Bake, broil or grill on a rack, or poach and do not use the liquid for sauces or gravy.

For more information
• Contact the Wisconsin Division of Public Health, Bureau of Environmental Health, PO Box 2659, Madison, WI 53701-2659, (608) 266-1120; or
• Visit the department's website, http://www.dhfs.state.wi.us/eh

Prepared by the Wisconsin Division of Public Health, with funds from the Agency for Toxic Substances and Disease Registry (ATSDR), Public Health Service, USDHHS.

(PPH 45014 6/2001)
Fish Consumption Advisory (for PCBs) on the Lower Fox River and Green Bay
(An Internet link to the new mercury guidelines can be found on the reverse page)

## Fox River from Little Lake Butte des Morts to the dam at De Pere

<table>
<thead>
<tr>
<th>Species</th>
<th>One meal a week</th>
<th>One meal a month</th>
<th>One meal in two months</th>
<th>Do Not Eat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carp</td>
<td></td>
<td></td>
<td></td>
<td>All Sizes</td>
</tr>
<tr>
<td>Northern Pike</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Smallmouth Bass</td>
<td>All Sizes</td>
<td></td>
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</tr>
<tr>
<td>Walleye</td>
<td>All Sizes</td>
<td></td>
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<tr>
<td>White Perch</td>
<td>All Sizes</td>
<td></td>
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</tr>
<tr>
<td>White Bass</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow Perch</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Fox River from the mouth up to De Pere Dam

<table>
<thead>
<tr>
<th>Species</th>
<th>One meal a week</th>
<th>One meal a month</th>
<th>One meal in two months</th>
<th>Do Not Eat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Crappie</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegill</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carp</td>
<td></td>
<td></td>
<td></td>
<td>All Sizes</td>
</tr>
<tr>
<td>Channel Catfish</td>
<td></td>
<td></td>
<td></td>
<td>All Sizes</td>
</tr>
<tr>
<td>Northern Pike</td>
<td>Less than 33&quot;</td>
<td>Larger than 33&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock Bass</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheepshead</td>
<td>Less than 10&quot;</td>
<td>10-13&quot;</td>
<td>Larger than 13&quot;</td>
<td></td>
</tr>
<tr>
<td>Smallmouth Bass</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walleye</td>
<td>Less than 16&quot;</td>
<td>16-22&quot;</td>
<td>Larger than 22&quot;</td>
<td></td>
</tr>
<tr>
<td>White Sucker</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Perch</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>White Bass</td>
<td></td>
<td></td>
<td></td>
<td>All Sizes</td>
</tr>
<tr>
<td>Yellow Perch</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Green Bay south of Marinette and its tributaries (except Lower Fox River) including the Menominee, Oconto, and Peshtigo Rivers from the river openings up to the first dam

<table>
<thead>
<tr>
<th>Species</th>
<th>One meal a week</th>
<th>One meal/month</th>
<th>One meal/two months</th>
<th>Do Not Eat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown Trout</td>
<td>Less than 17&quot;</td>
<td>17-28&quot;</td>
<td>Larger than 28&quot;</td>
<td></td>
</tr>
<tr>
<td>Carp</td>
<td></td>
<td></td>
<td></td>
<td>All Sizes</td>
</tr>
<tr>
<td>Channel Catfish</td>
<td></td>
<td></td>
<td></td>
<td>All Sizes</td>
</tr>
<tr>
<td>Chinook Salmon</td>
<td>Less than 30&quot;</td>
<td></td>
<td>Larger than 30&quot;</td>
<td></td>
</tr>
<tr>
<td>Northern Pike</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rainbow Trout</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheepshead</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smallmouth Bass</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scape</td>
<td>Less than 16&quot;</td>
<td>16-20&quot;</td>
<td>Larger than 20&quot;</td>
<td></td>
</tr>
<tr>
<td>Sturgeon</td>
<td></td>
<td></td>
<td></td>
<td>All Sizes</td>
</tr>
<tr>
<td>Walleye</td>
<td>Less than 22&quot;</td>
<td>22-29&quot;</td>
<td>Larger than 29&quot;</td>
<td></td>
</tr>
<tr>
<td>White Perch</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Sucker</td>
<td>All Sizes</td>
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<tr>
<td>White Bass</td>
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<td>All Sizes</td>
</tr>
<tr>
<td>Whitefish</td>
<td></td>
<td></td>
<td></td>
<td>All Sizes</td>
</tr>
<tr>
<td>Yellow Perch</td>
<td>All Sizes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How Do PCBs Get Into the Fish I Eat?

1. Polychlorinated Biphenyls (PCBs) are chemicals that can be harmful to children and unborn babies. These chemicals were released by industries into the Fox River. Although industries have stopped releasing PCBs in the river since 1976, PCBs still remain.

2. Small marine life eat PCBs which are then eaten by fish. PCBs build up and are stored in the fat of fish. Larger, older fish high in fat have more PCBs than smaller, younger, and leaner fish.

3. People who fish contain store these body fat for

4. PCBs can especially be harmful to children and unborn babies. A woman can pass PCBs onto her baby during pregnancy and breastfeeding. PCBs in children's bodies can cause slower development and learning disabilities. Women who are pregnant or who intend to become pregnant, and children under the age of 15 years should be very careful about the fish they eat.

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NOTICE

Fish from these waters contain chemicals. Eating too much may be harmful, especially for women and children. Follow the safe fish eating guidelines below.

Los peces de estas aguas están contaminados. Su consumo puede ser malo para la salud, especialmente las mujeres y niños. Para protegerse y proteger a su familia, siga las recomendaciones siguientes.

Ntses los ntawm cov dej no muaj yam tshuaj khesmis thiab yog noj ntau dhau lawm kuj yuav tsis zoo ib zaug, qhov tseem ntsiab lus yog tsis zoo rau cov poj niam thiab menyuam yaus noj. Ua ntej yuav noj ntses ua zoo saib lawv li cov xwm txheej lus qhia raws li nram qab no.

Once/Month
Hasta una comida al mes

Yellow Perch
Walleye
Carp

White Perch
White Bass
Smallmouth Bass
Northern Pike

This information is based on the Wisconsin Departments of Health & Family Services and Natural Resources joint fish consumption advisories. For more information or to obtain a fish advisory booklet, please contact your local health department.

http://dhfs.wi.gov
http://dnr.wi.gov

Little Lake Butte Des Morts to De Pere Dam

Printed by the Division of Public Health, Wisconsin Department of Health and Family Services, with funds from the Agency for Toxic Substances and Disease Registry, Public Health Services, USDHHS. PPH 45065 (Rev. 5/14/04)
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Ntses los ntawm cov dej no muaj yam tshuaj khesmis thiab yog noj ntaw dhaus lawm kuj yuav tsis zoo ib zaug, qhov tseem ntsiab lus yog tsis zoo rau cov poj niamb thiau menyam yaus noj. Ua ntej yuav noj ntses ua zoo saib lawv li cov xwm txheej lus qhia raws li nram qab no.

This information is based on the Wisconsin Departments of Health & Family Services and Natural Resources joint fish consumption advisories. For more information or to obtain a fish advisory booklet, please contact your local health department.


DEPERE DAM TO MOUTH OF FOX RIVER

Printed by the Division of Public Health, Wisconsin Department of Health and Family Services, with funds from the Agency for Toxic Substances and Disease Registry, Public Health Services, USDHHS. PPH 45066 (Rev. 5/14/04)
EPA, DNR Amend 2002 Lake Cleanup Plan

By Susan Pastor, U.S. Environmental Protection Agency

A more balanced cleanup plan of capping, sand covering and dredging is the new cleanup approach U.S. Environmental Protection Agency and Wisconsin Department of Natural Resources will be taking on Little Lake Butte des Morts according to a June 12 decision.

The new plan, referred to as an amended record of decision, replaces a previous one for the lake approved by EPA and Wisconsin DNR in 2002. Also known as Operable Unit 1, Little Lake Butte des Morts will still have a cleanup that involves dredging as in the 2002 plan, however, the new plan adds capping to allow for a faster cleanup at a lower cost.

“After reviewing the results of over 6,300 sediment samples taken since 2004, we think this is the best way to go,” said EPA Remedial Project Manager Jim Hahnenberg. “Adding a capping component will reduce the time to complete the cleanup by five years while still providing protection to people and the environment.”

He added that 70 percent of the contaminated sediment has already been dredged over the past four years under the 2002 cleanup plan. The addition of sand covers and caps will continue to meet the agencies’ cleanup objectives while protecting people and the environment. Fish advisories and regular monitoring of PCBs in sediment, water and fish tissue will remain in effect.

Glatfelter, WTM I and Menasha Corp., the paper companies responsible for the PCB contamination, are expected to voluntarily continue to pay for the cleanup under the new decision.

EPA, in consultation with Wisconsin DNR, made its decision to revise the cleanup plan after evaluating input from about 60 people during its comment period which ran from Nov. 26, 2007 to Jan. 31, 2008.

The amended record of decision will be available at the information repositories and administrative record locations listed on Page 7 and online at www.epa.gov/region5/sites/foxriver.
Little Lake Butte des Morts Dredging
To Be Completed This Summer
By Susan Pastor, U.S. Environmental Protection Agency

With the last of the dredging underway, a portion of the Little Lake Butte des Morts cleanup is on track to be completed by July.

Dredging 40,000 cubic yards of PCB-contaminated sediment resumed in April. According to EPA Remedial Project Manager Jim Hahnenberg, when dredging is finished by the end of June, that portion of the cleanup of Little Lake Butte des Morts will be done. Work will continue using gravel/sand caps and sand covers mainly in the central part of the lake.

“The remaining work for this year includes dredging around and north of the Highway 441 Bridge,” he explained. “We expect all of that to be done by late fall.”

Two hydraulic dredges will operate from 7 a.m. to 7 p.m. six days per week completing the work by July. Sediment and water will be pumped into large plastic “geotubes” in a staging area near the shore by the bridge. There, sediment will be dried out and taken to a state-licensed landfill in Chilton for proper disposal.

See Little Lake Butte, Page 6

Information Kiosks Vandalized
By Jessica Maloney, Wisconsin Department of Health and Family Services

Vandals recently struck some new information kiosks that were installed along the Lower Fox River in the past year. The glass-enclosed stations, which host updated information on fish advisories and cleanup operations on the Lower Fox River, have suffered broken glass and one was reportedly stolen.

These kiosks are an essential part of public information concerning the river. News is updated routinely by local parks and health departments. If you notice any tampering or active vandalism of these signs, please report it to the local police department. Vandalism is a crime and people can be prosecuted for this offense.
EPA, DNR Put Some River Work On Hold
By Susan Pastor, U.S. Environmental Protection Agency

Since sediment with the highest levels of PCBs has been removed from the Lower Fox River below the DePere Dam, the remainder of contaminated sediment will temporarily remain in place.

After last year’s cleanup in the reach of the river from DePere to the mouth of Green Bay was completed, it was decided to leave lower levels of contaminated sediment behind until the rest of the cleanup “catches up.”

According to EPA Remedial Project Manager Jim Hahnenberg, EPA and Wisconsin Department of Natural Resources agreed to combine completion of the “residual” contamination with the overall cleanup. “We plan to do more dredging and using sand covers and caps in 2011,” he explained. “We’ll roll this into the rest of the cleanup when other actions move downstream to the area below the DePere Dam in 2011 rather than clean it up now and risk recontaminating the area later on.”

The agencies believe this is the best approach since the remaining levels have been greatly reduced in the area and are similar to the rest of the river areas that have not yet been addressed.

“We decided it would make more sense to let the larger project catch up,” he continued. “We’ll be back there in 2011.”

Out and About...
By Susan Pastor, U.S. Environmental Protection Agency

The Fox River Intergovernmental Partnership is made up of U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, Oneida Tribe of Indians of Wisconsin and Menominee Indian Tribe of Wisconsin. These partners, as well as other supporting agencies, regularly provide speakers to organizations in the Fox Valley area. The following people recently made presentations:

April

♦ Jennifer Hill-Kelley and Betsy Galbraith, Oneida Tribe: Department of Interior Natural Resource Damage Assessment Program workshop, Phoenix, AZ; restoring the environment, sustaining Oneida.

May

♦ Greg Hill, DNR: University of Wisconsin Infusing Sustainability into College Curricula workshop, Oshkosh; general Lower Fox River cleanup and local environmental issues.
The Fox River Current is featuring promising natural resource damage assessment projects in and near the Lower Fox River.

Spotlight On:
Leicht Memorial Park

By Colette Charbonneau, U.S. Fish and Wildlife Service

The city of Green Bay created a waterfront location along the west bank of the Lower Fox River for downtown picnicking, community special events and watercraft-oriented activities. Leicht Memorial Park includes a walkway along the river, a dock that can be used as a canoe-kayak launch and a fishing pier. At the park’s dedication, Green Bay Mayor Jim Schmitt said it was a great day for the community. “In years to come, this park will be a focal point for culture, celebrations and family fun,” he stated. “It’s the perfect place to bring people together to enjoy our city’s beautiful riverfront.”

Leicht Memorial Park can be found along Dousman Street on the west side of Ray Nitschke Memorial Bridge. Several community special events already have been held at the park including International Bayfest, the Tall Ship Festival and the Fire Over the Fox fireworks show.
Spotlight from Page 4

This valuable piece of property was donated by Russ Leicht and his mother, Margaret, for use as a public park. Over its 100-year history, Leicht Transfer & Storage Co. has employed thousands of people from the community to fill warehousing and distribution positions.

The Fox River/Green Bay Natural Resource Trustee Council approved this project as part of the Fort James/Georgia-Pacific final natural resource damage assessment and restoration agreement. The natural resource-based, public-use projects provide recreation and enjoyment related to aquatic habitats that are similar to those damaged by the presence of PCBs in and around the Lower Fox River and Green Bay. These types of projects are expected to bring people to the river and bay for their pleasure and to gain appreciation of the resource so they will want to protect it into the future.

The natural resource trustees are comprised of Wisconsin Department of Natural Resources, U.S. Fish and Wildlife Service, Oneida Tribe of Indians of Wisconsin, Menominee Indian Tribe of Wisconsin, Michigan Attorney General, Michigan Department of Environmental Quality, Michigan Department of Natural Resources and National Oceanic and Atmospheric Administration.

For further information on NRDA projects, contact Trustee Council Coordinator Colette Charbonneau, FWS, at Colette_Charbonneau@fws.gov or at 920-866-1726.

Leicht Memorial Park will be a focal point for community events.
EPA To Review Cleanup Progress

By Susan Pastor, U.S. Environmental Protection Agency

A formal review of the Lower Fox River project will begin this fall to determine if current cleanup measures are effective.

Under the Superfund law, cleanups are reviewed every five years at sites where cleanup activity is still underway or where some levels of contaminants were left behind limiting a site’s use. Although the review, which is due by August 2009, will include all reaches of the Lower Fox River and Green Bay, the 2004 construction startup in Little Lake Butte des Morts (also referred to as Operable Unit 1) started the five-year cycle.

EPA Remedial Project Manager Jim Hahnenberg will be leading the review. “We want to know if the cleanup is being protective or not,” he explained. “Of course, we’re not done yet, so we’re just checking in on the site’s progress.”

This five-year review will be a snapshot of the conditions of the site with an eye toward protection. Hahnenberg will do a physical site inspection, look at the information that has been gathered so far, re-evaluate current conditions and make some general observations. The findings and some recommendations on what needs to be done will be assembled and put into a report that will be available to the public next summer.

“It’s highly unlikely we’re going to discover something we didn’t already know,” he said. “The purpose of these reviews is to ensure the site is safe and the cleanup continues to protect people and the environment.”

During these reviews, EPA typically looks at project files, any changes in surrounding land use, new field inspections and the history of local community involvement.

Hahnenberg concluded, “Citizen input will be welcome when the review starts.”

Little Lake Butte from Page 2

Areas in the lake that cannot be dredged will be cleaned up next year using 6-inch sand covers or a combination of sand and gravel caps. Sand covers in various parts of the lake and sand and gravel caps in the northern portion of the lake will be installed in areas where dredging is not feasible.

Hahnenberg said when that work is done in 2009, the Little Lake Butte des Morts cleanup is expected to be deemed complete.

“We were on a six-year schedule to complete the lake cleanup and it looks like we are going to meet that goal.”

EPA, DNR Put from Page 3

Work plans are being developed and equipment is being ordered now so work can begin downstream in late spring 2009. This will include the reach from Little Rapids (also known as Deposit DD) and above the DePere Dam (referred to as Operable Unit 3) and above the dam (part of Operable Unit 4). These portions of the river cleanup are expected to be finished by fall 2009.

In 2010, final cleanup activities will resume downstream and move north of the dam.
Information Available at Local Libraries

The Intergovernmental Partners invite the public to review technical reports, fact sheets and other documents related to the Lower Fox River cleanup at information repositories set up in the reference sections of the local libraries listed below. Information repositories at the public libraries in De Pere, Kaukauna, Little Chute, Neenah and Wrightstown have been discontinued. However, binders containing fact sheets and newsletters are being maintained at these locations as well as at the following repositories:

- **Appleton Public Library**, 225 N. Oneida St., Appleton, Wis.; 920-832-6170
- **Brown County Library**, 515 Pine St., Green Bay, Wis.; 920-448-4381, Ext. 394
- **Door County Library**, 107 S. Fourth Ave., Sturgeon Bay, Wis.; 920-743-6578
- **Oneida Community Library**, 201 Elm St., Oneida, Wis.; 920-869-2210
- **Oshkosh Public Library**, 106 Washington Ave., Oshkosh, Wis.; 920-236-5205

**Check out these Web sites:**

http://www.epa.gov/region5/sites/foxriver
http://contaminants.fws.gov/Issues/Restoration.cfm
http://www.fws.gov/midwest/nrda/index.html

An administrative record, which contains detailed information upon which the selection of the final site cleanup plan was based, is also available for review at two DNR offices: 801 E. Walnut St., Green Bay, Wis. and 101 S. Webster St., 3rd Floor, Madison, Wis. An administrative record is also available at the EPA Record Center, 77 W. Jackson Blvd., 7th Floor, Chicago, Ill.
Ecosystems Study Guide
Test Date: __________

- Define Ecosystem and Ecology
- Identify 6 major biomes of the world.
- Food Chain: Producers, consumers, decomposers, herbivores, carnivores, omnivores, scavengers
- Create an example food chain
- Energy Pyramid: Understand key conclusions and levels
- Explain and know the difference between interdependent, dependent and independent relationships
- Know the 4 major types of relationships (isms) among animals
- Define Invasive Species and the examples in our watershed.
- Know the Difference between Population, Community, Niche and Habitat
Ecosystems Assessment

Section 1: Multiple Choice
Directions: Circle the appropriate choice below each question. (1 point each)

1. The energy necessary for all life on Earth comes from the
   a. sun
   b. soil
   c. consumers
   d. producers

2. A food chain always begins with a
   a. consumer
   b. decomposer
   c. producer
   d. reducer

3. Which of the following are decomposers?
   a. bacteria
   b. rabbits
   c. humans
   d. grasses

4. What organisms are able to use energy form the sun directly?
   a. consumers
   b. fungi
   c. decomposers
   d. producers

5. When animals and plants work together perfectly, scientists call this:
   a. commensalism
   b. symbiosis
   c. web
   d. parasitism

6. Spiders prey on other insects. What will probably happen to the spider population if the population of insects decreases?
   a. decrease
   b. increase
   c. stay the same
   d. double
Section 2: Matching
Directions: Match the letters with the appropriate answer. (4 points each)

___ Population  A. All the populations living in an area.
___ Community  B. The role of an organism in the community.
___ Niche  C. The place where an organism lives.
___ Habitat  D. All organisms of a species living in the same area.

Section 3: Short Answer
Directions: Answer each question with a complete sentence.

1. **Draw and label** a food chain. **Identify** the producers and consumers.

2. **Classify** each of the following:

<table>
<thead>
<tr>
<th>herbivore</th>
<th>carnivore</th>
<th>omnivore</th>
<th>decomposers</th>
</tr>
</thead>
<tbody>
<tr>
<td>fungi</td>
<td>ants</td>
<td>bees</td>
<td>bear</td>
</tr>
<tr>
<td>humans</td>
<td>Eagles</td>
<td>squirrels</td>
<td>bacteria</td>
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<tr>
<td>lions</td>
<td>cows</td>
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</tbody>
</table>

3. **Use a Venn Diagram to Compare and Contrast** two Biomes that you studied in class.

4. The habitat for trout is a lake. During the summer, gasoline leaks from boat engines into the water. Because of this the trout are dying.

   - What basic need is being taken from the fish?
   - How could this change the ecosystem?
Section 4: Essay Questions
Directions: Answer each question with a complete sentence. (4 points each)

1. **Define** the word “ecosystem,” include one example of an ecosystem.

2. **Explain** the difference between abiotic and biotic factors in an ecosystem. Give one example of each.

3. **What** is an invasive species? Describe and **List** at least two examples.

4. **Describe** how an animal becomes endangered or threatened. Provide an example of a specific animal on the endangered or threatened species list.

5. We discussed many relationships (the “isms”) among animal and plant populations. **Mutualism** **Parasitism** **Commensalism**
   Choose one of these relationships and **describe** it in detail. **Include at least one specific example of this relationship in an ecosystem.**

6. **Define** what a watershed is. What watershed do we live in?

7. How do humans affect ecosystems? Write two examples—one positive human influence on an environment and one negative influence.
Ecosystem Assessment - Modified

1. The energy necessary for all life on Earth comes from the
   a. sun
   b. soil
   c. consumers
   d. producers

2. A food chain always begins with a
   a. consumer
   b. decomposer
   c. producer
   d. reducer

3. **Draw and label** a food chain. **Identify** the producers and consumers. Use the Cards to help you.

4. **Choose and place** each of the following as a producer, consumer:
   
   - humans
   - trees
   - oats
   - monkeys
   - ants
   - bees
   - grass
   - lion

<table>
<thead>
<tr>
<th>Producers</th>
<th>Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. **Compare** producers and consumers. Which one are you?
River Ecosystem

Description of the Site: Circle one.

Urban (City) Rural (Country)

River Bank Plant Survey:
Circle how much of the shore is covered by plants, rocks and logs (no exposed soil).

All Most Some None

Check the types of plants found along the shore.
Underneath write how many of each: a lot some none.

_____ bushes _____ grasses _____ trees

Erosion--How much soil is washed into the River?

_____ a lot _____ some _____ no visible erosion
River Bank Animal Survey: Record any animal that you see directly or animals that left evidence of their presence.

Total the number of types of animals (species): _____

<table>
<thead>
<tr>
<th>Animal Name and Description</th>
<th>How many?</th>
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Water Quality
Dissolved Oxygen:
How much dissolved oxygen is available to living things in the lake? ____________ (ppm) parts per million.

Turbidity:
Record the level of particulate matter in the water ________ JTU.

Temperature: _________ degrees (C/F)
Putting it all together!!

1. Using the data collected do you think this river can support a wide variety of life? Why or Why not?

2. If you’ve tested another lake, pond or river, which can support more life? Why?
Method of Protection

Food/Food Gathering Method

Name of Invertebrate

River Adaptations

Oxygen Gathering Adaptations
Pond Ecosystem

Description of the Site: Circle one.

Urban (City)  Rural (Country)

Pond Plant Survey:
Circle how much of the shore is covered by plants, rocks and logs (no exposed soil).

All  Most  Some  None

Check the types of plants found along the shore.
Underneath write how many of each:  a lot  some  none.

_____ bushes  _____ grasses  _____ trees

Erosion--How much soil is washed into the pond?

_____ a lot  _____ some  _____ no visible erosion
Pond Animal Survey: Record any animal that you see directly or animals that left evidence of their presence.

Total the number of types of animals (species): ______

Animal Name and Description

__________________________________________________________________________ How many?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Water Quality
Dissolved Oxygen:
How much dissolved oxygen is available to living things in the pond?
______________ (ppm) parts per million.

Turbidity:
Record the level of particulate matter in the water _______ JTU.

Temperature: __________ degrees (C/F)
Putting it all together!!

1. Using the data collected do you think this pond can support a wide variety of life? Why or Why not?

2. If you’ve tested another lake, pond or river, which can support more life? Why?
Biotic Index of Water Quality

*Circle any of the organisms you find in your basin.*

Group 1: Sensitive - These organisms are generally pollution-intolerant. Their dominance usually signifies GOOD water quality.

Group 2: Somewhat Sensitive - These organisms can exist in a wide range of water quality conditions.

Group 3: Tolerant - These organisms are generally tolerant of pollution. Their dominance usually signifies POOR water quality.

Number of sensitive organisms found __________
Number of somewhat sensitive organisms found __________
Number of tolerant organisms found __________

This number times 3 = ____ index value
This number times 2 = ____ index value
This number times 1 = ____ index value

Add the three index values together = ____ Total Index Value

Compare this total index value to the following numbers to determine the water quality of the river. Put an “X” next to the water quality rating of the river.

WATER QUALITY RATING

____ Excellent (> 22)  ____ Good (17 - 22)  ____ Fair (11 - 16)  ____ Poor (< 11)
Lake Ecosystem

Description of the Site: Circle one.

Urban (City) Rural (Country)

Lake Shore Plant Survey:
Circle how much of the shore is covered by plants, rocks and logs (no exposed soil).

All Most Some None

Check the types of plants found along the shore.
Underneath write how many of each: a lot some none.

_____ bushes _____ grasses _____ trees

Erosion--How much soil is washed into the lake?

_____ a lot _____ some _____ no visible erosion
**Lake Shore Animal Survey:** Record any animal that you see directly or animals that left evidence of their presence.

Total the number of types of animals (species): ____

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**Water Quality**

**Dissolved Oxygen:**
How much dissolved oxygen is available to living things in the lake?
___________ (ppm) parts per million.

**Turbidity:**
Record the level of particulate matter in the water _______ JTU.

**Temperature:** _________ degrees (C/F)
Putting it all together!!

1. Using the data collected do you think this lake can support a wide variety of life? Why or Why not?

2. If you’ve tested another lake, pond or river, which can support more life? Why?
Biotic Index of Water Quality

*Circle any of the organisms you find in your basin.*

Group 1: Sensitive - These organisms are generally pollution-intolerant. Their dominance usually signifies GOOD water quality.

- Dobsonfly Larva
- Caddisfly Larva
- Gilled or Orb Snails
- Stonefly Nymph
- Mayfly Nymph
- Water Penny

Group 2: Somewhat Sensitive - These organisms can exist in a wide range of water quality conditions.

- Scud
- Clams
- Cranefly Larva
- Crayfish
- Beetle Larva
- Damselfly Nymph
- Isopod or Sowbug

Group 3: Tolerant - These organisms are generally tolerant of pollution. Their dominance usually signifies POOR water quality.

- Aquatic Worms
- Midge Larva
- Leech
- Blackfly Larva

Number of sensitive organisms found ___.
Number of somewhat sensitive organisms found ___.
Number of tolerant organisms found ___.

This number times 3 = ____ index value
This number times 2 = ____ index value
This number times 1 = ____ index value

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WATER QUALITY RATING
____ Excellent (> 22)  ____ Good (17 - 22)  ____ Fair (11 - 16)  ____ Poor (< 11)
Adapted from a River Key

Key to Macroinvertebrates

Shells

Single Shell
- spiral, opening on left
- spiral, opening on right
- coiled
- conical

- Pouch Snail
- Gilled Snail
- Orb Snail
- Limpet
- Fingernail Clam
- Freshwater Clam

Double Shell
- tiny white
- 2 to 8 inches

Legs

- long breathing tube
- two fringed tails
- smooth, "stiff", large

- Rat tailed Maggot Larva
- Water Snipe Fly Larva
- Horsefly Larva

10+ legs

- lobster-like
- shrimp-like, swims on side
- walks on bottom

- Amphipod or Scud
- Isopod or Aquatic Sowbug

Four pairs of legs

- tiny, swims in water
- runs on top of water

- Water Mite
- Fishing Spider

No Wings

- small, crawls on bottom
- swims moving hind legs alternately

- Riffle Beetle
- Water Scavenger Beetle

No Obvious Tails

- green, tan, orange or white body
- six legs and prolegs on abdomen
- suction cup-like
- large, hinged mouth
- lives in stone house
- lives in stick house

- addisfly Larva
- Pyralid Caterpillar
- Water Penny
- Dragonfly Nymph
- Caddisfly Larva
- Caddisfly Larva
- Alderfly Larva
- Dobsonfly Larva

One or Two

- dark head, green or tan body
- small, spines on side
- large mouth, spines on
Biotic Index of Water Quality

*Circle any of the organisms you find in your basin.*

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**WATER QUALITY RATING**

- Excellent (> 22)
- Good (17 - 22)
- Fair (11 - 16)
- Poor (< 11)
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GRADE 5

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<td>GEORGE</td>
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<td>NAGDA</td>
<td>$6.95</td>
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(UPDATED JUNE 2006)
Exploring the natural world around us is an important step towards environmental literacy. Yet many students don't know how water gets to their taps or the names of the birds and trees that are common in their neighborhoods. Abstract concepts such as food webs and water cycles can be made more tangible if students can visualize the connections between the water, land, climate, wild and human life that surrounds them and understand the ecosystem services that support their own lives.

For a model of activities and resources that enable you and your students to map your ecological address, see the North Carolina Department of Natural Resources’ "Discover Your Ecological Address" site at http://www.ee.enr.state.nc.us/ecoadr/ecoadr.htm. David Sobel’s "Mapmaking with Children: Sense of Place Education for the Elementary Years" (Heinemann, 1998) is a good resource for younger students. The sites below will help you find information for your local area. For related descriptions and resources of environmental topics such as water, soil, and waste, see http://www.envlirliteracy.org/

**TOPOGRAPHY MAPS**

State Department of Natural Resources
Most state departments of natural resources provide teachers with free resources specific to their state. Contact information for many natural resource agencies is available at http://offices.fws.gov/statelinks.html. If that doesn’t work, search your state’s official website or the government pages in the phone book.

United States Geological Service
The USGS provides free or low cost maps to educators. One of their newest (and most stunning) maps shows the geological age of rock across the United States. Call 1-800-ASK-USGS and mention you are an educator. For state-specific resources, contact your local USGS office at http://interactive2.usgs.gov/contact-us/index.asp or access state fact sheets and local program information at http://water.usgs.gov/wid/index-state.html

**SOIL**

National Soil Survey Center: State Soils
Did you know your state not only has an official state bird or flower, but also a state soil? See a picture of your state soil series at http://www.statlab.iastate.edu/soils/photosal statalestatesoils/list1.htm

To reach your state soil office, see http://www.statlab.iastate.edu/soils/soldiv/personnel/states.htm

**WATERSHED**

EPA: Locate Your Watershed
Plug in your zip code and this site will tell you what watershed you’re in and provide an environmental profile of the area. http://cfpub1.epa.gov/surflocater/index.cfm

EPA: Information About Your Drinking Water
Click on the map to get information on your local drinking water source, read local water quality reports, and access area drinking water offices. http://www.epa.gov/safewater/dwinfo.htm For information about how to read the reports see http://www.waterqualityreports.org

**WETLANDS**

National Fish and Wildlife Service: National Wetland Inventory
You can locate all the areas designated as wetlands in your area by using the interactive mapping tool at this site. Information is also provided about plant species that occur in wetlands. http://www.nwifws.gov/

**WILDLIFE AND PLANT LIFE**

eNature.com
Enter your email and your zip code to access pictures and profiles of local wildlife. The site also offers an electronic field guide to over 4800 North American plants and animals.

http://www.enature.com/localguide/localguide_home.asp

For a list of the endangered species in your state see the U.S. Fish & Wildlife Service at http://ecos.fws.gov/webpageWebpage_usa_lists.html?state=all

National Geographic Society: WildWood
Designed to accompany the free WildWood maps sent to schools across the country, this site presents information on the terrestrial, freshwater, and marine ecosystems of the world. You can search by zip code to obtain a profile of your local ecosystem and conservation areas. The site includes an Educator’s Guide for lower grade levels.

http://www.nationalgeographic.com/wildwood/

**LAND USE**

This site permits you to display and print custom maps that include the environmental, resource, demographic, and other characteristics that you select. You can construct maps that display urbanization, agriculture, and types of land use. http://nationalatlas.gov/
Curriculum References


Wisconsin Department of Natural Resources (2009). *EEK!* Retrieved June 28, 2009 from http://www.dnr.state.wi.us/eek/