Evaluate and increase the infusion of Environmental Education in Campbellsport High School classes.

by

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ABSTRACT

The duration of this project was one year. At the beginning of the 2006 school year an initial survey was sent to the Campbellsport School District staff to see who was teaching EE, what EE standards were being taught, and how many teachers had resources to teach EE. Throughout the year, individual teachers were contacted and given hand picked lessons that fit with that teacher's particular class. The chosen teachers showed some initial interest in wanting and using EE resources. The high school Principal and Associate Principal were consulted and a Project WET and Project WILD workshop was offered at no cost to the teachers in March 2007 thanks to professional development funds. The workshop was advertised in the workrooms, on the Internet, and via e-mail to the entire Campbellsport School District. In addition, the staff was invited to participate in an Earth Week theme of Global Warming. Since not much interest was shown, the theme was broadened to Reduce, Reuse, and Recycle which could be tied into Global Warming. Lastly, a resource binder was compiled throughout the year that contained EE resources available to the staff in a useable system organized with tables of contents for ease of access. This binder includes a list of activity guides, games, books, videos, information packets, and field guides available at Campbellsport and Wisconsin Center for Environmental Education via UWSP. Two identical binders were assembled. One binder was placed in the professional section of the high school library, and the other was placed in the high school workroom. The post survey showed there to be a minimal increase in the number of teachers teaching EE, but a significant increase in the number of teachers who have EE resources and an increase in the amount of EE being infused by those who do incorporate EE in their curriculum.
ACKNOWLEDGEMENTS

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Chapter One

Problem and Setting

Problem
This project attempts to facilitate and increase the interdisciplinary teaching of Environmental Education (EE) at Campbellsport High School (CHS) by increasing the number of EE resources available to CHS teachers.

Subproblems
Subproblem 1. To find out which EE standards are being taught in the different high school classes and to assess the resource needs.
Subproblem 2. To explore ways to increase the number of EE standards being taught at CHS.
Subproblem 3. To provide resources/information to the teachers who are willing to increase their EE instruction.

Delimitations
1. This project is limited to the high school level unless middle school teachers take the initiative to check out resources that are developed and/or become available at the library.
2. This project is limited to teachers who are willing to include EE in their curriculum.
3. This project will not evaluate the teachers’ or the students’ competency.
Definitions List

A. EE: Environmental education, teaching knowledge and skills about human interactions and the environment for students to become environmentally responsible citizens.

B. Interdisciplinary: Incorporating various subjects and grade levels.

C. Resources: Materials such as videos, lesson plan guides, posters, visual aids, etc. that can be used to help teach.

D. CHS: Campbellsport High School located in Campbellsport, Wisconsin in Fond du Lac County.

E. MAP test: Measure of Academic Progress test used to chart the growth of students over time in the areas of reading, math, and language usage.

F. WKCE: Wisconsin Knowledge and Concepts Exam is a state sponsored assessment of Reading/Language Arts, Math, Science, and Social Students for grades 4, 8 and 10.

Assumptions

1. There is a need for EE resources and inservice training in their use.

2. EE standards are not being formally addressed/policed at CHS.

3. The survey will be taken seriously by the educators.

4. Resources and information will be found to disseminate to teachers.

5. Staff will be willing to incorporate EE in their curriculum.
Importance

The Campbellsport school district has started to officially map curriculum and there is little to no attention being given to EE. When teachers were asked to link their instructional content and assessments to state standards, EE standards were overlooked. Science teachers correlated their curriculum to the science standards, math teachers to the math standards, and English teachers to English standards. Core subjects and elective classes stuck to one set of standards, and interdisciplinary standards, like EE and technology, were overlooked. Not only have individual classes disregarded outside standards, the connection to other subjects also has been forgotten. With little connection made between subjects, teachers often focus on their particular subject. Science has been an exception in how it incorporates math, history, and language arts in daily activities. All classes, however, need to include EE in an attempt to provide a well-rounded high school education.

This lack of concern for EE is partly due to the fact that non-core standards are not on state tests. The main focus of instruction and testing is on language arts and math. These two areas are tested up to three times per year at CHS - twice on tests and once on the WKCE test depending on the grade. MAP tests are conducted in the fall and spring for grades nine and ten. Only sophomores take the WKCE at the high school level that are given each fall.

Another reason there is little attention paid to EE in most classrooms is a lack of resources. The one location for shared resources for teachers, other than paper in the workroom, is the library. The high school library has a wonderful assortment of resources for teachers, including videos, compact discs, and reference manuals for all the core subjects. However, there are no hands-on materials or separate curriculum guides for infusing EE. In
order to facilitate the addition of EE in all classrooms, appropriate resources need to be available for all teachers.

With growing concern for global warming and many other environmental issues, there needs to be a renewed emphasis on EE in all classrooms. Many teachers are willing to incorporate current local and global topics in their curriculum, but lack the awareness or access to the resources needed. An EE liaison would be the ideal solution to this problem. Since CHS is not large enough to foster a paid EE liaison, other options must be explored. If the entire staff had at least one person and/or place to go to for ideas and resources, then infusing EE would not be such a large hurdle in the path of already overloaded educators.
Chapter Two

Literature Review

Environmental Education

According to the United States Environmental Protection Agency (EPA), EE inspires a deeper understanding of the environment, is a means to increase public knowledge of issues, and helps the public understand how their actions affect the environment. Experts have put their own twists on the definition. The United Nations Environmental, Scientific, and Cultural Organization (UNESCO) defines EE as means to mold a world population into environmentally responsible individuals through awareness, knowledge and skills. EE teaches about the environment, how humans affect the environment, and how the environment affects humans. Through EE, skills are learned and practiced which creates environmentally conscious individuals who strive to keep the earth healthy. EE is more than amassing knowledge; it teaches skills that people can infuse into daily life.

As the nation became more aware of the impact humans have on the quality of air and water, plans were made by concerned educators to change our ways of thinking and teaching. EE has been taught for over five decades as conservation education, but the need for EE became more apparent in the 1960s when research on this topic started to make an impact on scientists and teachers. A nationwide survey was conducted from 1964 to 1974. This survey of 10,264 tenth and twelfth grade students from 199 schools in the Great Lakes Area and the western states found that twelfth graders scored significantly higher on environmental concepts, but the data did not show a strong understanding of environmental knowledge from either grade. The survey also revealed a positive attitude toward environmental management, but little idea on how to achieve or maintain a quality environment (Roth, 1974). In 1972,
the United Nations sponsored the Stockholm Conference to discuss the importance of EE and teaching interrelationships between people, nature, and natural resources. Providing students with a quality environmental education was identified as being so important that the Wisconsin Department of Public Instruction required that EE be taught in Wisconsin schools as of the 1980s and were later included in the Wisconsin Model Academic Standards as EE standards. The National Environmental Education Act of 1990 required the EPA to take a role in increasing environmental literacy (Engleson, 2007). State and national EE standards still exist today to ensure EE continues to be an important part of our youth’s education.

EE is of importance because our society has lost touch with the reality of the natural aspect of the world. The economics of our society have trained us to be consumers that buy excessive packaging to keep our products more attractive, drive resource wasters that elevate social status, and become landfill junkies because products are cheaper to replace than repair. In addition, the increased use of fossil fuels has caused an increase in atmospheric carbon dioxide, which in turn has sparked global warming. Global warming is a world-wide problem. As a society, there are steps for fixing the problem and steps for preventing the problem from getting worse (Winters, 2007). Education is the key to prevention. EE can lead to sustainable development and behaviors (Barraza, 2003). Through education, students are taught the skills they need to become critical thinking citizens (Moroye, 2005). Studies have shown that EE can increase environmental awareness and actions. A survey conducted by the University of Wisconsin-Stevens Point showed that environmentally literate individuals claimed to have a higher knowledge of environmental issues and took more action than those who were not environmentally literate (Champeau, 1997).
In Richard Louv’s book “The Last Child in the Woods”, the author discussed the importance of having green space for “kids to be kids.” Green space leads to less stress and more creativity. Children have become dependent on entertainment that deals with technology, such as TV and video games. When Louv asked students about their relationship with the outdoors, one student stated that computers lead to jobs and are therefore of higher priority than nature. Louv discusses the “nature-deficit disorder” which alienates humans from nature. There is research to back up a link between a lack of interaction with nature and a list of physical and emotional illnesses (Louv, 2006).

**Strategies for Infusing Environmental Education**

Environmental education resources can include a gamut of items including, but not limited to, labs, videos, literature, curriculum guides with premade lessons, speakers, kits, local sites, and field trips. Local Department of Natural Resources (DNR) staff and naturalists are excellent resource personnel that can lead educators in the right direction. Many of the EE curriculum guides i.e. Learning, Experiences, and Activities in Forestry (LEAF) and K-12 Energy Education Program (KEEP) correlate lessons to topics, grade levels, and standards. These guides allow for an easy infusion of materials into an existing curriculum. In addition, Bloom and Gardner’s methods are also met with the variety of activities from constructing models to role playing. Gardner’s multiple intelligences are an important aspect for curriculum planning, as is Bloom’s concepts of layering the content and assessment to reach a variety of intellectual levels. Lessons dealing with EE offer the variety and complexity needed to incorporate these two philosophies of education.
EE standards can be met in a variety of ways. For a hands-on approach, educators should teach about nature through school forests, prairies, or trips to DNR sites. The use of local resources will help put a relevant spin on the lesson that should in turn have a lasting effect. There are many resources available for infusing EE into a variety of curriculum subjects. The Wisconsin Center for Environmental Education (WCEE) is located in the UW-Stevens Point library and is entirely devoted to such resources. In addition, workshops are available to familiarize teachers with award winning state and national curriculum guides like KEEP, LEAF, Project Learning Tree (PLT), Project WET, Project WILD, and various others. These curriculum guides are excellent resources to help teachers infuse lessons into subjects and units that are already being taught. In addition, many of these lessons are correlated to state and national standards and include teaching strategies that address a variety of learning styles.

For EE to be effective, it must be taught in schools (Worster, 2006). When incorporating EE in lessons, the key is to not instill ecophobia by dwelling only on degradation of the environment (Louv, 2006). With any EE, care needs to be taken to present both or many sides of a situation and not to focus solely on the destructive aspects (Louv, 2006). EE should be taught at all levels and in all subject areas. In addition, lessons and skills need to reflect what is practical to the real world. The topics must be relevant to the students and placed-based education is a must (Louv, 2006). Students need to get away from being passive listeners and dive into participatory roles. One of the best approaches is conservation field sites where students learn outside of the normal environment of the classroom (Korach, 2005).
Teacher Attitudes and Barriers

When asked whose responsibility it is to teach EE, many will say science teachers. With No Child Left Behind (NCLB) legislation, teachers are hard pressed to find time to cover the content needed to prepare students for high stakes testing. These state mandated tests harm the style and content of teaching, especially when it comes to EE (Bently, 2005). Research shows that EE is best infused in an interdisciplinary approach (Powers, 2005). An interdisciplinary approach to EE would mean that all subjects used the environment to teach their content. Most often this is done through an EE program or a school theme such as a local site or topic of concern. There is a lack of ownership of the non-core subject standards like technology and EE.

Students from schools with an EE program have scored higher on standardized tests in core subjects such as math and language arts. Students who have EE infused in their classes tend to be more motivated and thus learn better (Duffin, 2005). When students can take ownership of the content they are empowered in their learning. This will increase interest in a subject and aid them in developing the skills being taught (Hungerford, 2001).

Several states, including Washington and California, have conducted research that showed how infusing EE positively influenced state standardized test scores. One such project was the Pacific Environmental Institute Assessment Project (1998-2006). Of the 148 schools studied, half had an EE program, half did not. The research indicated that students from schools with an EE program scored higher on state tests than students from schools without an EE program.

Other obstacles that prevent EE from being taught include funding, resources, and training. Fortunately these obstacles are not insurmountable. Inservice workshops can be
brought to the school or resource personnel, such as local DNR staff, can assist educators in collaborating with neighboring schools. Funding can be supplemented with grants such as a Wisconsin Environmental Education Board grant. In addition, grants exist to offset the cost of some training involving EE curriculum guides. KEEP is an example of a program that provides financial assistance to educators to participate in training in the use of their curriculum guide. Depending on the energy supplier for each area, the cost of attending the KEEP workshops can be substantially reduced. Teachers must be trained in the use of a new curriculum for the implementation of the new materials to be successful. Shortages of resource materials can be eliminated by sharing existing resources, using grants or local support for purchasing resources, or finding free resources via WCEE or local DNR and natural sites like an Ice Age Trail.

Summary

Environmental education teaches necessary skills to mold model citizens. There will always be barriers to teaching EE; however, with the resources available and research to support how EE benefits both our environment and student learning, EE needs to take precedent in school curriculum. Teachers need to embrace Wisconsin's EE standards, be willing to teach outside of the classroom, and take advantage of all the resources that are readily available to support an EE friendly curriculum.
Chapter Three

Methodology

The Methods discussed here elaborate on how research was completed to identify the level of support for EE instruction and implementation of EE at CHS and whether providing EE resources can impact EE instruction and support for EE.

Subproblem 1: To identify the support for and the current implementation of EE in the CHS curriculum.

The first step in infusing EE in the CHS curriculum was to identify the need, if any, for infusing EE. Curriculum mapping had not been officially addressed at this school in several years. With a newly appointed curriculum director position came a renewed interest in mapping the curriculum being taught at CHS. Consulting the curriculum coordinator, Michael Maxon, was the first step in assessing the EE needs. During a meeting it was established that EE standards need to be specifically addressed just as technology standards and core standards, such as mathematics, language arts, science, and social studies do.

CHS recently set up curriculum committees, and assigned each teacher in the school to a committee. Each committee focused on one of the sets of state standards. Initially all high school science teachers were assigned to the science committee. EE was not a separate committee, so I was appointed to EE as a subcommittee upon request. The first task of the science committee was to examine the benchmarks covered in each teacher’s own curriculum.

With standards and benchmarks fresh in teachers’ minds, a survey was conducted to see what the staff knew of the EE standards, what EE standards they were already
incorporating, and what EE standards they wanted to add to their curriculum. (See Appendix A.) The survey consisted of three yes or no questions: (1) “Do you infuse EE standards into your curriculum?; (2) “Do you have EE resources?”; (3) “Would you like EE resources appropriate for your classroom?” The individual EE standards for the twelfth grade were listed below the three questions. Teachers were asked to put an “X” next to standards they already incorporate in their curriculum and a “?” next to standards they would like to or could infuse into their curriculum with assistance. Surveys were e-mailed and a hard copy was put in each teacher’s mailbox on the first workday of the new school year. Teachers were given three days to return the survey with an incentive of a treat for completing and returning the form.

Subproblem 2: To discover the areas of interest in EE from the staff.

Once the surveys were returned, they were categorized by corresponding subject of the teacher who filled out the survey. Teachers that did not return surveys were contacted and once again asked to participate. The response to the yes and no questions of the returned surveys were charted. This allowed for easier calculating of percentages of responses. The EE standards were checked off according to subject to reveal which standards are being taught and in how many classes. This will also point out which standards students are not being exposed to. On the bottom of the survey, teachers were asked to write their areas of interest for infusing EE. These separate comments were noted and allowed for a starting point in gathering resources.

Knowing who was interested in resources helped in discovering the needs of the staff. Suggestions from teachers helped focus on which subjects, grade levels, or specific topics the
EE materials should cover. These needs were cross-referenced with the curriculum guides available and resources from WCEE. Individualized lessons were copied and hand-delivered to teachers to match their specific interests. In addition, all teachers were given access to the tables of contents of various EE curriculum guides, such as KEEP, Project WET, and Project WILD. The lessons were correlated to subject and grade level to help show teachers that EE fits into many different disciplines. (See Appendix B.)

Subproblem 3: To create and make available resources for infusing EE.

A lack of time prevents teachers from implementing curricular change. Time is needed to search for new material, see how the material can fit within the curriculum layout, learn the new material, and develop appropriate assessments for the lessons. A resource binder was compiled to search for materials which will make available resources easy to identify and access. Staff development is key to implementing change. Creating an easy to access resource packet and hand-picking ideal samples for teachers helps to cut down the time needed for teachers to do the research themselves. This resource binder contains sample lessons, curriculum guide contents for the guides at the school, bibliographies for the K-12 resources at WCEE with the library’s website, and a list of EE resources available for sharing among the staff at CHS. (See Appendix C.) The curriculum guides and EE resources are housed by myself and J. Dichraff (who also has his Master’s in EE through UW-Stevens Point), and are available to be signed out to any teacher.

During an early release inservice, all teachers were shown the resource binder and where they could locate it along with a brief summary on the importance of infusing EE in all subjects. In addition, teachers were given a list of the contents of the EE resource binder to
keep for their own records. An electronic copy of the resources available was also sent to educators as a reminder and for electronic storage. This document will serve as an excellent reminder each year to staff.

With little staff development freedom at CHS, extra effort was needed to spark an interest in infusing EE. To reach a wide audience, a Project WET and Project WILD workshop was scheduled to be held onsite in the high school library on March 17th of that school year. (See Appendix D.) The workshop was facilitated by Jackie Scharfenburg, a natural resource educator through the DNR. As an added incentive, the school covered the cost of registration and materials, so the teachers only needed to sign up and show up for the workshop. At the workshop teachers received three curriculum guides, posters, and other EE resources, and training on how to use the materials. This training was essential for making teachers comfortable with the content and delivery of the lessons.

As an additional push for implementing EE in all subjects, teachers were asked to infuse global warming into one of their lessons around the time of Earth Day. With Earth Day being on a Sunday, teachers had a two-week window to present material. The request was made the first week of April to allow time for thought and preparation before classes were released for spring break. A follow-up e-mail was sent the week before Earth Day as a reminder. In addition to the original and follow-up e-mail, sample lessons and websites were offered along with the promise of advice to those who wanted more ideas specific to their classes. (See Appendix E.)

In May, a follow-up survey was conducted to see whether changes occurred in the number of teachers infusing EE and in the amount of EE teachers infused into their lessons. (See Appendix F.) The survey asked if the teacher participated in the Earth Day: Global
Warming theme and what methods helped them infuse more EE into his or her curriculum. In addition, the survey asked what barriers were still present that prevented him/her from including EE in each of their classes. This follow-up survey was then compared to the survey conducted at the beginning of the year. Comparisons were made to the overall infusion of EE before and after EE materials were disseminated. (See Appendix G.)
Chapter Four

Results

The results for each subproblem in this study are described in this section of the paper.

Subproblem 1: To identify the support for and the current implementation of EE in the CHS curriculum.

During the 2004/2005 and 2005/2006 school years, curriculum mapping and curriculum assessment were high priorities in the Campbellsport School District. Mr. Maxon, the curriculum coordinator, worked with several educators on ideas for tackling the major project of deciding on the curriculum for the school district. Throughout these two years, teachers filed what they taught and how they taught using Rubicon Atlas Curriculum Mapping software. This software linked content and assessment to the Wisconsin Model Academic Standards. (See Appendix H.) Then teachers came up with benchmarks to be used for assessing the content being taught.

Committees were established at the end of May 2006. Each teacher in the school district was assigned to a committee and the committees were categorized by standard subjects, i.e., math, science, language arts, agriculture, history, technology, art, and business. (See Appendix I.) These committees were in charge of evaluating the curriculum maps as well as the materials involved in the instruction. One example was text books. No new text books could be ordered without first gaining approval from the curriculum committee and then the curriculum coordinator. During an informal meeting with Mr. Maxon, the issue of EE standards not being included in the curriculum mapping process was mentioned. In
response, Mr. Maxon deemed it appropriate for the science committee to have an EE subcommittee.

Throughout the 2006/2007 school year, little action took place within the curriculum committees. The science committee met twice. The first meeting consisted of introductions and expectations for the committee. Less than half of the assigned members were present at the start of this initial meeting. The second meeting of the science team allowed for review of textbooks. Chemistry, Anatomy, and Advanced Biology instructors described why they were in need of new texts and brought sample copies for the team to inspect. The elementary teacher members showed little interest in high school textbook selection. Again, several members were absent or arrived quite late to the meeting. During this school year the science committee did nothing else in regard to the curriculum maps or assessing the standards being taught.

In January 2007 on a teacher inservice day, a speaker was brought in to discuss Link for Learning. This program will replace Rubicon Atlas Curriculum Mapping. This new program is meant to save the district money and be a more productive tool in keeping the curriculum maps current while still being able to analyze the data to ensure the school district is teaching to the needs of the student body. Once again, EE was not mentioned in this process. Several teachers verbally expressed concern over being jostled around from new software to newer software without actually getting any benefit from the work needed to build a database.
Subproblem 2: To discover the areas of interest in EE from the staff.

A survey of the staff was conducted at the beginning of the 2006/2007 school year. The survey was placed in each teacher’s mailbox and e-mailed to each teacher’s school address. The survey consisted of three simple “yes” or “no” questions, and below these three questions, the EE standards were listed from sections A, C, D, and E. Section B was left out because those standards related to specific science content. Teachers placed an “X” by standards they currently teach and a “?” by standards they would or could infuse into their curriculum. Of the forty-one surveys sent out, nineteen teachers responded. Every survey that was handed back had the top three questions filled out to some extent.

Table 1 Survey Response Rate

<table>
<thead>
<tr>
<th>Department</th>
<th># responded</th>
<th># in department</th>
<th>% response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>2</td>
<td>2</td>
<td>100%</td>
</tr>
<tr>
<td>Science</td>
<td>3</td>
<td>3</td>
<td>100%</td>
</tr>
<tr>
<td>Math</td>
<td>3</td>
<td>4</td>
<td>75%</td>
</tr>
<tr>
<td>Music</td>
<td>2</td>
<td>2</td>
<td>100%</td>
</tr>
<tr>
<td>Social Studies</td>
<td>2</td>
<td>4</td>
<td>50%</td>
</tr>
<tr>
<td>Art</td>
<td>2</td>
<td>2</td>
<td>100%</td>
</tr>
<tr>
<td>At Risk</td>
<td>1</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>FACE</td>
<td>1</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>Language Arts</td>
<td>1</td>
<td>4</td>
<td>25%</td>
</tr>
<tr>
<td>Technology Ed.</td>
<td>1</td>
<td>3</td>
<td>33%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>Special Ed.</td>
<td>0</td>
<td>6</td>
<td>0%</td>
</tr>
<tr>
<td>Spanish</td>
<td>0</td>
<td>2</td>
<td>0%</td>
</tr>
<tr>
<td>Phys Ed.</td>
<td>1</td>
<td>3</td>
<td>33%</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>40</td>
<td>~45%</td>
</tr>
</tbody>
</table>

Less than half of the surveys were filled out and returned. Most of the surveys that were returned were the hard copy that was placed in each teacher’s mailbox. Only three of the nineteen surveys that were returned came via the original e-mail document.
Table 2 Questions on initial survey.

1. Do you infuse Environmental Education standards in your classroom?
   __Yes __No __What are Environmental Education Standards?

2. Do you have Environmental Education resources?
   __Yes __No __What are Environmental Education resources?

3. Would you like Environmental Education resources appropriate for your classroom?
   __Yes __No __I still don’t understand what an Environmental Education resource is.

Over fifty percent (10/19) of the surveys reported already infusing EE in their curriculum, yet almost forty percent (7/19) claimed to not have any EE resources. Just under seventy percent (13/19) of those who handed in surveys answered that they would like EE resources. Three individuals left one or more questions blank or wrote in a response because they were unsure if they should check yes or no.

Table 3 Percent response on initial survey.

Below the three questions, the staff was asked to put an “X” next to the EE standards they already infuse in their curriculum and a “?” next to the standards they feel they could or
would infuse in their lessons. The standards were place in order of the sections that were laid out by the Wisconsin Model Academic Standards. Section A contains standards related to "questioning and analysis." The B section of the EE standards, "knowledge of environmental processes," were left off of the survey for two reasons. First, without the B standards, the survey fit on one page. Second, the B standards processes were quite in depth in the science field and therefore are assumed to be covered in science classes. Section C was labeled "environmental issue investigation skills." Section D contained standards related to "decision and action skills," and finally section E encompassed "personal and civic responsibility."

Every EE standard except E.12.2 was identified as being taught. This standard refers to evaluating why people do or do not participate in environmental issues. The A section of the EE standards were taught by more teachers than any of the other sections. In fact, every standard in section A had a higher percent of infusion that any other standard. Section E had the least infusion with the highest standard being taught by less than twenty percent of those who responded. In sections C, D, and E, more teachers responded to being able or willing to infuse more standards than those who claim to already infuse these standards. This means there is great potential for improving the amount of EE being taught.
In addition to the questions asked, one third (6/18) of the surveys had additional comments. Some of these comments offered clarification to a "yes" or "no" answer such as to question 2, "Do you have EE resources?" Two of the comments related to this question were "I don’t think so" and "Um a text from a class I took in college." The survey also asked for additional comments on the back side pertaining to areas of interest in which resources could be found. Only two of the eighteen surveys returned had comments such as these. One pertained to E85 for a debate in a chemistry class, the other comment asked for statistics on population trends to analyze for pre-calculus and calculus.
Subproblem 3: To create and implement resources for infusing EE.

Of the eighteen surveys returned, only two stated they did not want EE resources appropriate for their classroom. Throughout the semester, lesson plans from various EE curriculum guides were disseminated to staff members who requested additional resources. Teachers who asked for EE resources as well as those that did not return surveys were also given materials throughout the year. In January 2007, teachers were e-mailed a synopsis of Project WET and Project WILD and asked if they would be interested in attending a workshop covering these topics. Teachers were also given hand-picked lessons from Project WET and Project WILD in an attempt to interest them in attending a workshop on these curriculum guides. (See Appendix B.) The subjects targeted included social studies, math, business, marketing, and language arts at the high school level. Most teachers seemed appreciative to receive the resources.

The Project WET/Project WILD workshop was scheduled for March 17th, 2007. Seven teachers from Campbellsport, one substitute teacher from the area, an English education college student, as well as two other educators from different school districts that heard of the workshop on the Internet signed up to attend the workshop. The teachers from Campbellsport included two elementary teachers, a junior high science teacher, an at-risk high school teacher, and three high school science teachers. Of the eight Campbellsport teachers, five had been in their current teaching position for less than five years. Two teachers did not show up on the day of the workshop.

In the workshop, the facilitator went through the activities of three guides: Project WET, Project WILD and WILD Aquatic. The teachers at the workshop participated in
various activities "acting like a student but thinking like an educator" as the facilitator said. The workshop was very hands on, allowing the educators an engaging way to become familiar with new content and new teaching strategies. In addition, the facilitator had many additional resources including posters, wild cards, and pamphlets for teachers to keep. Also, various books and guides were displayed to give the educators an idea of other resources that exist for personal and professional development.

A resource binder was compiled to help organize the EE resources in the possession of two teachers at CHS. (See Appendix C for the table of contents of the resource binder.) The binder consisted of a list of the videos, pamphlets, books, and curriculum guides pertaining to EE that may be borrowed for personal or professional use. In addition, the binder contained copies of resources that could easily be used by teachers from a wide variety of subjects. Lastly, the resource binder contained the Wisconsin Model Academic Standards for the core classes as well as EE. The majority of these resources were obtained through WCEE or through graduate classes taken via UW-Stevens Point's Masters of Science in EE program and workshops taken via the DNR. The resource binder was introduced to the staff at an inservice meeting on May 16, 2007. In a ten-minute time slot, the binder and the importance of EE were described. No additional questions were asked at that time.

In the beginning of April, the staff was sent an e-mail message with a request to incorporate the theme of global warming into a lesson within a week of Earth Day. The e-mail also contained ideas, a list of websites that have resources to aid educators in infusing EE in their lessons, and access to Al Gore's video "An Inconvenient Truth". One staff member asked to borrow the video, and two others inquired on more detailed ideas for their
classrooms. Another teacher responded with an idea to begin a recycling project at the school for plastic bottles. Midway through April, individualized lesson plans were hand picked to form a packet for teachers to incorporate in their classrooms that relate to reduce, reuse, recycle, and energy use. Those teachers who showed interest were given copies, and additional copies were left in the staff workroom with “Please take and use me” written on the front. Unfortunately, most of the packets left in the workroom stayed in the workroom.

The follow-up survey showed little to no change in the number of teachers who infused EE in their curriculum. The second survey was also handed out to all forty-one teachers of CHS and twenty-one surveys were returned. This is three more surveys returned compared to the original survey. Two more individuals claimed to infuse EE in their classrooms; however, the percentage of those who returned surveys and said “yes” to infusing EE stayed the same. The same number of teachers responded “no” or “what are EE standards” in both the original and the follow-up survey.

The second question showed more of an impact from the project. The number of teachers claiming to have EE resources went from forty-four percent (8/18) to sixty-two percent (13/21). The percentage of individuals who claim to not know what EE resources are fell from sixteen percent to fourteen percent. The number of teachers who still do not have EE resources also dropped from thirty-nine percent (7/18) to thirty-three percent (5/21).
Participation in the Earth Week theme was quite low. Of the twenty-one surveys returned, only six claimed to have participated, which equaled twenty-nine percent. The majority of those who returned surveys did not participate, seventy-one percent (15/21). Even fewer of those who returned surveys claimed to have infused more EE in their curriculum this year compared to other years, twenty-four percent (5/21).

Barriers that prevented the staff from infusing EE in their curriculum ranged from time, lack of knowledge/information, to lack of administrative support to include EE in all classes. The survey showed that time was the major factor restricting staff members from infusing EE into their curriculum (See Appendix F.)

Although there are many teachers still not infusing EE in their curriculum, the project did seem to influence some teachers. When asked if more EE was infused this year compared to previous years, five of the twenty-one surveys returned said yes (twenty-four percent).
Table 6 Follow up Survey on Participation

Follow up survey on participation

% of response

Did you participate in the Earth Day Theme? Have you infused more EE in your curriculum this year compared to other years?

- 26 -
Chapter Five

Conclusions and Recommendations

These Conclusions and Recommendations discuss the implications of the results on the overall project as well as future projects that could embellish upon the original work.

Administration and Curriculum

Having the curriculum coordinator and building principal involved would have added a lot of support to a project like this. Although there was support from the curriculum coordinator, Mr. Maxon, the staff was not always on board with the curriculum coordinator. The friction between the staff and the curriculum coordinator/Junior High principal played a part in preventing the project from fully developing. Because of this opposition, there was neither a push for teachers to be aware of what EE they were teaching nor administrative support to encourage all teachers to incorporate EE in their teaching. The high school building principal and associate principal gave every indication that EE was important during informal conversations, but no leadership was provided by either to encourage teachers to increase the integration of EE in classes other than helping fund workshop fees. Next year, there will be separate positions for principal and curriculum coordinator, and Mr. Maxon will only function as a curriculum coordinator. Hopefully this will allow Mr. Maxon more time to focus on the importance of the standards being taught and the importance of addressing the EE standards.
Teachers and Curriculum

Throughout the two years of curriculum mapping, many teachers had difficulty in getting their curriculum mapped. Reasons for this difficulty ranged from a lack of time, lack of confidence with the software, and lack of ownership. These reasons contributed to a lack of teacher interest in focusing on EE standards. A majority of the teachers did not return surveys distributed by the researcher, and it can be assumed that a large portion of the teachers that did not return surveys did not infuse EE or do not know what the EE standards are. This lack of ownership was very difficult to overcome and provided one of the major barriers to this project.

Another major barrier to mapping curriculum and focusing on EE was a lack of time. Teachers were given new software to learn, new computers in some cases, and a half-day of inservice training to listen to the how’s and why’s of curriculum mapping. Teachers were then given half a day of time to actually write out their curriculum in the format provided by the software. Very few teachers had enough time to complete the task, and the remainder of the task was left for teachers to complete on their own time. Time grew sparse and many teachers forgot how to even access their started curriculum maps.

Unfortunately, this lack of motivation was evidenced in the completion of surveys as well. Less than half of the staff returned either survey. To increase participation on the second survey, Lifesavers were attached and the e-mail referred to each teacher as a “life saver” for filling out the survey. The second survey did have a slightly larger return rate. It seems that requesting a personal favor was a higher motivating factor than doing what is best for the school and curriculum, or teachers felt guilty about taking the Lifesaver and not filling out the survey.
The survey results were surprising at first with a large number of teachers who returned the survey stating that they already infuse EE (fifty-five percent). But if all the teachers who did not return surveys also did not infuse EE, then the percent of Campbellsport teachers infusing EE would drop to twenty-three percent. That is a substantial margin for error. The number of teachers who infuse EE, according to the second survey, did increase by two out of eighteen teachers, but the more impressive change came with the number of teachers who claimed to have EE resources. This number went from eight to thirteen or forty-four percent to sixty-one percent. So the teachers were getting resources, but were not ready or willing to impart the new material. Therefore, teachers need to overcome the barriers to infusing the material. The follow up survey showed that time was the major barrier to infusing EE. Many teachers believe that a great amount of time is needed to permeate EE or that infusing EE would take away from teaching the content they already focus on. Future work needs to be done to show teachers how simple modifications can alter the curriculum to take the same amount of time and still infuse EE such as choosing an environmental theme as the topic for whatever they are working on.

EE Standards

The survey did reveal that all the EE standards were being taught somewhere in the curriculum; however, not all the classes that taught some of the standards were mandatory. Therefore, it is logical to assume that most students were missing out on one or more of the EE standards.

A future project could follow the EE standards for every class offered at the high school and then use a sample population to determine exactly which standards these students
were missing. In addition, of the EE standards, section E standards were taught dramatically less than the other standards. An additional project could focus on disseminating materials and sharing information through instructive meetings on infusing more EE content and skills through educational approaches that teach about the environment.

Workshop Attendance

Originally there were over fifteen teachers who showed interest in attending the one-day workshop on Project WET and Project WILD. However, when the time came to commit to the workshop, the numbers went down to less than ten Campbellsport teachers. A couple of teachers attributed this to time, but most chose to ignore their original interest. On the actual workshop day, three teachers of the ten that signed up for the workshop did not show. One was called and did meet us shortly there after. She stated that she was unaware of her confirmation even though more than one e-mail was sent regarding this.

Those who attended the workshop seemed genuinely interested in the material and enthusiastic about the hands-on approach. The facilitator was great at physically showing the teachers the different activities in the guide so teachers were more comfortable and familiar with what the guide contained. This will greatly influence the amount of EE lessons these teachers will infuse in their classrooms.

Conclusions

Overall, this project showed that teachers can be all smiles when you offer new materials and advice, but more often than not those resources are shelved, forgotten, or thrown away. Fortunately there are exceptions to this trend that make the effort worth it. A
couple of teachers (mainly special education and at-risk teachers) welcomed the new materials and even came back looking for more. One teacher even took it upon herself to expand on the Global Warming Earth Week theme and started looking into a feasible way to increase recycling at the school. Next year a team of three teachers and the CD (cognitively disabled) students plan to take responsibility for plastic and aluminum recycling, as the school currently only offers paper recycling. This will give these students more practice in real world applications and help make a positive change in the school.

Another lesson learned is that a new approach is needed to conduct surveys among the staff. Surveys must be either directly administered at a staff meeting or physically delivered to ensure participation. Teachers are busy and easily side tracked, so the expectation to remember a survey that is not important to them is much too high. In addition, the survey questions may have been confusing. Surveys should be reviewed by a teacher from the English department to ensure the survey is readable and is worded to obtain useful information.

An optimistic attitude can take one a long way in a project such as this, but optimism will not always be imbued to the rest of the staff. There will always be barriers in the way, but there will also always be ways to improve a project. Sometimes the small victories need to be celebrated, such as influencing two more teachers to infuse more EE or even getting EE resources and the information about EE to the staff members.

Optimism and realism both need to be taken into consideration. Providing a resource binder without follow-up training in its use is an ineffective approach to providing EE resources to the staff. The staff will need reminders that the binder exists and ongoing encouragement to use more EE resources. Realistically, many teachers find EE easy to
ignore because of time constraints. In the future, this misconception needs to be addressed in a way that physically shows teachers the truth about how easy EE is to infuse and that this infusion does not need to add time to a curriculum.

In the future, Earth Week themes will be presented to the staff, recycling opportunities will become more available, and EE curriculum resources will continue to be presented to the staff. The “never give up” approach may not bring every teacher on board, but if a few are influenced each year, then a major impact will be seen over time.
Bibliography


Appendix A

Initial Survey to Staff
Please complete this survey (paper copy or emailed response) by Thursday August, 31st for a special treat.
Name: ___________________________
Grade/subject(s) ________________

Check all that may apply:
1. Do you infuse Environmental Education standards into your curriculum?
   _ Yes _ No _ What are Environmental Education standards?

2. Do you have Environmental Education resources?
   _ Yes _ No _ What are Environmental Education resources?

3. Would you like Environmental Education resources appropriate for your classroom (posters, activities, visual aids, etc)?
   _ Yes _ No _ I still don’t understand what an Environmental Education resource is.

4. Please put an “X” in front of EE standards you already infuse and please put a “?” in front of the EE standards you would like to (or could) infuse in your curriculum. (I left out the mainly science related standards in section B: Processes and Systems)

QUESTIONING AND ANALYSIS
   A.12.1 Identify questions that require skilled investigation to solve current problems cited in literature, media, or observed through personal observations
   A.12.2 Suggest possible investigations and describe the results that might emerge from the investigations
   A.12.3 Evaluate personal investigations and those of others, critiquing procedures, results, and sources of data and suggest improvements to the investigation
   A.12.4 State and interpret their results accurately and consider other explanations for their results
   A.12.5 Communicate the results of their investigations to groups concerned with the issue

ENVIRONMENTAL ISSUE INVESTIGATION SKILLS
   C.12.1 Compare the effects of natural and human-caused activities that either contribute to or challenge an ecologically and economically sustainable environment
   C.12.2 Explain the factors that contribute to the development of individual and societal values
   C.12.3 Maintain a historical perspective when researching environmental issues; include past, present, and future considerations
   C.12.4 Identify the strengths and weaknesses of different approaches to investigating an environmental issue and identify some of the assumptions for each approach
DECISION AND ACTION SKILLS

D.12.1 Identify a variety of approaches to environmental issues, evaluate the consequences of each, and select and defend a position
D.12.2 Evaluate reasons for participation or nonparticipation in an environmental activity in the home, school, or community
D.12.3 Describe the range of political and legal options available to resolve an environmental problem; state for each the costs, benefits, and limitations of effectiveness in practice; and select and defend the best option
D.12.4 Describe the rights and responsibilities of citizenship in regard to environmental problems and issues
D.12.5 Develop a plan to maintain or improve some part of the local or regional environment, and enlist support for the implementation of that plan
D.12.6 Identify and analyze examples of the impact beliefs and values have on environmental decisions
D.12.7 Analyze political, educational, economic, and governmental influences on environmental issues, and identify the role of citizens in policy formation
D.12.8 Use cost-benefit analysis to evaluate proposals to improve environmental quality
D.12.9 Describe the regulatory and economic approaches to improving the environment and explain the advantages and disadvantages of each

PERSONAL AND CIVIC RESPONSIBILITY

E.12.1 Articulate their personal beliefs regarding their relationship to the environment
E.12.2 Write a plan of action based on personal goals of stewardship for an economically and ecologically sustainable environment
E.12.3 Take action in regard to environmental issues in the home, school, or communities

On the back or an additional sheet/email, please let me know areas of interest you have for infusing EE. I have a very large database to choose from at UWSP and a multitude of items to browse if you are interested. Stop by anytime!!

Thank you very much for your time and effort, Tanya Monet-Bakken, room 81-don’t forget your treat😊
Appendix B

Samples of Individual Environmental Lessons Handed to Staff from Project WET Curriculum Guide

Math
Easy Street
The Price is Right

History
Water Crossings

Government
Hot Water

Government and Marketing
The CEO

Government and Sociology
Dilemma Derby
Easy Street

You use about 50 to 100 gallons (190 to 280 liters) of water a day... how much did your great-great-grandparents use?

Objectives
Students will:
• compare and contrast contemporary and historical water uses.
• identify water conservation strategies.

Materials
• Copies of Drought Days Simulation
• Copies of Water Use Calculations Worksheet
• Calculators
• Copies of Cool Clear Water and The Bath

Making Connections
People often use water without thinking about the implications. Comparing present access to water to that of the late 1800s, helps students appreciate how convenience can lead to increased use of a resource.

Background
Too often, we take water for granted. It easily flows from taps, spurts from the ends of garden hoses, flushes down toilets. Because water is convenient, it is also easy to think of water as plentiful, almost limitless.

This was not always so. In North America less than 100 years ago, many people had to pump and haul their own water for washing, cooking, bathing, and other needs. A dependable well or spring was a critical factor in choosing a homestead, and an inadequate supply of water caused daily hardship. In many parts of the world, including some regions of North America, hauling water remains a common practice.

Imagine how differently we would feel about water if we had to pump and carry it by hand. Imagine, also, the effects of drought or pollution on the life-giving supply we too-easily think of as infinite.

Procedure
Warm Up
Ask students to guess how much water their families use every day. Have them gather and compare estimates from individual family members. If necessary, review math skills needed to complete the Water Use Calculations Worksheet.

The Activity
Part I
1. Ask students to work through the Drought Days Simulations, starting with the present day, then moving to the 1890 family, and record their computations on the Water Use Calculations Worksheet.
2. Discuss results. Do students think the average household in 1890 would consume 200 gallons (760 liters) of water per day (not including water for livestock), as many households do today? Ask students to list several reasons why they would or would not.

Part II
1. Give the class time to read the short selections, Cool Clear Water and The Bath.
2. Discuss the following questions:
   • Why do students think homesteaders recycled so much of their water?
   • How would students feel if they had to haul water to their house every day?
instead of simply turning on a tap?

- Do students know that in some places in the world people still have to carry water to their homes?
- What lifestyle impact do students think hauling water has on people who live in less-developed parts of the world?
- Do students think they would alter the amount of water they use every day if they had to haul it themselves?

**Wrap Up and Action**
Ask students to estimate again how much water their families use per day and compare with their original guesses. Have the class brainstorm conservation ideas. Encourage students to discuss water conservation at home. Have them talk with grandparents or other older relatives about times when they had to haul water or do without indoor plumbing.

**Assessment**
Have students:
- compare and contrast water use habits from the 1890s and the present (Part I, steps 1 and 2).
- provide reasons why a modern family might use more water than one in the 1890s (Part I, step 2).
- analyze a story about water use in the past to evaluate their own use of water (Part II, step 2).
- develop strategies for water conservation (Wrap Up).

**Extensions**
Calculate what students' monthly water bills would be without any conservation measures, then figure the savings after changes are instituted (using their figures from the calculation worksheet).

Ask students to get a copy of their families' last water bill, then institute several water conservation measures with the help of their parents. See if these changes are reflected in the next bill.

Have students research their family histories to determine when their ancestors stopped hauling water and installed indoor running water.

Visit a local retirement home to interview residents about their water use experiences before modern plumbing. Students can tape their interviews.

Bring in a local expert from the water commission or city water board to discuss local and regional water use problems.

**Resources**
- Cramer, Marian. 1984. Lantern Glow. Contact: Marian Cramer, RR 1, Box 147, Bryant, SD 57221.
Drought Days Simulation

Name: ___________________________ Date: __________________

1890 Family

This scenario is based on a homesteading household in the American West. You are a family of eight persons: two adults and six children (a 9-month-old boy, a 3-year-old girl, a 6-year-old boy, an 8-year-old boy, a 10-year-old girl, and a 15-year-old girl). You live in a wooden house with three rooms.

You get your water from a well located near the barn, 150 feet (45 m) from your house. Your dad recently dug a pit for an outhouse. Your family has five horses (consuming 12 gallons [45.6 l] of water per horse per day), two hogs (3 gallons [11.4 l] per hog per day), and four cows (12 gallons [45.6 l] per cow per day). Also, you rely on a garden for most of your family’s vegetables.

Problem 1: You have noticed that the well is unable to meet your family’s water needs during prolonged periods of hot and dry weather. If dry weather conditions persist, you will have to decrease your water consumption or take some other action.

On the Water Use Calculations Worksheet, list the ways your family uses water. Remember, there was no running water or electricity in 1890. In addition, water was often recycled for several purposes. For example, bath and dish tub rinse water were used to water the garden.

Problem 2: How much water do you think your family of eight would consume in one day?

How much of this total would be consumed by livestock?

Why do you think the well was dug closer to the barn than to the house?

If the family had to decrease water consumption, how would they do it? List your ideas on the worksheet.

GALLONS OF WATER CONSUMED BY COMMON USES
Before Running Water

<table>
<thead>
<tr>
<th>Water Use</th>
<th>Gallons</th>
<th>Liters</th>
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<tbody>
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<td></td>
<td>0</td>
</tr>
<tr>
<td>Wash basin</td>
<td>1</td>
<td>3.8</td>
</tr>
<tr>
<td>Washing dishes by hand</td>
<td>2</td>
<td>7.6</td>
</tr>
<tr>
<td>Drinking water (see present-day common uses)</td>
<td>10-20</td>
<td>38-76</td>
</tr>
<tr>
<td>Washing clothes by hand</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Watering the garden</td>
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WATER USE CALCULATIONS WORKSHEET — Past

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<th>Gals.</th>
<th>1st Change</th>
<th>Saved</th>
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</tbody>
</table>

TOTAL USE

©The Watercourse and Council for Environmental Education (CEE).
Drought Days Simulation

Name: ___________________________ Date: ___________________________

The Present

Think of your family and its water use. Typically, a person uses about 50 to 100 gallons (190 to 280 liters) of water every day. Using that figure as a guide and referring to the chart, Gallons of Water Consumed by Common Uses, calculate how much water your household requires daily.

Consider the following two problems and perform calculations:

Problem 1: The area in which you live is beginning to experience a water shortage because of persistent hot, dry weather. Your water department has requested that each household voluntarily reduce water consumption by 20 percent. Decide how you will deal with the request. List the ways your family commonly uses water and determine quantities. Identify five changes you can make in your water use habits. Record your computations on the Water Use Calculations Worksheet.

Problem 2: Two weeks have passed. Hot and dry conditions continue to plague your area. The water department has asked each household to decrease water consumption another 20 percent. On the Water Use Calculations Worksheet, list an additional five changes you can make and figure the result.

GALLONS OF WATER CONSUMED BY COMMON USES
Present-Day

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<thead>
<tr>
<th>Water Use</th>
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<th>Liters</th>
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</thead>
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<td>Brushing teeth (water running)</td>
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<td>7.6</td>
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<td>Drinking water (1 quart/ 50 lbs. (1 l/22.5 k) body weight/day)</td>
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<td></td>
</tr>
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<td>Flushing toilet</td>
<td>5-7</td>
<td>19-26.6</td>
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<td>Dishwasher</td>
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<td>38</td>
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<td>Shaving (water running)</td>
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<tr>
<td>Leaky faucet (per day)</td>
<td>25-30</td>
<td>95-114</td>
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<td>Washing dishes by hand (water running)</td>
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<tr>
<td>Bath</td>
<td>35</td>
<td>133</td>
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<tr>
<td>Ten-minute shower (without water-saving head)</td>
<td>25-50</td>
<td>95-190</td>
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<td>Washing machine (large load)</td>
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<td>Watering lawn (10 minutes)</td>
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<td>Washing car (hose running)</td>
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WATER USE CALCULATIONS WORKSHEET — Present

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<th>Saved</th>
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<td>TOTAL USE</td>
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</tr>
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</table>

Easy Street
Project WET Curriculum and Activity Guide
Kerwhump-squeak, kerwhump-squeak. The cold water gushed from the pump. Was any drink ever as sweet as that you caught in an improvised hand-cup dipper and sucked up noisily?

Towering above the well was the windmill, sentinel of the prairie. Kicked into gear she whipped her AEROMOTOR or DEMPSTER tail away from the wind and pushed her wheel to catch the breeze. With a clank of gears the pump-stick began its up and down rhythm lifting cool water from the depths of earth, sending it splashing into the wooden stock-tank or waiting buckets.

It took very little wind to operate the mill. Ten to fifteen miles an hour would keep things going nicely.

The well was the hub of the farm. If possible the barn was located nearby. This was best for labor if not hygienic reasons. All livestock had a mighty thirst.

Children of the bygone era were, as now, loved for themselves but they filled a real need in the family unit. A child was measured, not only on the kitchen door where heights were carefully charted, but in the chores they were able to accomplish. A child could take pride in and know he was really growing up and amounting to something when he could help with the watering.

It began with a small bucket dipped full from the tank and lugged drippingly beside Dad who swung along with two five-gallon pails hanging light as feathers from his powerful fingers. Gradually you progressed to a twelve-quart galvanized pail that only had to be set down a couple of times as you watered the chickens.

That nice pail-full of water offered many youngsters their first practical lesson in physics. How fast must you windmill your arm, swinging the pail in a complete circle to prevent any water from spilling? No one mentioned centrifugal force; it was called "Spin the Pail."

You knew you had arrived the day Dad said, "Use the five-gallon pail beside the barn and water the pigs, I’ll feed the calves."

It was a feeling of sheer power to stand by the fence, alone, pouring water into the hog trough as the squealing porkers fought noisily for a drink. The livestock, your family needed you!

The importance wore a bit thin as you made possibly ten trips. It was an incentive to keep trying to haul two pails at one time and cut the trips to five.

If the well and water tank were in the best possible position it might be possible to arrange fences so that at least two yards had access to it.

The water tank, because of its importance and danger, had an unofficial set of rules for children. For toddlers... "Stay away from the tank. You may fall in and drown."

For middle sized children... "Yes, you may sail stick boats on it but take them out when you are done and DON’T stir up the water. The horses will be in from the field at noon and need a good, fresh drink."

If by chance a few days of calm descended on the farm the hand pump would be pressed into service. Farm boys with an inclination for arithmetic could tell how many strokes it took to fill the tank.

Farm children were and are notorious dreamers of big dreams. Pumping water was a chore that required almost no concentration and visions of wonder flashed through active minds as they pumped away. Not one of the most accomplished, wildest dreamers envisioned a farm where water fountains supplied every pen and barn with an automatic supply of water, warmed and kept from freezing in cold weather; center-pivot irrigation units watering a quarter-section of land; or rural water systems with mains crossing the countryside bringing water to every farm.

If such notions had been proposed to a B.E. (Before Electricity) farm kid he would surely have laughed and answered... "Ya, come with me; I’ll race you to the foot of the rainbow."

—Marian Cramer, Lantern Glow

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The Bath

Ma took down the wash-boiler from the back-porch wall about three o'clock on Saturday afternoon and summoned her chief water-hauler, a boy about ten years old. He must fetch four pails of water for the boiler. Though washday was past or coming whichever way you looked at it, this was Saturday—the night of the bath.

Ma and the girls would start things off with a head-wash every second week. Since their hair was long it was nice to do that in the afternoon as it would be completely dry by bedtime.

After supper the boiler steamed away on the stove. In winter the steam that collected on the windowpane quickly froze to thick, white frost but near the stove it was cozy.

Some families had tin bath tubs you could soak in. Some used the round rinse-tub from washday in which you stood and scrubbed; some used a wash basin. It was sort of a matter of tradition and using what you had.

The kitchen was hot with the stove really fired up. Ma brought out a big hooked rug and put it right in front of the open oven door. The turns usually went from the youngest to the oldest ending with Pa. Sometimes a boy or girl of courting age might have Saturday night plans and they could be worked in the early part of the schedule. During summer when the whole family went to town on Saturday night the bath hour was moved up so the baths came before town.

In winter Ma laid out neat piles of clean underwear and night clothes for each member of the family. With a pail of cold water at hand to blend with the hot water it was bath time.

Ma presided over scrubbing the small children until they were considered old enough to manage themselves and then they could bathe alone and be checked afterwards.

Privacy was honored. No one interfered as one by one the family members took their turn enjoying the nice hot water. It usually wasn’t emptied between bathers, but more water could be added to keep it nice and warm. Homemade soap was used for scrubbing, but sometimes there was a bar of town-soap with its good smell.

There would be at least three bath towels for family use. These would be nice, soft, terry cloth, not the hard huck toweling used for everyday. As one towel got wet it could be draped over the oven door to dry and later used again. Ma had likely cut and hemmed the wash rag from a bath towel gone thin in the middle.

There might be a bottle of lotion set on the table to smooth on elbows and rough heels.

Pa, the last one in the bath, took care of emptying the water into slop pails. He would wipe out the tub and hang it on the back-porch wall by the boiler.

Ma would come in quietly wearing her night clothes with her hair braided into one big braid down her back. She picked up the piles of discarded clothes for her washbox and tidied up the kitchen for tomorrow was Sunday.

Sunday could come. Her family was all clean for another week.

—Marian Cramer, Lantern Glow

**COURTESY: NEBRASKA STATE HISTORICAL SOCIETY**

**Easy Street**
Project WET Curriculum and Activity Guide
When you pay your water bill, what exactly are you paying for?

Objectives
Students will:
• calculate the costs involved in supplying clean water to consumers and removing wastewater.
• recognize that cost and environmental considerations influence the planning and construction of water projects.

Materials
• Sample water bill (optional)
• Copies of Student Data and Instruction Sheet
• Copies of Water Development System Map
• Calculators
• Ruler

Making Connections
Students who earn their own spending money likely understand the value of certain things, such as compact disks, snack foods, or gas for their cars. They've probably heard adults complain about paying bills, such as the water bill. They may wonder why we pay for water. Learning the real and sometimes hidden costs and processes involved in supplying clean water to and removing wastewater from homes helps students appreciate the value of water resources.

Background
Individuals, businesses, communities, states, and countries are all involved in water resource economics on a daily basis. The cost of water influences individual and community decisions, such as whether to take long showers, whether to purchase a new water-efficient irrigation system, and whether to upgrade a wastewater plant.

When current water supplies no longer meet the needs of a growing community or when the waste generated by this growing population becomes too much for a treatment plant to process, water management decisions must be made. Options include reducing water consumption through conservation, installing more efficient water technologies, and building new treatment facilities. People may be asked to approve an increase in taxes or an increase in water or wastewater treatment bills to cover additional costs. Whatever option is chosen, chances are public funds will be needed; therefore, citizens will have opportunities to voice their opinions and to raise concerns. Most levels of government conduct public planning forums. There is far more to constructing a water project than meets the eye. Aside from the construction of the physical plant, surveying potential sites, engineering water lines, establishing operation systems, and maintaining production also contribute to the cost. The list in the side bar on page 335 highlights costs associated with various water projects. (Costs vary among different regions of the country.)
The Activity
1. Explain to students that their task is to help a community redesign their municipal water and wastewater treatment systems. A new water treatment plant has already been built, but they need to construct water lines through which untreated water can flow from the source (a ground water well field) to the new plant. In addition, a new wastewater treatment plant must be built and sewer lines run from the community to the plant. Both construction projects need to use Best Management Practices; "best" can be defined as the route and location that require the least costs and have fewer environmental effects. NOTE: Real-life situations would involve many other considerations for choosing the best location, including health concerns, substrate conditions, aesthetics, political matters, and so forth.

2. Divide the class into small groups; supply each group with a copy of the Water Development System Map and review its contents and environmental features. Give each group a copy of the Student Data and Instruction Sheet and discuss.

3. Allow time for groups to identify what they think is the best location for each project.

Wrap Up
Have each group present its proposed plan and calculated costs for class review. Group members should summarize considerations and factors they used to help them make the decision. Encourage students to provide constructive criticism for the proposed plans. Can the class reach consensus regarding where to locate the projects?

Present students with the Answer Key. Do students agree with the solutions given in the key? Tell students that if this was a real-life situation, other factors and conditions would come into play, and the actual locations might be different. In other words, students may have justifiable reasons why their proposals are better.

Inform students that in some situations, citizens must pay additional taxes to fund the construction of water management projects. How do
they feel about citizens incurring the cost of the project through increased taxes? Do students think they would willingly pay the price for new water supplies? Which would they rather do: change their habits and use less water, or pay more money for increased supplies? Discuss how the cost of water management projects is often a prohibiting factor to building new systems.

Have students learn about water projects in local communities. How much did they cost? Who paid for them?

**Assessment**

Have students:
- analyze what factors affect water use charges (Warm Up and Wrap Up).
- calculate the cost to build an untreated water line, a wastewater treatment plant, and sewer lines (step 3).
- determine the route for an untreated water line to a treatment plant, select a site for the construction of a wastewater treatment plant, and justify their choices (step 3 and Wrap Up).
- evaluate other students' selected locations for water projects (Wrap Up).

**Extension**

Have students role-play bankers and project designers. The project designers request a loan for their water development system. Because the bank will only loan funds to one group of project designers, students should be well prepared to answer the banker's questions, such as "How much money do you need?" "What is your economic justification for the loan?" and "How do you intend to repay this loan?" The banker will consider the best designed project plans, proposed budget, and responses to questions when determining the loan recipient.

**Resources**


Student Data and Instruction Sheet

Instructions
Read the following information and refer to the map and data to find the best locations for the untreated water line and the wastewater management plant.

Untreated Water Line
- sketch possible routes for the water line
- calculate costs for each route
- assess environmental impacts of each route
- use the above information to determine the most cost-effective and environmentally sensitive route

Wastewater Treatment Plant
- consider placing the wastewater treatment plant at each of the six designated sites on the map
- assess the best location based on the following:
  - costs (of running a single major sewer line from town to the plant)
  - environmental concerns (specifically; proximity to discharge site [the river], direction of streamflow, quality of ground water being drawn into pumping wells, quality of river water that could become part of the ground water)
  - legal placement of wastewater lines (it may be unlawful to cross wetlands, public property, state parks, or wildlife refuges)
  - aesthetics and health issues (including odor, downstream flows, and landscape considerations)
- use the above information to determine the most cost-effective and environmentally sensitive location

Prepare a presentation for your classmates, including reasons why you think your routes and sites are the best.

Data
NOTE: The following are hypothetical costs; they include materials and labor. Contact local engineers, treatment plants, and construction companies to obtain costs more relevant to your community.

- untreated water line (runs from well field to plant) = $12/foot ($40/meter)
- main sewer line (runs from sewer collection point to wastewater treatment plant) = $9/foot ($30/meter)
- wastewater treatment plant = $45,000,000
- easement on farmland = $1,000 per linear mile
- construction of lines under existing two-lane highway = $100,000
- construction of line to cross river (this complicated process involves permits and completing environmental impact statements) = $500,000
- construction of line to cross existing bridge = $50,000
- construction of line to cross wetland = illegal

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Water Development System Map

Name: ___________________________ Date: ___________________________

The Price Is Right
Project WET Curriculum and Activity Guide
Water Crossings

It is the late 1800s, your wagon is packed, and you are traveling west. You arrive at a raging river, 1 mile (1.6 km) wide. Now what?

Objectives

Students will:
- analyze the influence of water crossings on settlement patterns.
- describe the water-related transportation problems that faced early explorers and settlers.
- design and build water-crossing conveyances.

Materials

- Copies or overhead of excerpt from The River of the West
- Map of the United States or local map
- State road maps
- Hard-boiled eggs, rocks, or tennis balls
- Student collected natural materials (e.g., twigs, dried grass, reeds, bark, cork)
- String or twine
- Waterproof glue
- Cake pan, bucket, or dish pan

Making Connections

Water crossings and the technology involved in bridging rivers have had a major impact on exploration and settlement patterns throughout history. Student understanding of the challenges posed by water crossings, and of the various historic methods used to overcome these obstacles, leads to a greater appreciation of the efforts of early explorers and pioneers.

Background

Pioneers crossing North America faced many challenges. While today there are interstates and highways, back then the land was untamed and relatively unchanged by people’s influence. The cross-country trip would have taken many months on roads that often were no better than trails. People traveled by steamboat and railroad, on horseback, in wagons pulled by horses or oxen, and on foot.

River crossings were common challenges. Consider crossing the Mississippi or Ohio Rivers today at a spot where no bridge exists. Consider, too, the dilemma facing a family encumbered by a wagon filled with all of their possessions, as they overlooked the Colorado River in 1890.

Rivers without crossings have a natural damming effect on travelers. A safe and efficient crossing acts like a funnel, drawing people from far and wide. Towns and cities all across the nation were established at river crossings. Riverboats and ferries added prosperity to local economies.

Successfully crossing waterways demanded innovation, hard work, group coordination, and luck. Sometimes a section of river could be found that was shallow enough to allow a ford. In other cases, ferries or cable and pulley systems were rigged to transport people and material. During winter, people could cross on the ice, once it had reached sufficient thickness. If a river’s course ran in generally the same direction as a party’s travel route, boats or rafts could be made and the river used as a roadway. Once a sufficient level of population and resources had been amassed at a crossing site, a bridge could be built to span the water. Even after a bridge was...
Arrived at the Yellowstone with his company, Smith found it necessary, on account of the high water, to construct Bull-boats for the crossing. These are made by stitching together buffalo hides, stretching them over light frames, and paying the seams with elk tallow and ashes. In these light wherries the goods and people were ferried over, while the horses and mules were crossed by swimming.

The mode usually adopted in crossing large rivers was to spread the lodges on the ground, throwing on them the light articles, saddles, etc. A rope was then run through the pin-holes around the edge of each, when it could be drawn up like a reticule. It was then filled with the heavier camp goods, and being tightly drawn up, formed a perfect ball. A rope being tied to it, it was launched on the water, the children of the camp on top, and the women swimming after and clinging to it, while a man, who had the rope in his hand, swam ahead holding on to his horse's mane. In this way, dancing like a cork on the waves, the lodge was piloted across; and passengers as well as freight consigned, undamaged, to the opposite shore. A large camp of three hundred men, and one hundred women and children were frequently thus crossed in one hour's time.

river and needing to get to the other side. Encourage them to use their imaginations when describing the river. They should explain the characters' feelings and indicate how they would cross the river.

Part II
1. Tell students they are about to gain insight into some of the challenges pioneers faced when they arrived at a river; they are going to participate in a water-crossing contest! The goal of the contest is for small groups of students to plan, design, and construct a means of carrying a load across a body of water. The competition should encourage a variety of interesting approaches.

2. Divide the class into small groups. Each team will build a water-crossing conveyance from natural materials collected from front yards, city parks, and school grounds. Since each team gets only one chance to succeed, encourage groups to discuss their options (e.g., a ferry, raft, wherry [a light, swift boat built for one person], etc.) before beginning construction.

3. Inform students that the load to be transported is a hard-boiled egg (or rock or tennis ball). Once each team has built its conveyance, an egg is placed on the center and the whole floated in a bucket or dish pan. The conveyance must support the load for two minutes, while not touching the sides or the bottom of the bucket. If the structure does not crack, capsize, or fall apart within two minutes, the team has succeeded in crossing the barrier. To increase the challenge and simulate treacherous crossing conditions, rock the pan, sprinkle water, or create wind with a fan.

4. Have students vote on the most successful strategy and brainstorm improvements in raft designs for

A stagecoach fords the Lamar River in Yellowstone National Park at the turn of the century. COURTESY: U.S. DEPARTMENT OF THE INTERIOR
another contest. Students can also vote on the most aesthetic, innovative, or unique design. Try to make every team a winner.

Wrap Up
Discuss with students the impact of water crossings during the travels of early explorers and pioneers. With the benefit of what they now know, how would students have chosen to cross the country in the past? Have students interview family members about their experiences with water obstacles.

Assessment
Have students:
• relate settlement patterns to river crossings (Part I, step 1).
• write a story illustrating problems explorers and early settlers faced in water-related transport (Part I, step 3).
• design, build, and test water-crossing conveyances (Part II, steps 2-3).
• judge the effectiveness of peers' water-crossing conveyances (Part II, step 4).

Extensions
Look at the routes of historical trails and recognize the effects of water obstacles on their course. Have students map a pioneer trail across America, minimizing water obstacles. Compare historical trails to the modern highway system and discuss the differences and similarities regarding rivers and lakes. Are modern bridges located at some of the same places as the historical crossings?

Conduct a bridge-building contest. Divide the class into small groups and provide each with the same set of materials (e.g., four 6-inch [15-cm] sticks of balsa wood, 20 popsicle sticks, waterproof glue, box of toothpicks, 20-inch [50-cm] length of string or twine). The bridge must span 10 inches (25 cm) and be at least 2 inches (5 cm) wide. There is no height limitation. Allow students a set amount of time to construct their bridge. The roadway of the bridge must have an opening for the test load. The test load will be applied to the center of the bridge and consists of a block of wood (2 1/2" x 2 1/2" x 1" [6.25 cm x 6.25 cm x 2.5 cm]) through which a 6-inch (15 cm) eyebolt has been screwed. A bucket is hung onto the eyebolt. The load is applied by a student adding cups of sand to the bucket until a failure occurs. The weight of the bucket and the results are recorded.

The contest has two categories for winning bridges: strongest (supporting the most weight) and most aesthetically pleasing.

Resources
Have you ever had to talk your way out of hot water?

Summary
Using debate strategies, students learn how to present valid arguments regarding water-related issues.

Objectives
Students will:
• apply basic principles and strategies in debating water resource issues.
• recognize the effectiveness of reason-based versus emotion-based presentations.

Materials
• 4 x 6 inch (10 x 15 cm) note cards
• Copies of Debate Ballots
• Video of actual debate (optional)

Making Connections
Students will be able to recall at least one time when they had a disagreement with a friend, parent, or teacher. They may have been in conflict over a minor incident, yet found themselves determined to win the argument. Participating in a formal debate helps students practice skills - such as impromptu speaking, effective listening, critical thinking, and sound reasoning - that help them to express their point of view and support their side of an argument.

Background
Every day, thousands of debates occur on water issues around the world - debates on topics that range from personal concerns to major issues, such as the loss of wetlands. For every water resource issue, a variety of individual views exist regarding how to resolve a problem. Interested parties, such as resource managers, community members, and business or agricultural representatives, desire to have their solution enacted. However, if they cannot communicate their positions effectively, their views will not be well received and may not be taken seriously. Never in the history of resource management has communication been more important than it is today.

Debate provides an opportunity for individuals to present their respective views regarding an issue. Debate involves two kinds of speeches: constructive and rebuttal.

Constructive speeches support and defend a viewpoint, while rebuttal speeches refute an opposing one. In other words, during the constructive speeches, each debater presents arguments supported by evidence (acquired through research and written on note cards) in favor of his or her viewpoint; and during the rebuttal speeches, each presents arguments, supported by evidence, to disprove or discredit the opposing viewpoint.

Procedure

Warm Up
Present and review with students a well-known issue, such as capital punishment or the reintroduction of wolves. Discuss different viewpoints people may have regarding these issues.

Have students brainstorm a list of controversial water topics that are characterized by two opposing viewpoints. Write the ideas on the board, presenting each issue in the form of a proposition. (For example, "There should be no further large-scale hydroelectric development in the United States.") Other examples of topics include: pros and cons of water storage, use of pesticides and herbicides, drought management, and water rights.

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Inform students that they are going to conduct a debate about an issue. Review debating procedures and related terminology. (Refer to Background and the following steps.)

2. Explain that the purpose of a debate is to provide an opportunity for two opposing sides to defend or argue a given proposition (viewpoint). One side will present positive support, and the other will argue against the proposition. Whichever side presents the strongest evidence will influence the action taken regarding this particular proposal.

3. Have students pair up. Assign each pair of students the responsibility of representing a particular viewpoint (pro or con) of a specific issue. For example, you may assign two students to argue for hydroelectric development and two to argue against; two for recreational uses of streams and two against (perhaps favoring irrigation uses, etc.). An alternative is to organize students into groups and assign two groups to opposite sides of the same issue. Group members work together to research and prepare their position on the issue. One member of each group is appointed spokesperson. Be sure each issue has both affirmative and negative representation.

4. Have students research their assigned water issue and record pertinent information on note cards. The evidence they collect must either support the particular viewpoint they are representing or refute opposing arguments.

5. Two pairs of students assigned to opposite sides of an issue will sit at the front of the classroom; students should stand when speaking. The remaining students will act as judges, keeping score and deciding who wins. The debaters will present their arguments in accordance with the following form (based on the Oregon Style of Debate):

<table>
<thead>
<tr>
<th>SIMPLIFIED DEBATE SCHEDULE FOR 2 SPEAKERS</th>
<th>MINUTES (MIDDLE SCHOOL)</th>
<th>MINUTES (HIGH SCHOOL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affirmative Constructive Speech</td>
<td>4*</td>
<td>8*</td>
</tr>
<tr>
<td>Cross-examined by the Negative</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Negative Constructive Speech</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Cross-examined by the Affirmative</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Negative, Rebuttal</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Affirmative, Rebuttal</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

* maximum time allowed in minutes

6. Toss a coin to determine who (affirmative or negative) gives their constructive speech first. Either speaker may give the first rebuttal. Preparation time for rebuttal may be allowed, but such time shall not exceed three minutes.

7. The judging will be done by assigning values from 1 to 4 (with 1 being the most convincing argument and 4 being the least convincing) for both the constructive and rebuttal sections. During the debate the judges will take notes on the arguments. At the end of the debate the results are tabulated, and the team with the lowest cumulative number of points wins.

In scoring, consider the following:

**ANALYSIS:** getting to the heart of the question

**PROOF:** supporting contentions with sufficient and convincing evidence

**ARGUMENT:** sound reasoning; logical conclusions

**ADAPTATION:** clashing with or responding to the opposition

**REFUTATION:** destroying opponents contentions; reinforcing your own

**ORGANIZATION:** clear, logical presentation of material

**SPEAKING:** effective delivery; favorable impact on audience

NOTE: Remember that although one team has been determined the “winner,” both teams have contributed to a deeper understanding and appreciation of water issues and the controversies involved.
Wrap Up
Ask students how they felt about the outcome of each debate. Have them summarize which approach worked (and which did not work) in the debate. Discuss how strategies and skills acquired during the debate can be applied to other areas of students' lives.

Assessment
Have students:
- design an affirmative or negative constructive argument using well-reasoned evidence (step 4).
- present an affirmative or negative constructive argument and participate in cross-examination and rebuttal on a water-related issue (step 5).
- evaluate the proceedings of a debate (step 7 and Wrap Up).

Extensions
Have students apply their skills to write a constructive letter to the editor of a newspaper, expressing their views about a water issue. (Remind students that they will be submitting their work to the editor as individuals; they should not imply that their school supports their opinions, unless they receive permission to do so.)

Resources

Debate video. 1986. Contact: Dale Publishing Company, P. O. Box 151, Grandview, MO, 64030. Topic: 1986; Resolved, that the federal government should establish a comprehensive national policy to protect the quality of water in the United States.

An Introduction to Debate. Contact: National Federation of State High School Associations, 11724 Plaza Circle, P. O. Box 20626, Kansas City, MO 64195


Project WILD. 1992. Activities “To Dam or Not to Dam” and “Facts and Falsehoods.” Aquatic Project WILD. Bethesda, Md.: Western Regional Environmental Education Council.

Debate Ballot

Team's Name: .................................. Judge’s Name: ..................................

Affirmative Number ______ Negative Number ______ Round ______

DIRECTIONS: Circle the number that best describes the debater(s) you judged, and record your comments below. Remember, a score of 1 = the most convincing argument, and a score of 4 = the least convincing argument.

<table>
<thead>
<tr>
<th>Overall Affirmative:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>Constructive Speech:</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Cross Examination of Negative:</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Rebuttal:</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Overall Negative:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>Constructive Speech:</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Cross Examination of Affirmative:</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Rebuttal:</td>
<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>Comments:</td>
<td></td>
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</tbody>
</table>

I determine the debate to have been won by _______. Reasons for my decision are:

Judge’s Signature

---

Hot Water
Project WET Curriculum and Activity Guide
As the Chief Executive Officer (CEO) of a company, why should you consider how water quality relates to your liquid assets?

Objectives
Students will:
• identify components of an environmental management program.
• analyze the relationship between economic benefits and environmental quality.
• apply environmental management strategies in the production of a product.

Materials
• Paper and writing materials
• Newspaper or magazine articles about business and the environment

Making Connections
Many students know that the goods they buy have been made by someone else and that the manufacturing process involves the use of water and other natural resources. They should also understand that if a company is going to stay in business, its profits must be greater than its expenses. By researching how businesses balance economic profit with environmental stability, students (tomorrow's CEOs) may better appreciate how essential the adequate supply of clean water is to the manufacturing of products they use.

Background
The relationship of the environment, the business community, and the general public is interwoven and intricate. Earth provides the resources needed to grow, process, and/or manufacture the products that people need and want: the iron to build railroads, the gas for the family car, the water used for manufacturing, even the baking soda found in some toothpastes.

People generate the demand for products. Historically, protecting the environment while providing goods and services has not been a priority of consumers or businesses. Today, a new attitude about protecting the environment has emerged among consumers. The public call is for sustainable development, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987).

Ensuring sustainable development has become a key responsibility of many companies' Chief Executive Officers. A CEO, whether of an international corporation or a family farm, must consider economical, social, political, and environmental factors. To remain in business, the costs of implementing an environmental protection program must be balanced with the margin of profit. Visionary businesses have embraced this challenge by developing corporate environmental management programs involving environmental policy, improvement, and education.

The success of a corporate environmental management program involves careful analysis of products and their life cycles. A typical product life cycle involves the following: conception and research, design and development, extraction and/or use of raw materials or resources (timber, minerals, water), a manufacturing process, product packaging, storage, distribution, marketing, use by consumers, and eventual disposal by consumers.
Each aspect of a product's life cycle can involve the use of water. The environment needs the help of businesspeople and consumers alike. Becoming involved with the environment is also the smart choice from a strictly business point of view. Many consumers are trying to minimize their negative impact on the environment by using fewer resources and trying to reduce their contribution to landfills. Aware that products they consume resources and produce waste, many consumers are demanding that these products should be "environmentally friendly," not causing undue damage to the environment. Anticipating the public concern for natural resource conservation and implementing effective environmental management policies can significantly improve a company's goodwill and success in the marketplace.

**Procedure**

**Warm Up**

Ask students to identify some of the products they use every day. Have them consider the natural resources used to manufacture these products. To what extent do students think water is required? Do the production processes impact the environment?

Do students think one person is responsible for ensuring the development, distribution, and sale of a product? Inform them that many companies have a Chief Executive Officer who does just that. Would they want to become the CEO of a company? What do students think are some of the responsibilities of a CEO? Check to see if protecting the environment and managing resources are among the list of responsibilities.

**The Activity**

1. Tell students they will now have the opportunity to become CEOs. For this activity, students will focus on only one responsibility of a CEO: developing and maintaining an environmental management program.

2. Discuss how environmental activities can affect the production of goods and services. How will future production of goods or services be affected if the stability of the resource base is threatened? Read or review articles about business and the environment. What relationships do students recognize between economic profit and environmental quality?

3. Before students can become CEOs of their own companies, they will need to do some research. Have students work in small groups, identifying some local businesses.
and contacting them for information. The most efficient way for them to gather information is through interviews. Discuss interviewing techniques and have the class develop a set of questions to ask community business people about creating and maintaining an environmental management program.

NOTE: Protocol for conducting interviews requires sending a letter of request that states the purpose of the interview. A follow-up phone call may be necessary. Review the set of questions. Dress professionally and listen carefully. Send a thank you letter within one week of the interview. Students may be able to talk directly to the CEO or may communicate with a representative.

Students might also conduct a job-shadowing session to observe a CEO at work, or they can review company reports to gather additional information.

They should determine one or more of the following:
* purpose of the company (past, present, and future plan)
* clientele/customers
* the product’s life cycle and the segments of the life cycle with which the company is directly involved (manufacturing, sales, waste management, etc.)
* how the product is manufactured (What resources are used in the production process? How is the resource obtained? Is environmental policy in place regarding resource extraction and/or use?)
* the role the environment plays in business management decisions (Are sales influenced by environmental policy? How has the company been affected by environmental regulations? Is the company involved in environmental improvement projects?)
* environmental management record (e.g., participation in supporting sustainable development, outreach programs, partnerships with environmental groups, supporting education projects, or community service activities).

4. Depending on time and resources, have groups do one of the following:
* Imagine that one student in the group is the CEO of the company interviewed; the others are stockholders. Students should prepare a report about the environmental management record of the company. What are its strengths and weaknesses? What recommendations for change would they make?
* Develop and produce a simple product to sell as a fund-raiser. (Funds raised can be used for a field trip, class picnic, donation to an environmental group, support for a community service project.) Plan for each of the steps of the life cycle of the product. Develop an environmental management program to guide production processes. Describe the results of the effort in an article for the school newspaper or the business section of a local paper.

▼ Wrap Up

Have students summarize the responsibilities of a CEO. Is this a career path they might choose? Challenge students to explain the importance of balancing economic profit with environmental quality. Have students express their views about achieving sustainable development.

Each group could send a copy of its final report to the CEO of the real company. This would be a positive signal that young people are interested in environmental management programs and may, in some cases, lead to changes in the way the company does business.

Assessment

Have students:
* research and report on the responsibilities of a CEO regarding the management of natural resources (steps 3 and 4).
* evaluate the environmental management program of a local company (step 4).
* produce a product, utilizing environmental management strategies (step 4).
* analyze the relationship between economic profit and environmental quality (Wrap Up).

Extensions

If students send a copy of their report to the CEO, they could conduct a follow-up interview to ascertain the CEO’s responses and recommendations.

Resources


Dilemma Derby

It's a hot August afternoon and your city is rationing water. You're on your way to an appointment, and running late. Suddenly, you see a fire hydrant gushing water onto a street corner. Should you 1) take the time to report it and possibly miss your appointment; 2) proceed to your appointment and assume someone else will report the situation; 3) forget the appointment and play in the water? or 4) . . ?

Objectives
Students will:
• outline reasons why managing water resources can create dilemmas.
• identify, analyze, and select actions related to a water resource dilemma.

Materials
• Dilemma Cards (These can be glued on index cards and laminated for extra durability.)

Making Connections
People confront dilemmas daily. Students may have weighed the pros and cons of completing a homework assignment versus taking the time to visit with friends. Students may also be familiar with water resource issues such as nonpoint source pollution, water shortages, and wetland restoration. As students investigate problems involving people and water, they will recognize the complexity of managing and protecting water resources.

Background
A dilemma is a problematic situation that requires a person to choose from two or more alternatives, each of which can produce desirable or undesirable effects. Managing water resources often creates dilemmas. As with most dilemmas, water resource management can involve conflicts between what one wants to do versus what one believes should be done. For example, disposing of motor oil by dumping it on the ground is easier than the environmentally sound, but more time consuming, alternative of recycling it. Taking a long, hot shower is relaxing, but a short, warm shower—though less comforting—conserves resources. Not voting on a ballot issue that would allocate tax money for water supply projects requires less effort than researching the potential impact of the projects.

People use various approaches to determine a course of action when confronted with a dilemma. These range from flipping a coin to conducting extensive research and attending high-powered meetings. However, a prudent method consists of listing the alternatives, identifying the pros and cons for each, and projecting possible outcomes. Factors to consider include cost (monetary and environmental), time, energy, persons likely affected, personal values, etc. Emotions and instincts also influence which alternative is chosen. Friends and family can help with the decision-making process as well.

Decision making and problem solving are critical thinking skills, necessary for productive and responsible citizenship. Although confronting dilemmas may not be easy, the experience (whether the outcome is positive or negative) helps people deal with similar conflicts in the future.

Procedure
• Warm Up
Provide students with the following scenario: Your friends have invited you to go out in their boat for an afternoon of
water-skiing, swimming, and fishing. You're really happy to be included. However, when you get to the dock and ask for your lifejacket, your friends tell you that they forgot to pack the lifejackets when they loaded the equipment early that morning. You are not a very good swimmer and you know it is illegal to go out in a boat without a lifejacket. Still, you don't want to miss out on the fun. What are you going to do?

Tell students that this is a dilemma. Ask them to list reasons why it is a dilemma. Have students describe approaches they have used to resolve similar situations. Inform them that managing water resources can also be a dilemma. What situations related to water can students recall that could be classified as dilemmas? Tell them they are going to do an exercise that introduces them to a few water-related dilemmas and tests their skills at addressing them.

\section*{The Activity}

Divide students into small groups and give each group one or more Dilemma Cards. Provide the groups with the following instructions:

One member of the group (the reader) selects a card and reads the situation aloud. Group members identify reasons why this situation is a dilemma. The reader presents the list of options to the group. Group members discuss the situation and decide what to do and why. They must select one of the available options or identify an alternative course of action. One approach to making a decision is to rate each option. Rank them on a scale of 0-10, with 0 being total disagreement and 10 being total agreement. A rating of 5 indicates "no opinion" or "needs more information."

\section*{Wrap Up}

Instruct one member of each group to report their dilemma(s) to the class. He or she should identify why it is a dilemma and identify the course of action favored by the group. Students should describe the considerations involved in making their decision. Ask the class to evaluate the option that was selected, and, if applicable, provide alternatives that might be better. Do students think they will change the way they will react to real-life water dilemmas? If so, how?

\section*{Assessment}

Have students:
\begin{itemize}
  \item use a ranking system to select a course of action to solve a water-related dilemma (The Activity).
  \item decide upon a course of action to resolve a water-related dilemma and present reasons for their choice (Wrap Up).
  \item explain why the management of water resources can create dilemmas (Wrap Up).
\end{itemize}

Upon completing the activity, for further assessment have students:
\begin{itemize}
  \item identify water-related dilemmas in their community and present alternative courses of action, citing pros and cons of each.
\end{itemize}

\section*{Resources}


©The Watercourse and Council for Environmental Education (CEE).
DILEMMA CARDS

DILEMMA 1: You’ve changed the oil in your car. You know the hazards of oil seeping into ground water, yet you are in a hurry to attend a meeting. How will you discard the used oil?
1. Put it in the back of the garage.
2. Place it in a garbage can for disposal in the city/county landfill.
3. Pour it on the ground somewhere out of sight while no one is looking.
4. Burn it.
5. Take it to an approved oil-disposal facility in your area.
6. Other?

DILEMMA 2: You are the mayor of a city which has an area known to flood. A developer wants to build houses on the floodplain. These houses will have a great view of the river, will be conveniently located near the business district, and will entice prosperous people to move to your struggling community. You must make the final decision on the developer’s request. Which option will you choose?
1. Inform the developer no building will be allowed.
2. Let the developer build in the flood area.
3. Insist the developer elevate the houses on piles of gravel in hopes of avoiding flood damage.
4. Instruct the developer to find an alternative building location out of the floodplain.
5. Other?

DILEMMA 3: You own a cabin on a lakeshore and there are 400 other cabins facing the lake. Several residents around the lake have been complaining because they think the lake’s water quality is poor. (There has been an increase in algae growth and unpleasant odors.) A public service announcement informed the community that these problems likely are caused by septic tanks leaking sewage into the ground water that feeds into the lake. The announcement advised that septic systems should be checked every three years. It has been almost ten years since yours has been checked, and you know other cabin owners have not checked theirs recently either. Checking your septic tank and fixing the problem could be costly. A fine could be imposed if your septic tank is found to be defective, although it is not likely the tank will be checked. What are you going to do?
1. Sell the cabin.
2. Do nothing; your tank probably isn’t leaking—and if it is, the fine can’t be that bad, and you can appeal it.
3. Have your septic tank checked; and if it’s leaking, pay to have the sewage pumped and hauled to a safe place.
4. Have your septic tank checked, and if it’s leaking, sell the cabin.
5. Have your septic tank checked; fix it if it’s leaking, and form a homeowner’s association to encourage everyone else to check their tanks, too.
6. Rally the public works system to develop a community water and sewage system and pay to have your cabin hooked up.
7. Other?

DILEMMA 4: You and a friend are hiking, and you see someone dumping a 55-gallon (209-L) drum of a dark liquid into a shallow stream. What should you do?
1. Go over and ask what is going on.
2. Run home and call the police.
3. Wait until the person leaves, then investigate by smelling and feeling the liquid.
4. Take down the license plate number of the nearby truck and report the situation to the fire department.
5. Other?
DILEMMA 5: You are the governor of your state. Many streams are drying up because water is being diverted for municipal, industrial, and irrigation uses. This has resulted in fish kills. Furthermore, people who like to canoe, raft, and kayak have sent letters of complaint. Industry and agriculture are major sources of income in your state, but you also like its reputation of being a "quiet place" where people can explore scenic rivers. What action will you take?

1. Ask water users to stop using water.
2. Locate and publicize other rivers around the state where people can fish and canoe.
3. Establish a committee to study the problem.
4. Propose constructing a dam and reservoir to store water for release when needed.
5. Buy out the water users so they will have to move to new locations.
6. Establish a water conservation program with incentives.
7. Other?

DILEMMA 6: Your friends have spread a plastic tarp on a hill and are spraying it with a hose. This creates a great water slide. However, sliding repeatedly kills the vegetation on the hillside, and large amounts of water are consumed during the game. Your community has experienced water shortages, but there have been no notices about conserving water for almost a year. You have been invited to take a dive down the hill. What should you do?

1. Report the game to the local authorities and have them cut off the water supply.
2. Change into your bathing suit and join the fun.
3. Try to encourage your friends to do something else, like play basketball or go skateboarding.
4. Join the activity, but only for a short while, encouraging your friends to stop with you.
5. Refuse to join in, and go home to watch television.
6. Lecture your friends on the reasons not to waste water.
7. Other?

DILEMMA 7: You are the head of a household. You are trying to save money; because your water bills have been large, you have decided to practice water conservation methods to reduce water consumption by family members. Although you have installed low-flow faucets on your showerheads and sinks, your family still insists on taking long, hot showers (sometimes over 20 minutes). What are you going to do?

1. Hold a family meeting to discuss why conservation is important, and ask that shower times be reduced.
2. Order family members to cut down their shower times to five minutes, or else you will turn the hot water heater down or off.
3. Figure the cost of water per gallon and how many gallons flow out of the showerhead each minute. Tell the family you will time their showers, and they will be charged (or their allowances reduced) for each minute over five minutes they shower.
4. Tell family members that you will compare monthly water bills, and if a bill is lower than the previous one, the money saved will go toward a family trip or entertainment event.
5. Nothing. Your family has a right to bathe for as long as they want.
6. Other?
DILEMMA 8: You are a city council member for a community located adjacent to a large, privately owned wetland. The wetland is home to rare wildlife and migratory birds; some wetland managers indicate that the wetland helps control surface runoff. The owner has decided to sell her land and move to a new location. The land is in an area surrounded by lucrative businesses, where land prices are high and parking is an issue. What should you encourage the council to do?

1. Provide tax incentives to a local development consortium, to help them purchase the land around the wetland and seek permits to develop it for business.
2. Launch an initiative to have the city purchase the land. This will require new taxes and protect the wetland forever.
3. Apply for a permit to fill the wetland with soil from a local hill, developing the wetland into a parking garage and community park.
4. Leave the fate of the wetland to the desires of the community’s special interest groups.
5. Wait and see who buys the wetland, and then decide what to do.
6. Other?

DILEMMA 9: You have moved across country. You love to fish, and you are known for your skill at catching a particular species. This species is not found in the lakes and streams around your new home. A friend from your old neighborhood has offered to bring a tank of these fish to introduce into one of your local streams. You have heard that introduced organisms (such as starlings, zebra mussels, and purple loosestrife) are competing with native species for resources. However, you have not found the local fishing practices appealing. How should you respond to your friend’s offer?

1. Tell your friend to bring the fish; you can’t wait to get a population growing.
2. Tell your friend you are already learning how to catch a new species of fish, so not to bother.
3. Check with a local fish and wildlife agent to learn if the introduced fish will compete with native fish.
4. Tell your friend to bring the fish; fry up a few and release the rest—they’ll probably die anyway.
5. Other?

DILEMMA 10: You are a taxpayer in a coastal state that owns large tracts of land which historically were wetlands. Through complex engineering, the land has been drained to provide flood protection and to open the area for development and agriculture. These accomplishments have saved lives and improved the standard of living for many residents, while increasing revenues from crop exports. However, populations of some organisms living in the wetlands (such as scarlet ibis, wood storks, and panthers) and along coastal areas (such as coral reefs, lobsters, and shrimp) have been greatly reduced. Shrimpers and other fishing industries have suffered from low harvests, and the number of tourists has declined. There is a proposal to restore the historic water flow pattern in some of these areas. This action will increase your taxes. What should you do?

1. Vote down the tax; you pay enough in taxes already.
2. Vote for the tax; a restored, healthy ecosystem is good for everyone.
3. Vote down the tax because communities will be flooded.
4. Vote for the tax because your best friend says you should.
5. Other?
Appendix C

Resource Binder Contents

Resource Binder Table of Contents

Resources in Mrs. Monet-Bakken's Room

Title of Reference Packets via UW-Stevens Point

KEEP cover page and table of contents

Project WET cover page and table of contents

Invaders of the Forest cover page and table of contents

LEAF cover page and table of contents

Recycling Guide cover page and table of contents

Nature's Recyclers cover page and table of contents

Wildland Fire cover page and table of contents

Project Learning Tree cover page and table of contents

Learning to Hunt cover page and table of contents

Project WILD Aquatic cover page and table of contents

Project WILD cover page and table of contents

Correlation templates for WI Secondary Standards

STUFF cover page and table of contents

Go MAD: 365 Daily Ways to Save the Planet cover page and Day 1
Resource Binder Table of Contents

1. List of resources in Mrs. Monet-Bakken’s room
   a. Books/Activity Guides/Lessons
   b. Pamphlets, videos, posters

2. List of resources available at WCEE
   (via UW-Stevens Point)

3. Table of contents for various Activity guides
   a. KEEP
   b. Project WET
   c. Invaders of the Forest
   d. LEAF
   e. Recycling Study Guide
   f. Nature’s Recyclers
   g. Wildland Fire Lesson Guide
   h. Project Learning Tree
   i. Learning to Hunt
   j. Project WILD Aquatic
   k. Project WILD

4. Wisconsin State Standards correlation templates

5. Stuff: The secret life of everyday things
   (book on how common items are made)

6. Go MAD: 365 Daily ways to save the planet

7. The Reports Environmental Handbook

8. Teacher’s Supplement to The Reporter’s Environmental Handbook
Resources in Mrs. Monet-Bakken’s room-Books & Videos

1) 2004 Wisconsin Energy Statistics
2) 2005 Directory of Foresters
3) A shoppers guide to cruelty free products
4) Advancing Education Through Environmental Literacy (booklet and CD)
5) Balancing Nature: Trapping in Today’s World (video 28 mins)
6) Birds in the City: Project Pigeon Watch
7) Checklist of Wisconsin Birds (x6)
8) Critters of Wisconsin Pocket Guide (x2)
9) Easy Breathers (video and guides about air quality and health problems)
10) Environmental Educational Materials: Guidelines for Excellence
11) Forest Trees of Wisconsin: How to know them
12) Groundwater Study Guide (lessons and materials)
13) Invaders of the Forest: Educators guide to Invasive Plants of Wisconsin’s Forests
14) KEEP curriculum guide
15) LEAF curriculum guide
16) Learning to Hunt curriculum guide
17) Little Book of Diet and Nutrition
18) Nature’s Recyclers
19) PLT (older version) curriculum guide
20) Pocket Prairie Guide
21) Project WET curriculum guide
22) Project WILD Aquatic curriculum guide
23) Project WILD curriculum guide
24) Recycling Activity Guide
25) Reduce, Reuse, Recycle activities (board game, word searches, etc)
26) Renewable Energy Today: Solar, Biomass, Geothermal, Hydro & Wind
27) Science Projects in Renewable Energy and Energy Efficiency
28) Spring Waters Gathering Places (five short stories about spring waters)
29) Through the Looking Glass...A Field Guide to Aquatic Plants
30) What Tree is That?: A guide to the more common trees found in the Eastern/Central US
31) Where’s the Air (lessons, software, materials)
32) Wild & Forever Free: The story of Wisconsin Wildlife Management (video 30 mins)
33) Wisconsin Forestree: Bridging the Gap between Environment and Ecology
35) Wisconsin Supplement to National Project WET
36) Wisconsin Wildlife Viewing Guide
More EE resources available from Mrs. Monet-Bakken-posters, pamphlets, CD ROM, DVD's)

Title of Resource

1. Access nature: a hands-on, habitat-based science curriculum for every child
2. Adopt a lake
3. Adopt an eagle nest
4. Adopt a wolf pack: program information
5. Answers to your questions: about groundwater
6. Biodiesel 101
7. Calling all wildlife: wildlife management basics
8. Common wildlife of Horicon marsh: a checklist of commonly sighted species
9. Conserving the nature of America
10. Critter condos: managing dead wood for wildlife
11. Discover groundwater and springs
12. Education connection: connecting people with the environment
13. Fireworks cause forest fires and more...
14. Forest is a home address for...
15. Forest view
16. Geo Thermal: Bringing comfort to your world
17. Getting the help you need: people and dollars for wildlife
18. Gimme shelter: shelter and food plots for wildlife
19. Global environmental teachings: connecting educators and students worldwide through environmental education
20. Going camping: don't let gypsy moth hitch a ride
21. Great Wisconsin and birding and nature trail: Lake Superior and Northwoods Region
22. Great Wisconsin birding and nature trail: Lake Superior Northwood region
23. Great Wisconsin birding and nature trail: Mississippi and Chippewa Rivers Region
24. Healthy water healthy people
25. Home on the range: restoring and maintaining grasslands for wildlife
26. Household hazardous waste: reduction as your first choice
27. Ideas: one stop online for Wisconsin's education community
28. If you bring it, burn it: help keep Wisconsin trees healthy
29. Invasive exotic plants: sustainable-managed forest provide
30. Inventory and monitor wildlife on your land
31. Just add water: restoring shallow wetlands for wildlife
32. Kettle moraine state forest: northern unit
33. Leaf: learning experiences and activities in forestry
34. Learning more about Wisconsin's changing landscape
35. Life in a rotted log
36. Little Book of Diet and Nutrition
37. Living with snakes: a guide to help keep snakes out of your yard and out in nature
38. Mammal tracks on Wisconsin
39. Managing leaves and yard trimmings
40. Managing Your Land for Wild Turkeys
41. National scenic trail Wisconsin: ice age trail
42. Naturally Productive: Wisconsin's Glacial habitat restoration area
43. Nature resources for educators: explore the wonders of nature
44. New tree planting
45. Next Big Wave, The: visual tour of renewable energy resources (CD ROM)
46. On edge: managing edge for wildlife
47. Prairie open field habitats area home address for...
UW-Stevens Point reference packets

Items to be checked out through UWSP with a description of each item (title, summary, grade level, length, and call number). Each packet is organized by activity guides, videos, books, and reference/background books.

1) Aquatics Systems (teal)
2) Biodiversity (pink)
3) Climate Change (salmon)
4) Energy (dark yellow)
5) Forest and Forestry (light green)
6) Human Populations (purple)
7) Land use (brown)
8) School sites (light yellow)
9) Solid Wastes/3 R’s (light blue)
10) Staff Favorites (grey)
Wisconsin
K-12 Energy Education Program

Activity Guide
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Appendices

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Subject Areas

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Invaders of the Forest

Educators’ Guide to Invasive Plants of Wisconsin’s Forests
Using the Activity Guide 

Defining the Problem
What are native, non-native, and invasive plants? How do they differ from weeds? How much do we know about them? What do they do?

Global Marketplace (grade 4 – 12) ................................................................. 9
Discover the non-native plants that we depend on for food, fibers, building materials, and medicine.

Wildflower, Weed, or Botanical Bully? (grade 4 – adult) ............................. 13
Collect and identify familiar plants and determine if they are native, non-native, non-native invasive, or native invasive.

Sizing Up Weeds (grade 7 – 12) ................................................................. 19
Survey fellow students and neighbors to assess awareness of invasive plants.

Identifying Invasive Forest Plants
What are invasive plants like? What characteristics do they have that make them so successful?

Ad-libbed Aliens (grade 2 – 8) ................................................................. 23
Fill in the blanks and create funny stories about invasive forest plants. Then make a super alien plant!

Invasive or Not? (grade 6 – adult) ................................................................. 29
Find a plant in a forest setting and use a checklist of invasive characteristics to predict whether it is an invasive species.

Field Notes (grade 2 – adult) ................................................................. 35
Practice sketching forest plants and noting their distinguishing features.

The Plant Hunters (K – adult) ................................................................. 39
Start a class herbarium containing local non-native plants.

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Understanding Connections

How do invasives change the balance of native communities?

Web of Life (grade 2-8) ................................................................. 45
Make connections between the plants and animals that live in a forest environment and watch what happens when invasive plants appear.

Outwit - Outplant - Outlast (grade 5-12) .................................... 53
Play a series of three simulation games to find out how quickly invasive plants can outcompete native plants.

Garlic Mustard Invasion (grade 2-adult) .................................. 59
Conduct a simple sampling activity to assess the affects that invasive plants have on other plants and animals in the forest.

Bane or Blessing? (grade 5-12) .................................................. 63
Discover the population explosion that occurs when an invasive species like autumn olive is planted and allowed to freely reproduce.

A Can of Worms (grade 4-adult) ............................................... 67
Assess the worm population of a forest and investigate the impact of non-native worms on native plants.

Preventing New Invasions

Invasive plants didn’t get here by themselves. How do we aid and abet alien invaders?

Plants of the Melting Pot (grade 6-12) ....................................... 75
Research some of the people and plants that immigrated to the United States from the 1700s to the present.

Means & Modes (grade 3-adult) ................................................ 79
Brainstorm how seemingly unrelated items could be connected to the spread of invasive plants.

Wanted Posters (grade 4-12) ...................................................... 83
Design wanted posters to post in school or community buildings to raise awareness of invasive plants.
Detecting & Monitoring Invasives

Early detection, rapid response, and continued monitoring are the keys to slowing the spread of invasives. How can you find invasive plants before they are a huge problem?

Eyewitness Accounts (K - adult) ..................................................... 85
Know your woods! Use phenology to track changes in native populations and non-native invasions!

Citizen Scientists (grade 5 - adult) .................................................... 89
Check out monitoring programs around the state.

Plotting Plants (grade 4 - 12) ............................................................. 93
Use mapping skills to locate and monitor invasive plants.

Diversity Index (grade 6 - 12) ............................................................. 99
Calculate the diversity index of beads in the classroom and the diversity of plants in a natural area.

Controlling Invasive Plants

How do you control invasive plants? Can you eliminate them? What are the options?

Stand Your Ground (grade 9 - adult) ................................................ 105
Choose sides in the invasive species debate, then write your own "quotable quotes."

How to Kill a Dandelion (grade 2 - 12) ........................................... 109
Use the scientific method to eliminate dandelions from a test plot.

Checking Out the Options (grade 5 - 12) ...................................... 113
Determine what the consequences are for various management options.

Shears, Sawbuck & Co. (grade 5 - 12) ........................................... 117
Examine the variety of specialized tools available to individuals and land managers trying to kill invasive plants.

Weed Out! (K - adult) .................................................................... 121
Organize and conduct an invasive plant control project.

Inspired by Wrath (K - adult) ............................................................. 125
Turn a pile of harvested invasives into art projects or supper!

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LESSON FORMAT ............................................................................................................................................................................. ·

LESSON 1 - THE FOREST ODYSSEY .......................................................................................................................................... 
Students learn about forest ecosystem functions and processes by reading an Aldo Leopold essay, doing research, and creating an original science-based essay as a class.

LESSON 2 - A HISTORY OF SUCCESSION .............................................................................................................................. 
Students explore how Wisconsin's forests have changed due to human and natural influences through a teacher presentation, readings, and a video. Current changes in Wisconsin's forest are discussed using a Wisconsin Land Cover Map.

LESSON 3 - FOREST BIODIVERSITY: TREE CASE STUDIES ............................................................................................... 
Students study how Wisconsin's climate and natural history influence forest biodiversity. They use case studies to develop insights into the question, What is a healthy level of forest biodiversity? In groups, they create an original poster and presentation.

LESSON 4 - THE FOREST MARKETPLACE ........................................................................................................................... 
Students identify factors that influence the supply of and demand for forest resources using basic economic principles. Using veneer as an example, students use graphs to describe markets in different geographic regions and examine the relationship between Wisconsin's forest resources and those of the rest of the world.

LESSON 5 - FOREST SCIENCE AND TECHNOLOGY ............................................................................................................ 
Students analyze the environmental impacts associated with wood, concrete, and steel by creating life cycle analyses. They study the roles that forest management, technology, and consumption play in sustaining forests and develop proposals to reduce the environmental impact of wood use.

CAREERS EXPLORATION ..........................................................................................................................................................

Students learn about job opportunities in natural resource fields by creating a resume from the education and experiences of college students in Wisconsin.

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LEAF Guide • 9-12 UNIT
Each day in school, at home, and at work students use skills like listening, writing, and speaking to communicate. Process skills combine a variety of such skills into skill sets that are necessary to succeed in many career fields.

Process skills are transferable and help students perform complex tasks. Process skills include such things as oral presentation, proposal development, and map interpretation, each of which is an important aspect of many professions.
Introduction

To Educators

Is it your turn to take out the trash? Pile your trash with all the food scraps, paper, old chairs, bottles and other solid waste generated in Wisconsin every year, and you get 4.6 million tons of stuff.

Fortunately, we started recycling in the 1990s, and one third of the trash we generate is recycled. Unfortunately though, the amount of waste we’re generating is growing twice as fast as our population, and our recycling rate is not keeping up with the increased generation of trash. That’s why we need to teach kids about recycling and introduce them to the concept of waste reduction.

This study guide is intended to help you and your students understand what solid waste is, where it comes from, why it’s a problem and what can be done about it. The guide includes an overview of solid waste and recycling, a glossary, suggested activities and a list of resources.

Consider talking with your students about solid waste, recycling and waste reduction before beginning your lessons to learn what they already know and think about it. Where are their trash and recyclables taken? Have they ever visited a landfill? What did people do before there were plastic bags, aluminum cans or trash removal services? Do people in other countries make as much trash or recycle as much as Americans do? By finding out your students’ thoughts and opinions, you can help them connect new concepts with what they already know.

The activities in this guide have been designed for use in grades 4-12. We also have the K-3 Supplement to the Recycling Study Guide, Waste Reduction: Thinking More About Less, and The Fourth “R”: An Action Booklet for Recycling in the Classroom and School. We encourage you to tailor the activities to meet your students’ needs. You are welcome to revise and/or reproduce any part of this guide for distribution to students and other educators.

Note:
- Words that appear in italics are defined in the glossary.
- Sections marked with * are based on materials from A Way With Waste curriculum guide, a program of the Washington State Department of Ecology (see Resources).
Nature's Recyclers

Activity Guide

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To Naturalists/Interpreters:

Glass, tin, paper, aluminum, oil... With Wisconsin's recycling law, people are busy recycling. Many of us don't realize that while we are washing, stomping, and separating materials, other creatures are also busy recycling. Lichens, mushrooms, sow bugs, earthworms and beetles spend their whole lives recycling for nature. Nature's recyclers are responsible for turning dead plants and animals back into usable nutrients for new plants and animals. Likewise, humans are responsible for turning garbage back into reusable materials.

Parks and outdoor recreation areas are prime locations for demonstrating the importance of recycling. The natural setting provides visual examples of cycles, recyclers, and natural resources. You can use these visual aids to make connections between natural and human recycling, and between recycling and preservation of natural resources. In addition to the physical setting being ideal, the atmosphere is too. People coming to parks to relax and enjoy resources are generally more receptive to recycling hints and ideas that will help save the natural resources they love.

This activity guide book is intended to help you teach people about natural recycling, cycles in nature and the important role people must play in recycling our natural resources.

The activities include things to do outdoors, indoors, at the property and back at home or school. They are organized by categories: Activities, On-Site/Take Home, Games, Crafts, Songs, Plays, and Exhibits. Each activity is laid out in the same format. You can assess the age level of the group, decide whether your goal coincides with the written goal, brief yourself with the background, gather materials and then perform the procedural steps. With any remaining time, encourage the group to partake in the activities listed in the Going Beyond section. A glossary is also included for your convenience.

This guide is designed for use with people 5 years old and older. You are encouraged to tailor the activities to meet each individual group's needs.

When leading groups and involving them with nature's recyclers, remember to use your basic interpretive skills. Also, remember that action is better than a thousand words. Let them feel it, touch it, smell it, and see it, not just hear it.
LEAF

Enriching Students.
Sustaining Forests.

The Wisconsin K-12
Forestry Education
Program

Wisconsin K-12
Wildland Fire Lesson Guide
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the legislation. They develop effective ways to resolve wildland fire issues.

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**LEAF Wildland Fire Lesson Guide**
9TH-12TH GRADE LESSON
Wildland Fire Issues and Education

NUTSHELL
In this lesson, students conduct research to determine the need for wildland fire education. Students learn about wildland fire issues in Wisconsin through reading a memo and conducting guided Internet research. They discuss and use the scientific method and public opinion surveys as a class. After creating and conducting a survey about wildland fire, the class analyzes the results and discusses their findings and the need for wildland fire education.

BIG IDEAS
- The ignition of wildland fire can be caused by human activity (e.g., debris burning and other outdoor burning, machine sparks, children playing with matches, power lines, fireworks) or natural sources (e.g., lightning, spontaneous combustion). Human activity is responsible for most wildland fires in Wisconsin (Subconcept 11).
- Current conditions are a result of past events. Decisions about the use of prescribed fire and the suppression of wildland fire affect present and future society (Subconcept 11).
- Fire can play an important role in the restoration and maintenance of ecosystems. In Wisconsin, periodic fire is an important component of a variety of plant communities (Subconcept 11).
- Homeowners have a responsibility to protect their property from wildland fire. The location, landscaping, maintenance, and design of a home can influence the threat of wildland fire to residents and their property (Subconcept 27).
- The wildland/urban interface is an area where human structures exist among wildland fuels. As people move into fire-prone areas, the potential for ignition of wildland fire increases, and buildings and other human-made objects become a possible fuel source (Subconcept 27).
- The use of some wildland fire management techniques (e.g., prescribed fire, construction of firebreaks, forest thinning) can be controversial because of safety issues and aesthetic impact. The use of these techniques is sometimes misunderstood (Subconcept 39).

OBJECTIVES
Upon completion of this lesson, students will be able to:
- Identify and explain four wildland fire issues in Wisconsin.
- List the four steps of the scientific method and explain how and why it is used.
- Explain the purpose of a public opinion survey and describe its use.

SUBJECT AREAS
- English Language Arts
- Science
- Social Studies

LESSON/ACTIVITY TIME
- Total Lesson Time: 220 minutes
- Time Breakdown:
  - Introduction: 20 minutes
  - Activity 1: 20 minutes
  - Activity 2: 45 minutes
  - Activity 3: 75 minutes + outside class time
  - Activity 4: 45 minutes
  - Conclusion: 16 minutes

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LEAF Wildland Fire Lesson Guide
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Mary Kay Salwey
Wisconsin Department of Natural Resources
WM-295-2005
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Below is an alphabetical listing of all of the activities found in the Project WILD Aquatic K-12 Curriculum and Activity Guide. Also listed are the page numbers, the approximate duration of the activity, and the broad topic categories for each activity.

GRADE LEVEL NOTE: An E indicates that the activity correlates to national learning standards for grades K-4, an M for grades 5-8, and an H for grades 9-12.

DURATION NOTE: The length of the activity is listed by a letter code: A = up to 45 minutes, B = 45 to 60 minutes, C = 60 to 90 minutes, D = 90 minutes to 3 hours, E = over 3 hours, and V = variable length.

TOPIC NOTE: Many of the topics listed incorporate important subtopics. For instance, Biodiversity includes Endangered, Invasive, and Exotic Species; Change includes Succession; Environmental Quality includes Pollution, Acid Rain, Erosion, and Eutrophication; Population Dynamics includes Predator and Prey Relationships and Limiting Factors; Sustainability includes Conservation; and Food Chains includes Food Webs, Energy Transfer, and Trophic Relationships.

Additional topics are indexed in the Expanded Topic Index on pages 244–250.

SYMBOL NOTE: The dot and triangle symbols are of equal value. They are placed in alternating columns for ease of tracking down the column.

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DURATION: A = up to 45 minutes, B = 45 to 60 minutes, C = 60 to 90 minutes, D = 90 minutes to 3 hours, E = over 3 hours, V = variable length
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## Topic Index

Below is an alphabetical listing of all of the activities found in the *Project WILD K–12 Curriculum and Activity Guide*. Also listed are the page numbers, the grade level, the approximate duration of the activity, and the broad topic categories for each activity.

**GRADE LEVEL NOTE:** An *E* indicates that the activity correlates to national learning standards for grades K–4, an *M* for grades 5–8, and an *H* for grades 9–12. A *P* indicates that the activity is also suitable for early childhood (pre-K).

**DURATION NOTE:** The length of the activity is listed by a letter code: *A* = up to 45 minutes, *B* = 45 to 60 minutes, *C* = 60 to 90 minutes, *D* = 90 minutes to 3 hours, *E* = over 3 hours, and *V* = variable length.

**TOPIC NOTE:** Many of the topics listed incorporate important subtopics. For instance, Biodiversity includes Endangered, Invasive, and Exotic Species; Change includes Succession; Environmental Quality includes Pollution, Acid Rain, Erosion, and Eutrophication; Population Dynamics includes Predator and Prey Relationships and Limiting Factors; Sustainability includes Conservation; and Food Chains includes Food Webs, Energy Transfer, and Trophic Relationships.

Additional topics are listed in the Expanded Topic Index on pages 503–512.

**SYMBOL NOTE:** The dot and triangle symbols are of equal value. They are placed in alternating columns for ease of tracking down the column.

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**DURATION:** A = up to 45 minutes, B = 45 to 60 minutes, C = 60 to 90 minutes, D = 90 minutes to 3 hours, E = over 3 hours, V = variable length
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**DURATION:** A = up to 45 minutes, B = 45 to 60 minutes, C = 60 to 90 minutes, D = 90 minutes to 3 hours, E = over 3 hours, V = variable length
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Simulated Field Trips

A simulated field trip is a powerful way for students to create vivid experiences in their minds. Many older people remember when the major form of entertainment was radio. With its absence of visual images, radio required its listeners to create mental pictures of the way various characters looked and acted. It was common for listeners to imagine landscapes, cities, and any number of exotic settings, thereby stretching their creativity.

Research has shown that with their eyes closed, people activate parts of their brain-mind systems that are not often stimulated. When we picture things in our minds, we call these parts of our brains into activity. Studies show skill in picturing things in our minds enhances our ability to enrich reading and to increase skill and imagination in writing. The capacity to remember concepts, words, names, and ideas is enhanced.

The following guidelines provide a basic, useful approach to simulated field trips as a teaching tool:

1. Ask the students to lay aside all pens, pencils, books, and such.
2. Instruct the students to sit in a comfortable and relaxed position with their eyes closed.
3. Wait until you see a general state of relaxation before beginning.
4. Using a steady and paced reading or speaking style, begin offering the students the narrative. Remember to speak slowly and steadily. If you want the students to create rich mental pictures, you must allow them time to do so. It takes about as much time to observe mental images as it does to carefully review actual physical settings.
5. Once the narrative is finished, invite the students to review all of the images they saw in their minds. Again, try to allow enough time for an adequate visual review—and remember, the review takes time.
6. After an adequate time for mental review (at least 1 minute and possibly 2 minutes), ask the students to open their eyes.
7. Begin discussing the simulated field trip in terms of the instructional purpose for its use.

In some cases, the process serves simply to provide a visual review of some of the students’ past experiences. At other times, you are providing stimuli for the students to create original images. In any case, it is important to realize that there are no mistakes in mental images. The images are data. If students create images that are consistent with what you expected, consider the images to represent differing perspectives rather than wrong answers. Try to honor and nourish variety as a means to add richness to the topics being explored. In addition to being a powerful and effective way to explore and remember concepts, regular use of simulated field trips also tends to relax students. When relaxed, they frequently will be more productive in all academic areas.
Secondary

Correlation template for Wisconsin's Model Academic Standards

Wisconsin's Model Academic Standards
Our state has established rigorous goals for teaching and learning in 18 subject areas. As defined in the introduction to each document:

- Academic standards specify what students should know and be able to do, what they might be asked to do to give evidence of standards, and how well they must perform. They include content, performance, and proficiency standards.

  - Content standards refer to what students should know and be able to do.
  - Performance standards tell how students will show that they are meeting a standard.
  - Proficiency standards indicate how well students must perform.

Paraphrased Standards
In this document, you will find that the performance standards have been reworded to fit the tables. We hope these shortened statements will give some meaning to the numbers and letters of the standards as you refer to the tables. While every attempt has been made to preserve the intent of the standards, you should always consult the original wording for clarification, reference, and further correlations.

About These Templates
These Microsoft Word templates were originally used to correlate Project Learning Tree activities with Wisconsin's Model Academic Standards. You will find these PLT correlations at www.dnr.state.wi.us. Search for Project Learning Tree or follow the links to educator resources. Many educators requested access to the blank templates to streamline correlating their own programs with the standards. These templates have been developed in Word 2000 and tested in Word 97. We designed these tables to be used as you see them and cannot make any guarantees about your success at modifying the layout, fonts, or other format attributes. We have tried to make them user-friendly by setting styles for entry and embedding the fonts. We suggest you establish shortcuts for the entry of symbols into the tables to save time and frustration. Both * and • are from "Wingdings2."

Project Sponsors
The Wisconsin Environmental Education Board provided funding for the development of these templates (grant number 2000-0019). Production would not have been possible without the assistance of the Wisconsin Department of Natural Resources and Wisconsin's PLT Advisory Committee. These templates were designed by Beth Mittermaier.

© 2001 WEEB and WDNR
A.12.1 Use effective reading strategies to achieve their purposes

A.12.2 Read, interpret, and critically analyze literature

A.12.3 Read and discuss literary and nonliterary texts

A.12.4 Read to acquire information

B.12.1 Create or produce writing to communicate

B.12.2 Plan, revise, edit, and publish clear and effective writing

B.12.3 Understand and use standard American English

C.12.2 Listen to, discuss, and comprehend oral communications

C.12.3 Participate effectively in discussion

D.12.1 Develop their vocabulary and ability to communicate

D.12.2 Recognize and interpret various adaptations of language

E.12.1 Use computers to acquire, analyze, and communicate

E.12.2 Create media products for an audience and a purpose

E.12.3 Create media products for an audience and a purpose

E.12.4 Demonstrate knowledge of media production and distribution

E.12.5 Make informed judgments about media and products

E.12.21 Use computers to acquire, analyze, and communicate

E.12.22 Analyze & edit media work for an audience & a purpose

E.12.23 Create media products for an audience and a purpose

E.12.24 Make informed judgments about media and products

E.12.25 Conduct research on self-selected or assigned topics

E.12.3 Prepare and deliver formal oral presentations

E.12.4 Understand and use standard American English

E.12.5 Analyze & edit media work for an audience & a purpose

F.12.1 Conduct research on self-selected or assigned topics

F.12.2 Research and inquiry

F.12.3 Media and technology

F.12.4 Oral language

F.12.5 Writing

G.12.1 Use effective reading strategies to achieve their purposes

G.12.2 Read, interpret, and critically analyze literature

G.12.3 Read and discuss literary and nonliterary texts

G.12.4 Read to acquire information

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I.12.5 Make informed judgments about media and products

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J.12.3 Create media products for an audience and a purpose

J.12.4 Demonstrate knowledge of media production and distribution

J.12.5 Make informed judgments about media and products

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K.12.5 Make informed judgments about media and products

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L.12.2 Create media products for an audience and a purpose

L.12.3 Create media products for an audience and a purpose

L.12.4 Demonstrate knowledge of media production and distribution

L.12.5 Make informed judgments about media and products

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M.12.3 Create media products for an audience and a purpose

M.12.4 Demonstrate knowledge of media production and distribution

M.12.5 Make informed judgments about media and products

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N.12.3 Create media products for an audience and a purpose

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P.12.5 Make informed judgments about media and products

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Q.12.5 Make informed judgments about media and products

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R.12.5 Make informed judgments about media and products

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S.12.3 Create media products for an audience and a purpose

S.12.4 Demonstrate knowledge of media production and distribution

S.12.5 Make informed judgments about media and products

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T.12.3 Create media products for an audience and a purpose

T.12.4 Demonstrate knowledge of media production and distribution

T.12.5 Make informed judgments about media and products

U.12.1 Use computers to acquire, analyze, and communicate

U.12.2 Create media products for an audience and a purpose

U.12.3 Create media products for an audience and a purpose

U.12.4 Demonstrate knowledge of media production and distribution

U.12.5 Make informed judgments about media and products

V.12.1 Use computers to acquire, analyze, and communicate

V.12.2 Create media products for an audience and a purpose

V.12.3 Create media products for an audience and a purpose

V.12.4 Demonstrate knowledge of media production and distribution

V.12.5 Make informed judgments about media and products

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W.12.2 Create media products for an audience and a purpose

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X.12.3 Create media products for an audience and a purpose

X.12.4 Demonstrate knowledge of media production and distribution

X.12.5 Make informed judgments about media and products

Y.12.1 Use computers to acquire, analyze, and communicate

Y.12.2 Create media products for an audience and a purpose

Y.12.3 Create media products for an audience and a purpose

Y.12.4 Demonstrate knowledge of media production and distribution

Y.12.5 Make informed judgments about media and products

Z.12.1 Use computers to acquire, analyze, and communicate

Z.12.2 Create media products for an audience and a purpose

Z.12.3 Create media products for an audience and a purpose

Z.12.4 Demonstrate knowledge of media production and distribution

Z.12.5 Make informed judgments about media and products

Performance Standards - By the end of Grade 12 students will:

- Demonstrate proficiency in reading, writing, speaking, and listening
- Understand and apply the standards for English language arts
- Use technology to enhance their learning and communication skills
<table>
<thead>
<tr>
<th>Performance Standard</th>
<th>By the end of Grade 12, students will:</th>
<th>Grade</th>
</tr>
</thead>
</table>

- Identify and analyze the impact of beliefs and values on environmental issues.
- Develop a variety of approaches to investigating environmental issues.
- Explain how individual and societal values develop over time.
- Maintain a historical perspective when researching issues.
- Identify the different approaches to investigating environmental issues.
- Develop a plan to maintain or improve the environment.
- Explain the regulatory and economic approaches to solving environmental problems.
- Articulate their personal beliefs about the environment and their role in it.
- Write a plan of action based on personal goals.
- Take action in regard to environmental issues.
- Evaluate possible investments and describe the results.
- Communicate the results of their investigations.
- Evaluate, critique, and improve investigations.
- Suggest possible investigations and describe the results.
- State, interpret, and evaluate their results.

Activity directly addresses the achievement of:
- Personal and Civic Responsibility
- Decision and Action Skills
- Investigation Skills
- Environmental Issues
- Questioning and Analyzing

E.12.2 Use cost-benefit analysis to evaluate proposals.
D.12.2 Explain the rights and responsibilities of citizenship.
D.12.1 Identify a variety of approaches to environmental issues.
D.12.3 Describe the political and legal options to resolve problems.
D.12.5 Develop a plan to maintain or improve the environment.
D.12.4 Identify the different approaches to investigating an issue.
C.12.2 Explain how individual and societal values develop.
C.12.1 Identify a variety of approaches to solving environmental problems.
C.12.5 Analyze the results of their investigations.
C.12.4 Evaluate, critique, and improve investigations.
C.12.3 Describe the political and legal options to resolve problems.
C.12.2 Evaluate reasons for participation or non-participation.
C.12.4 Maintain a historical perspective when researching issues.
C.12.3 Develop a plan to maintain or improve the environment.
C.12.1 Explain the regulatory and economic approaches to solving environmental problems.
C.12.2 Identify the different approaches to investigating environmental issues.
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Activity directly addresses the achievement of:
- Personal and Civic Responsibility
- Decision and Action Skills
- Investigation Skills
- Environmental Issues
- Questioning and Analyzing
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</tr>
</thead>
<tbody>
<tr>
<td>Evaluate the relationship of matter and energy</td>
<td>Describe the value of ecosystems</td>
<td>Analyze the factors that determine population size</td>
<td>Predict population response to changes in the environment</td>
<td>Evaluate the importance of biodiversity</td>
<td>Analyze ecosystem degradation and species extinction</td>
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<td>Evaluate the importance of biodiversity</td>
<td>Analyze ecosystem degradation and species extinction</td>
</tr>
</tbody>
</table>

**Performance Standards - By the end of Grade 12, students will:**

1. **Knowledge of Environmental Processes**
   - Activity reinforces or supports the achievement of the standard.
   - Activity directly addresses the achievement of the standard.

2. **Education**
### Mathematics

**Performance Standards - By the end of grade 12 students will:**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Name of your program</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>A. Mathematical Processes</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>A.12.1 Use reason and logic</td>
</tr>
<tr>
<td>A.12.2 Communicate logical arguments</td>
</tr>
<tr>
<td>A.12.3 Analyze nonroutine problems and arrive at solutions</td>
</tr>
<tr>
<td>A.12.4 Develop effective oral and written presentations</td>
</tr>
<tr>
<td>A.12.5 Organize and present mathematical procedures &amp; results</td>
</tr>
<tr>
<td>A.12.6 Read and understand mathematical literature</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>B. Number Operations and Relationships</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>B.12.1 Use complex counting procedures to solve problems</td>
</tr>
<tr>
<td>B.12.2 Compare real numbers</td>
</tr>
<tr>
<td>B.12.3 Perform and explain operations on real numbers</td>
</tr>
<tr>
<td>B.12.4 Select and use appropriate computational procedures</td>
</tr>
<tr>
<td>B.12.5 Create and critically evaluate numerical arguments</td>
</tr>
<tr>
<td>B.12.6 Routinely assess the acceptable limits of error</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>C. Geometry</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>C.12.1 Identify, describe, and analyze properties of figures</td>
</tr>
<tr>
<td>C.12.2 Use geometric models to solve problems</td>
</tr>
<tr>
<td>C.12.3 Show the truth of statements and generalizations</td>
</tr>
<tr>
<td>C.12.4 Use the two-dimensional rectangular coordinate system</td>
</tr>
<tr>
<td>C.12.5 Demonstrate an understanding of sine, cosine &amp; tangent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>D. Measurement</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>D.12.1 Identify, describe, and use derived attributes</td>
</tr>
<tr>
<td>D.12.2 Select and use tools to determine measurements directly</td>
</tr>
<tr>
<td>D.12.3 Determine measurements indirectly</td>
</tr>
<tr>
<td>Grade</td>
</tr>
<tr>
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</tbody>
</table>

**E.12.1** Work with data in the context of real-world situations

**E.12.2** Organize and display data from statistical investigations

**E.12.3** Analyze information from organized and displayed data

**E.12.4** Analyze, evaluate, and critique statistical experiments

**E.12.5** Determine the likelihood of occurrence of complex events

**F.12.1** Analyze patterns of change and numerical sequences

**F.12.2** Use mathematical functions in a variety of ways

**F.12.3** Solve linear and quadratic equations and inequalities

**F.12.4** Model and solve a variety of problems

- Algebraic Relationships
- Statistical and Probabilistic Reasoning

Mathematics

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**Performance Standards - By the end of grade 12 student will:**

- Activity directly addresses the achievement of the standard.
- Activity reinforces or supports the achievement of the standard.

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<table>
<thead>
<tr>
<th>A12.1</th>
<th>Apply the themes of science to develop visions of the future</th>
</tr>
</thead>
<tbody>
<tr>
<td>A12.2</td>
<td>Show how assumptions lead to different opinions</td>
</tr>
<tr>
<td>A12.3</td>
<td>Show how quick and reasonable solutions are developed</td>
</tr>
<tr>
<td>A12.4</td>
<td>Show how conflicting explanations start with similar evidence</td>
</tr>
<tr>
<td>A12.5</td>
<td>Show how science can be used to make real-life decisions</td>
</tr>
<tr>
<td>A12.6</td>
<td>Identify and replace inaccurate personal explanations</td>
</tr>
<tr>
<td>A12.7</td>
<td>Re-examine the evidence and reasoning that led to conclusions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B12.1</th>
<th>Show how cultures and individuals contribute to science</th>
</tr>
</thead>
<tbody>
<tr>
<td>B12.2</td>
<td>Identify the cultural conditions during periods of discovery</td>
</tr>
<tr>
<td>B12.3</td>
<td>Relate the major themes of science to human progress</td>
</tr>
<tr>
<td>B12.4</td>
<td>Show how research contributes to new discoveries</td>
</tr>
<tr>
<td>B12.5</td>
<td>Explain how science is based on assumptions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C12.1</th>
<th>Ask questions, build hypotheses, and design and conduct investigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>C12.2</td>
<td>Evaluate the results of investigations to construct explanations</td>
</tr>
<tr>
<td>C12.3</td>
<td>Choose the best data-collection procedures and materials</td>
</tr>
<tr>
<td>C12.4</td>
<td>Identify and replace personal explanations</td>
</tr>
<tr>
<td>C12.5</td>
<td>Use explanations and models to explain their investigations</td>
</tr>
<tr>
<td>C12.6</td>
<td>Present the results of investigations to concerned groups</td>
</tr>
<tr>
<td>C12.7</td>
<td>Evaluate articles and reports in different media</td>
</tr>
</tbody>
</table>

Performance Standards - By the end of grade 12 students will:

- Activity arising from the standard
- Activity directly addressed the achievement of the standard
- 

C. Science Inquiry
B. Nature of Science
A. Science Connections
<table>
<thead>
<tr>
<th>Grade</th>
<th>Name of Your Program</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

**Subject: D. Physical Science**

<table>
<thead>
<tr>
<th>D.12.1</th>
<th>Describe atomic structure and the properties of matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.12.2</td>
<td>Explain the forces that hold the atom together</td>
</tr>
<tr>
<td>D.12.3</td>
<td>Explain exchanges in chemical and atomic reactions</td>
</tr>
<tr>
<td>D.12.4</td>
<td>Explain how substances interact with one another</td>
</tr>
<tr>
<td>D.12.5</td>
<td>Identify patterns in chemical and physical properties</td>
</tr>
<tr>
<td>D.12.6</td>
<td>Identify the forces that act on them</td>
</tr>
<tr>
<td>D.12.7</td>
<td>Analyze the motion of objects and the forces that act on them</td>
</tr>
<tr>
<td>D.12.8</td>
<td>Explain the forces that hold the atom together</td>
</tr>
<tr>
<td>D.12.9</td>
<td>Understand the types of chemical interactions</td>
</tr>
<tr>
<td>D.12.10</td>
<td>Understand the law of conservation of energy</td>
</tr>
<tr>
<td>D.12.11</td>
<td>Describe models of light, heat, and sound</td>
</tr>
</tbody>
</table>

**Performance Standards - By the end of Grade 12, students will:**

- Activity
- Activity directly addresses the achievement of

**E.12.1** Distinguish between internal and external energies

**E.12.2** Analyze the geochemical and physical cycles of the earth

**E.12.3** Describe theories of the origins and evolution of the universe

**E.12.4** Analyze how the universe is understood

**E.12.5** Understand the use of resources and technology
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F-121

Evaluate cells in single-celled & multiple-celled organisms

F.12-2 Understand how cells differentiate & hew cells are regulated
F.12_3 Explain current ideas and information about heredity
F.12-4 Relate the functions of cell and organism to genetics
F.12.5 Understand evolution, natural sel~tion & classification
F.12.6 Use evolution & heredity to account for species diversity

·-

F.12.7 Investigate how organisms both cooperate and compete
F -12-8 Infer changes prompted by environmental conditions
JF-12.9 Show how energy is stored in food and then released

F.12-10 Unc.~rstand the impact of energy on organisms
F.12-11 Investigate the complexity & organization of organisms
F-12.12 Trace the sensory & nervous systems of various organisms

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<table>
<thead>
<tr>
<th>Standard</th>
<th>Grade</th>
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<tbody>
<tr>
<td>G.12.1 Identify personal interests in science and technology</td>
<td></td>
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<tr>
<td>G.12.2 Design, build, evaluate, &amp; revise models and explanations</td>
<td></td>
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<tr>
<td>G.12.3 Analyze a scientific or technological innovation</td>
<td></td>
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<tr>
<td>G.12.4 Show the personal impact of scientific or technological change</td>
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<tr>
<td>G.12.5 Choose a specific problem &amp; identify alternative solutions</td>
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<tr>
<td>G.12.6 Evaluate data and sources of information</td>
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<tr>
<td>H.12.1 Analyze a resource management proposal &amp; its impact</td>
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<tr>
<td>H.12.2 Evaluate policy recommendations in science &amp; technology</td>
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<tr>
<td>H.12.3 Show how policy decisions in science depend on many factors</td>
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<tr>
<td>H.12.4 Advocate a solution or combination of solutions to a problem</td>
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<tr>
<td>H.12.5 Investigate the impact of current plans or proposals</td>
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<tr>
<td>H.12.6 Use scientific knowledge &amp; reasoning to make decisions</td>
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</tr>
<tr>
<td>H.12.7 Evaluate policy recommendations in science &amp; technology</td>
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</tr>
</tbody>
</table>

*Activity reinforces or supports the achievement of the standard.
**Activity directly addresses the achievement of the standard.

Perspectives

Science in Social and Personal Application
<table>
<thead>
<tr>
<th>Grade</th>
<th>A.12.1 Use atlases and vocabulary to describe a place</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A.12.2 Describe the advantages and disadvantages of land use</td>
</tr>
<tr>
<td></td>
<td>A.12.3 Analyze the effects of geographic or environmental change</td>
</tr>
<tr>
<td></td>
<td>A.12.4 Analyze the effect of population on the environment</td>
</tr>
<tr>
<td></td>
<td>A.12.5 Analyze the unequal global distribution of natural resources</td>
</tr>
<tr>
<td></td>
<td>A.12.6 Identify the world's major ecosystems</td>
</tr>
<tr>
<td></td>
<td>A.12.7 Analyze the distribution of products among global markets</td>
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<tr>
<td></td>
<td>A.12.8 Identify the world's major ecosystems</td>
</tr>
<tr>
<td></td>
<td>A.12.9 Identify and analyze cultural factors that influence design</td>
</tr>
<tr>
<td></td>
<td>A.12.10 Analyze the effect of cultural ethics and values</td>
</tr>
<tr>
<td></td>
<td>A.12.11 Describe scientific and technological developments</td>
</tr>
<tr>
<td></td>
<td>A.12.12 Assess the advantages and disadvantages of land use</td>
</tr>
<tr>
<td></td>
<td>A.12.13 Analyze the effect of cultural ethics and values</td>
</tr>
<tr>
<td></td>
<td>A.12.14 Analyze the distribution of products among global markets</td>
</tr>
<tr>
<td></td>
<td>A.12.15 Examine the unequal global distribution of natural resources</td>
</tr>
<tr>
<td></td>
<td>A.12.16 Identify the world's major ecosystems</td>
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<tr>
<td></td>
<td>A.12.17 Analyze the effect of population on the environment</td>
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<td></td>
<td>A.12.18 Analyze the effect of cultural ethics and values</td>
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<tr>
<td></td>
<td>A.12.19 Describe scientific and technological developments</td>
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<tr>
<td></td>
<td>A.12.20 Assess the advantages and disadvantages of land use</td>
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<tr>
<td></td>
<td>A.12.21 Use atlases and vocabulary to describe a place</td>
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<tr>
<td></td>
<td>A.12.22 Describe the advantages and disadvantages of land use</td>
</tr>
<tr>
<td></td>
<td>A.12.23 Analyze the effect of cultural ethics and values</td>
</tr>
</tbody>
</table>

*Activity reflects or supports the achievement of the standard.*

A Geography, People, Places.

**Social Studies**
<table>
<thead>
<tr>
<th>B12.1</th>
<th>Explain different points of view of the same historical event</th>
</tr>
</thead>
<tbody>
<tr>
<td>B12.2</td>
<td>Identify opposing national and global interests</td>
</tr>
<tr>
<td>B12.3</td>
<td>Analyze why governments have chosen peace or war</td>
</tr>
<tr>
<td>B12.4</td>
<td>Analyze Wisconsin's American Indian tribes and bands</td>
</tr>
<tr>
<td>B12.5</td>
<td>Describe scientific, intellectual, and religious changes</td>
</tr>
<tr>
<td>B12.6</td>
<td>Select, select, and analyze significant events</td>
</tr>
<tr>
<td>B12.7</td>
<td>Identify major works of art and literature</td>
</tr>
<tr>
<td>B12.8</td>
<td>Recall, select, &amp; explain the significance of important people</td>
</tr>
<tr>
<td>B12.9</td>
<td>Identify significant changes in military and foreign policies</td>
</tr>
<tr>
<td>B12.10</td>
<td>Assess the validity of interpretations of historical periods</td>
</tr>
<tr>
<td>B12.11</td>
<td>Identify opposing national and global interests</td>
</tr>
<tr>
<td>B12.12</td>
<td>Analyze Wisconsin's American Indian tribes and bands</td>
</tr>
<tr>
<td>B12.13</td>
<td>Describe current treaties, alliances, and organizations</td>
</tr>
<tr>
<td>B12.14</td>
<td>Analyze why governments have chosen peace or war</td>
</tr>
<tr>
<td>B12.15</td>
<td>Analyze Wisconsin's American Indian tribes and bands</td>
</tr>
<tr>
<td>B12.16</td>
<td>Describe scientific, intellectual, and religious changes</td>
</tr>
<tr>
<td>B12.17</td>
<td>Identify opposing national and global interests</td>
</tr>
<tr>
<td>B12.18</td>
<td>Analyze Wisconsin's American Indian tribes and bands</td>
</tr>
</tbody>
</table>

**Performance Standards - By the end of Grade 12, students will:**

- Activity directly addresses the achievement of the standard.

**Social Studies**
| C.12.1 | Study the rights and responsibilities of citizens. |
| C.12.2 | Describe how political systems protect human rights. |
| C.12.3 | Trace how legal interpretations have changed over time. |
| C.12.4 | Explain the multiple purposes of democratic government. |
| C.12.5 | Analyze theories of how governmental powers might be used. |
| C.12.6 | Analyze federalism and the separation of powers. |
| C.12.7 | Describe American political parties and interest groups. |
| C.12.8 | Use information to understand an issue of public concern. |
| C.12.9 | Identify and evaluate how advocates influence public policy. |
| C.12.10 | Identify ways to participate in community affairs and social movements. |
| C.12.11 | Evaluate how public opinion can influence & shape policy. |
| C.12.12 | Explain the United States' relationship to other nations. |
| C.12.13 | Evaluate the organization of society & political powers. |
| C.12.14 | Analyze political and social movements. |
| C.12.15 | Analyze the origins & consequences of human persecution. |

Performance Standards: By the end of grade 12, students will:

- Activity reinforcement or support of the achievement of the standard.
- Activity directly addresses the achievement of the standard.
D.12.1 Explain how decisions determine the nation's economy

D.12.2 Compare & contrast local, regional, & national economies

D.12.3 Evaluate the role of Wisconsin & the US in world economics

D.12.4 Evaluate technology, interdependence, & competition

D.12.5 Explain how federal budgetary policy influences the economy

D.12.6 Analyze historical & contemporary economic development

D.12.7 Compare, contrast, & evaluate different types of economies

D.12.8 Explain the basic characteristics of international trade

D.12.9 Explain how financial instruments & institutions work

D.12.10 Analyze production & distribution in competitive markets

D.12.11 Explain how interest rates are determined by market forces

D.12.12 Compare how values & beliefs influence decisions

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D.12.14 Analyze the economic roles of institutions

D.12.15 Explain how federal budgetary policy influences the economy

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Performance Standards - By the end of Grade 12, students will:

Social Studies
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<td>E.12.3 Compare how cultures define rights &amp; responsibilities.</td>
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<td>E.12.4 Analyze the role of institutions in continuity and change.</td>
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<td>E.12.5 Describe the ways cultural and social groups are defined.</td>
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<td>E.12.8 Analyze cultural assimilation and cultural preservation.</td>
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<td>E.12.9 Defend a point of view related to an ethical issue.</td>
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<td>E.12.10 Describe a particular culture as an integrated whole.</td>
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<td>E.12.11 Evaluate how cultures resolve conflicting beliefs &amp; practices.</td>
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<td>E.12.13 Compare artistic expressions from three different cultures.</td>
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<td>E.12.14 Develop an informed position on an issue.</td>
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<td>E.12.15 Identify the skills needed to work effectively in society.</td>
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<td>E.12.16 Analyze factors that influence a person's mental health.</td>
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Activities that contribute to individual identity and society:

- Activity directly addresses the achievement of the standard.

* Activity not directly addressed.
STUFF
The Secret Lives of Everyday Things

John C. Ryan
Alan Thein Durning

With research assistance by
Sara Jo Breslow
Christy Halvorson
Ankur Tohan

Illustrated by
Don Baker

NEW Report No. 4
January 1997

Northwest Environment Watch
Seattle, Washington
NEW thanks editor and typesetter Ellen W. Chu and reviewers Rey Abruzzi, Jim Cooperman, Bill McKibben, Sandra Postel, Robert Rice, Dave Salman, Betsy Taylor, and John Young for their skilled contributions. We also thank interns Sean Bowles, Rachel Gussett, and Paige Plumers and volunteers Peter Carlin, Aaron Contorer, Sandra Blair Herrishaw, Norman Kunkel, Flo Lipton, Lyn McCollum, Holly Pearson, Ellen Pyle, Marilyn Roy, Sandra Singler, Scott Stevens, and Lorri Vertola for their dedicated assistance.

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My name is Dana, and I am a consumer. Today, as soon as I got out of bed, I started consuming. I had a coffee. I ate breakfast. I read a newspaper. I put on my clothes. I commuted to work. All day long I went about my ordinary business, consuming stuff and unwittingly affecting places and people around the world.

This book follows a day in the life of a fictional, typical North American—a middle-class resident of Seattle. It is a day in which nothing terribly unusual or dramatic happens. Or so it seems.

I don’t usually think of myself as a consumer. Though I don’t spend much time worrying about the environment, I don’t have a wasteful lifestyle either. I recycle. I have a compost bin in my garden. I’ve even biked to work before.

North Americans have grown more concerned and knowledgeable about the environment in recent years. And many environmental problems—urban smog, water pollution, lead in our air—are less pronounced than they were just a couple of decades ago.

But cleaning out my basement recently got me thinking. Though it felt good to throw out all that junk, my back was sore for a week afterward. Wading through all the objects of my life was a chore. Making them in the first place must have been one too.

Americans throw out about four pounds of garbage each in their daily trash. It’s not much in the grand scheme of things. Though they see only a fraction of it, Americans consume 120 pounds—nearly their average body weight—every day in natural resources extracted from farms, forests, rangelands, and mines.

There I was, piling old paint cans into a cardboard box when something caught my eye. It was a sticker that had fallen off the back of who-knows-what stowed in the basement. It said, “Made in Taiwan.” I’d seen thousands of such stickers in my life without ever giving them a second thought. Taiwan. Taiwan. Not just a word on a sticker. It’s an island. A country. A real place with real people across an ocean from me.

Suddenly, the overloaded shelves around me looked different. I was stripped of the illusion that stuff comes from stores and is carted “away” by garbage trucks: everything on those shelves came from a real place on the Earth and will go to some other place when I’m done with it. Everything had a history—a trail of causes and effects—and a future. Everything had a life, of sorts. If you tried very hard, you could put a “Made in ____” sticker on each car wax bottle, speaker component, or old magazine on those shelves.

Consumption on the North American scale—our own body weight each day—is possible only because of chains of production that reach all over the planet. Most of the production, and most of its impacts, are hidden from view—in rural hinterlands, fenced-off industrial sites, and far-off nations.

I started wondering where the things in my life come from. As coffee beans, newspapers, and soda.
Go M.A.D!
365
DAILY WAYS TO SAVE THE PLANET

Go Make A Difference!
The 52 sections in Go MAD cover topics as diverse as cars, sleeping, love and pest control – which goes to show that every aspect of our lives has an impact on the environment. The aim of this book is to provide practical ways to make sure this impact is a positive rather than a negative one. In order to compile the tips we have contacted over 250 organisations – some are global-scale campaigning groups, others work in areas as specific as toy manufacture or promoting the use of cotton nappies. Whatever their size, they all play an invaluable role in helping people make a difference to the environment.

Likewise, small actions count just as much as big actions. We have organised the tips within each section in order of ascending "difficulty". The first tip in each section provides eye-opening background information on the topic. The second tip is either a tip for children (which doesn’t mean that adults can’t do it too!), or a tip which can easily become a part of your daily routine. As the tips in each section progress they gradually demand more effort. Tip seven is the "get out there, make your voice heard and find out more" tip. It points to places where you can find more information and gives details of specific campaigns you can get involved in.

As well as getting out there and making a difference, please come back to us with your tips, too! There must be hundreds of brilliant ideas that we’ve missed – please let us know what they are.

You can send your tip by post or email and if we use it we’ll send you a free copy of next year’s edition of Go MAD. Please send your tip, along with any supporting information and contact details to:

Email: watchdog@thinkpublishing.co.uk
Post: Go MAD tips, The Ecologist, Unit 18, Chelsea Wharf, 15 Lots Road, London, SW10 0QJ.

Please remember to include your name, address and contact telephone number to ensure you receive a copy of next year’s edition of Go MAD.

---

Cut down on baby paraphernalia

When you are or your partner is pregnant one of the last things you may be thinking about is the environment. Parents-to-be and their families, encouraged by advertising, go on huge spending sprees with little consideration for the impact they are having on the environment, not to mention the money they are wasting on products they probably don’t need or will only use for a short amount of time.

It’s easy to spend £2,000 on baby paraphernalia before and during the first year of a child’s life... but those first 21 months can be made calmer and easier by cutting down on extra products and making sure those you buy are simple, and natural.
Project WET/Project WILD

- Workshop flyer

- Informational packet for teachers
Project WILD and
Project WET
Combined Workshop

March 17, 2007 (Saturday)
8:00 am to 4:30 pm
Campbellsport High School Library
Cost: $40.00/participant

Join us for a fun-filled educational day as we explore the 165 activities of Project WILD that uses wildlife as a portal to the exploring workings of nature. We will splash our way through the 48 activities in the Aquatic Project WILD and wade through the more than 90 lessons in Project WET (Water Education for Teachers). All these programs offer easy to use activities that include background information, evaluation suggestions, lesson objectives, procedures, key vocabulary terms, materials needed, time considerations and suggested grade levels.

You will also be introduced the wide variety of additional educational materials/programs offered by the Wisconsin Department of Natural Resources and other state agencies.

These Programs Meet Your Teaching Needs

- meets Wisconsin teaching standards
- meets Wisconsin model academic learning standards and National Science Standards
- are hands-on
- are interdisciplinary
- motivate student learning
- are designed to be supplemental
- demonstrate values and ethics dilemmas
- involve students in local action/service learning projects
- help students learn "how to think not what to think"
- lead students from awareness to understanding to action

REGISTER BY MARCH 2nd BY CONTACTING
Tanya Monet-Bakken
Science Teacher/Drama Director
Campbellsport School District
114 West Sheboygan Street
Campbellsport, WI 53010
920-533-4811 ext 3081

Bring a bag lunch!

Workshop Facilitator: Jackie Scharfenberg, Naturalist, Kettle Moraine State Forest - Northern Unit
Who: Any and all who are interested (teachers, aids, student teachers, prospective teachers, people who home school teach, etc)

What: Workshop on Project Wet and Project Wild facilitated by Jackie S. Scharfenberg (Forest Naturalist/Environmental Educator)

When: March 17th, 8am-4:30pm (30 minute lunch break)

Where: High School Library

Why: Along with the training on how to use the guides, you will receive your own copies of the curriculum guides full of wonder lessons that can be infused into your classroom. The lessons cover all grades and all subjects. Attached are the lessons correlated to subjects and grades as well as a sample lesson. The cost of the program is ~$40.00 (price may have fluctuated a bit with the new year), but the cost may be deferred by filling out a pre-approval conference form.

For more information contact Tanya Monet-Bakken (TMonet-Bakken@csd.k12.wi.us) or 533-4811 ext 3081
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**Grade Levels**

*Grade levels indicated in the activity were determined by the results of the national fieldtest. Based upon the individual educator's assessment of students' understanding, activities may be adapted for the span of grade levels referenced in this chart.*

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**Appendices**

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Appendices

Project WET Curriculum and Activity Guide
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The Incredible Journey

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**

**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.

**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, any time 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 their station. (At the cloud station
they will line up in single file; at the rest of the stations they should line up in pairs.) Students roll the die and go to the location indicated by the label facing up. If they roll stay, they move to the back of the line. When students arrive at the next station, they get in line. When they reach the front of the line, they roll the die and move to the next station (or proceed to the back of the line if they roll stay).

In the clouds, students roll the die individually, but if they leave the clouds they grab a partner (the person immediately behind them) and move to the next station; the partner does not roll the die.

7. **Students should keep track of their movements.** This can be done by having them keep a journal or notepad to record each move they make, including stays. Students may record their journeys by leaving behind personalized stickers at each station. Another approach has half the class play the game while the other half watches. Onlookers can be assigned to track the movements of their classmates. In the next round the onlookers will play the game, and the other half of the class can record their movements.

8. **Tell students the game will begin and end with the sound of a bell (or buzzer or whistle). Begin the game!**

**Wrap Up and Action**

Have students use their travel records to write stories about the places water has been. They should include a description of what conditions were necessary for water to move to each location and the state water was in as it moved. Discuss any cycling that took place (that is, if any students returned to the same station).

Provide students with a location (e.g., parking lot, stream, glacier, or one from the human body—bladder) and have them identify ways water can move to and from that site. Have them identify the states of the water.

Have older students teach "The Incredible Journey" to younger students.

**Assessment**

Have students:
- role-play water as it moves through the water cycle (step 8).
- identify the states water is in while moving through the water cycle (step 4 and Wrap Up).
- write a story describing the movement of water (Wrap Up).

**Extensions**

Have students compare the movement of water during different seasons and at different locations around the globe. They can adapt the game (change the faces of the die, add alternative stations, etc.) to represent these different conditions or locations.

Have students investigate how water becomes polluted and is cleaned as it moves through the water cycle. For example, it might pick up contaminants as it travels through the soil, which are then left behind as water evaporates at the surface. Challenge students to adapt "The Incredible Journey" to include these processes. For example, rolled-up pieces of masking tape can represent pollutants and be stuck to students as they travel to the soil station. Some materials will be filtered out as the water moves to the lake. Show this by having students rub their arms to slough off some tape. If they roll clouds, they remove all the tape; when water evaporates it leaves pollutants behind.

**Resources**


Where will this student go next on her incredible journey?
## Water Cycle Table

<table>
<thead>
<tr>
<th>STATION</th>
<th>DIE SIDE LABELS</th>
<th>EXPLANATION</th>
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<tbody>
<tr>
<td>Soil</td>
<td>one side plant</td>
<td>Water is absorbed by plant roots.</td>
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<tr>
<td></td>
<td>one side river</td>
<td>The soil is saturated, so water runs off into a river.</td>
</tr>
<tr>
<td></td>
<td>one side ground water</td>
<td>Water is pulled by gravity; it filters into the soil.</td>
</tr>
<tr>
<td></td>
<td>two sides clouds</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 stay</td>
<td>Water remains on the surface (perhaps in a puddle, or adhering to a soil particle).</td>
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<tr>
<td>Plant</td>
<td>four sides clouds</td>
<td>Water leaves the plant through the process of transpiration.</td>
</tr>
<tr>
<td></td>
<td>two sides stay</td>
<td>Water is used by the plant and stays in the cells.</td>
</tr>
<tr>
<td>River</td>
<td>one side lake</td>
<td>Water flows into a lake.</td>
</tr>
<tr>
<td></td>
<td>one side ground water</td>
<td>Water is pulled by gravity; it filters into the soil.</td>
</tr>
<tr>
<td></td>
<td>one side ocean</td>
<td>Water flows into the ocean.</td>
</tr>
<tr>
<td></td>
<td>one side animal</td>
<td>An animal drinks water.</td>
</tr>
<tr>
<td></td>
<td>one side clouds</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 stay</td>
<td>Water remains in the current of the river.</td>
</tr>
<tr>
<td>Clouds</td>
<td>one side soil</td>
<td>Water condenses and falls on soil.</td>
</tr>
<tr>
<td></td>
<td>one side glacier</td>
<td>Water condenses and falls as snow onto a glacier.</td>
</tr>
<tr>
<td></td>
<td>one side lake</td>
<td>Water condenses and falls into a lake.</td>
</tr>
<tr>
<td></td>
<td>two sides ocean</td>
<td>Water condenses and falls into the ocean.</td>
</tr>
<tr>
<td></td>
<td>one side stay</td>
<td>Water remains as a water droplet clinging to a dust particle.</td>
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</table>
### Water Cycle Table, continued

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<tr>
<th>STATION</th>
<th>DIE SIDE LABELS</th>
<th>EXPLANATION</th>
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</thead>
<tbody>
<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>
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<tr>
<td>Animal</td>
<td>two sides <em>soil</em></td>
<td>Water is excreted through feces and urine.</td>
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<td></td>
<td>three sides <em>clouds</em></td>
<td>Water is respired or evaporated from the body.</td>
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<tr>
<td></td>
<td>one side <em>stay</em></td>
<td>Water is incorporated into the body.</td>
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<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>
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<tr>
<td></td>
<td>three sides <em>stay</em></td>
<td>Water stays underground.</td>
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<tr>
<td>Glacier</td>
<td>one side <em>ground water</em></td>
<td>Ice melts and water filters into the ground.</td>
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<tr>
<td></td>
<td>one side <em>clouds</em></td>
<td>Ice evaporates and water goes to the clouds (sublimation).</td>
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<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>
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</table>
Skills Index

Below is an alphabetical listing of all activities found in the Project WILD K-12 Curriculum and Activity Guide. Also listed are the page numbers, suggested grade levels, settings (indoor or outdoor), and the skills addressed for both cross-discipline and subject-specific areas. Under Grade Level, an E indicates that the activity correlates to national learning standards for grades K-4, an M for grades 5-8 and an H for grades 9-12. A P indicates that the activity is also suitable for early childhood (pre-K). The specific skills for each subject area can be found on the Project WILD Website at www.projectwild.org.

SYMBOL NOTE: The dot and triangle symbols are of equal value. They were used to help distinguish between the Cross-Discipline Skills and the Subject Area Skills.

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<th>Subject Area Skills</th>
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<td>88</td>
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Appendix E

Earth Week Theme

Initial Email to Teachers

Informational Packet Handed out at Staff Meeting

Resources/Lesson Plans & Activities

Recycling (WDNR)

Don’t Throw Away Energy (KEEP)

Energy Debate (KEEP)

View Points (KEEP)

Why Use Renewable Energy (KEEP)

Energy Prices (KEEP)

Driving Reasons (KEEP)

Reading Utility Bills (KEEP)

Reading Utility Meters (KEEP)

Energy Story (KEEP)
Hello fellow educators,

I am offering a suggestion. Earth Day (April 22nd), is right around the corner. I was hoping that we as a staff could find time, either in the week before or the week after, to infuse the topic of global warming into one of our lessons. I have some resources in my room, the web is full of ideas and I am willing to sit down with you after or before school one day (or via email) to find a way to fit the topic into your class.

Global warming has become a major concern worldwide, I believe it is our responsibility as teachers to educate the youth on global issues such as this. By uniting on one theme, we can connect to the students and hopefully start to make a difference.

Below are some links that offer ideas. Please take the time to consider taking part in this venture.

Tanya Monet-Bakken

http://www.epa.gov/climatechange/wycd/school.html
http://www1.eere.energy.gov/kids/
http://education.arm.gov/teacherslounge/lessons/alphalessons.stm
http://www.envirolink.org/
http://commtechlab.msu.edu/sites/letsnet/noframes/subjects/science/b5u1.html
http://hdgc.epp.cmu.edu/teachersguide/teachersguide.htm
Global Warming—why we need to infuse more environmental education in our curriculum.

Is The Climate Warming?
Since the 1900s global average temperature and atmospheric CO2 concentration have increased dramatically, particularly compared to their levels in the 900 preceding years. The rapid rise in both surface temperature and CO2 is one of the indications that humans are responsible for some of this unusual warmth.

Are Humans Causing Climate Warming?
Like all other animals, humans participate in the natural carbon cycle, but there are also important differences. By burning coal, oil, and natural gas, humans are adding carbon dioxide (CO2) to the atmosphere much faster than the carbon in rocks is released through natural processes. And clearing and burning forests to create agricultural land converts organic carbon to carbon dioxide gas. The oceans and land plants are absorbing a portion, but not nearly all of the CO2 added to the atmosphere by human activities.

What Effects Might Climate Warming Have?
- Sea Level Rise
- Impacts of Sea Level Rise on Humans
- Impacts of Sea Level Rise on Nature
- Flooding in Eastern Maryland
- Water Resources
- Traditional Cultures
- Health and Disease
- Agriculture
- Ecosystems

What Should Be Done About Climate Warming?
Some countries emit more CO2 into the atmosphere than others, and each country will be affected differently by the changing climate. The international pattern of CO2 emissions and greenhouse warming impacts will change through time. The challenge for policy makers is to pursue globally equitable solutions (such as alternative energy sources) that address these changing international differences.

Teaching our youth about environmental concerns and environmentally friendly behavior will help to foster a productive attitude toward maintaining a healthy environment for people and nature. It starts with knowledge, and then building action skills before citizen action can take place. Teachers need to help foster a learning environment that includes this knowledge and teaches these skills to mold students into productive members of their local and global community.

Resource Binder Table of Contents

1. List of resources in Mrs. Monet-Bakken’s room
   a. Books
   b. Pamphlets, videos, posters

2. List of resources available at WCEE
   (via UW-Stevens Point)

3. Table of contents for various Activity guides
   a. KEEP
   b. Project WET
   c. Invaders of the Forest
   d. LEAF
   e. Recycling Study Guide
   f. Nature’s Recyclers
   g. Wildland Fire Lesson Guide
   h. Project Learning Tree
   i. Learning to Hunt
   j. Project WILD Aquatic
   k. Project WILD

4. Wisconsin State Standards correlation templates

5. Stuff: The secret life of everyday things
   (book on how common items are made)

6. Go MAD: 365 Daily ways to save the planet

7. The Reports Environmental Handbook

8. Teacher’s Supplement to The Reporter’s Environmental Handbook
Resources in Monet-Bakken’s room-Books & Videos

1) 2004 Wisconsin Energy Statistics
2) 2005 Directory of Foresters
3) A shoppers guide to cruelty free products
4) Advancing Education Through Environmental Literacy
   (booklet and CD)
5) Balancing Nature: Trapping in Today’s World (video 28 mins)
6) Birds in the City: Project Pigeon Watch
7) Checklist of Wisconsin Birds (x6)
8) Critters of Wisconsin Pocket Guide (x2)
9) Easy Breathers
   (video and guides about air quality and health problems)
10) Environmental Educational Materials: Guidelines for Excellence
11) Forest Trees of Wisconsin: How to know them
12) Groundwater Study Guide (lessons and materials)
13) Invaders of the Forest: Educators guide to Invasive Plants of Wisconsin’s Forests
14) KEEP curriculum guide
15) LEAF curriculum guide
16) Learning to Hunt curriculum guide
17) Little Book of Diet and Nutrition
18) Nature’s Recyclers
19) PLT (older version) curriculum guide
20) Pocket Prairie Guide
21) Project WET curriculum guide
22) Project WILD Aquatic curriculum guide
23) Project WILD curriculum guide
24) Recycling Activity Guide
25) Reduce, Reuse, Recycle activities (board game, word searches, etc)
26) Spring Waters Gathering Places
   (five short stories about spring waters)
27) Through the Looking Glass...A Field Guide to Aquatic Plants
28) What Tree is That?: A guide to the more common trees found in the Eastern/Central US
29) Where’s the Air (lessons, software, materials)
   (video 30 mins)
31) Wisconsin Forestree: Bridging the Gap between Environment and Ecology
33) Wisconsin Supplement to National Project WET
34) Wisconsin Wildlife Viewing Guide
<table>
<thead>
<tr>
<th>Title of Resource</th>
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<tbody>
<tr>
<td>1. Access nature: a hands-on, habitat-based science curriculum for every child</td>
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<td>2. Adopt a lake</td>
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<td>3. Adopt an eagle nest</td>
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<td>4. Adopt and wolf pack: program information</td>
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<td>5. Answers to your questions: about groundwater</td>
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<td>6. Biodiesel 101</td>
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<td>7. Calling all wildlife: wildlife management basics</td>
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<td>8. Common wildlife of Horicon marsh: a checklist of commonly sighted species</td>
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<td>9. Conserving the nature of America</td>
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<td>10. Critter condos: managing dead wood for wildlife</td>
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<td>11. Discover ground water and spring</td>
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<td>12. Education connection: connecting people with the environment</td>
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<td>13. Fireworks cause forest fires and more...</td>
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<td>14. Forest is a home address for...</td>
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<td>15. Forest view</td>
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<td>16. Geo Thermal: Bringing comfort to your world</td>
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<td>17. Getting the help you need: people and dollars for wildlife</td>
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<td>18. Gimme shelter: shelter and food plots for wildlife</td>
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<td>19. Global environmental teachings: connecting educators and students worldwide through environmental education</td>
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<tr>
<td>20. Going camping: don’t let gypsy moth hitch a ride</td>
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<td>21. Great Wisconsin and birding and nature trail: Lake Superior and Northwoods Region</td>
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<tr>
<td>22. Great Wisconsin birding and nature trail: Lake Superior Northwood region</td>
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<tr>
<td>23. Great Wisconsin birding and nature trail: Mississippi and Chippewa Rivers Region</td>
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<tr>
<td>24. Healthy water healthy people</td>
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<td>25. Home on the range: restoring and maintaining grasslands for wildlife</td>
</tr>
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<td>26. House hold haz waste: reduction as your first choice</td>
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<td>27. Ideas: one stop online for Wisconsin’s education community</td>
</tr>
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<td>28. If you bring it, burn it: help keep Wisconsin trees healthy</td>
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<td>29. Invasive exotic plants: sustainable-managed forest provide</td>
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<td>30. Inventory and monitor wildlife on your land</td>
</tr>
<tr>
<td>31. Just add water: restoring shallow wetlands for wildlife</td>
</tr>
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<td>32. Kettle moraine state forest: northern unit</td>
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<td>33. Leaf: learning experiences and activities in forestry</td>
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<tr>
<td>34. Learning more about Wisconsin’s changing landscape</td>
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<tr>
<td>35. Life in a rotted log</td>
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<tr>
<td>36. Little Book of Diet and Nutrition</td>
</tr>
<tr>
<td>37. Living with snakes: a guide to help keep snakes out of your yard and out in nature</td>
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<tr>
<td>38. Mammal tracks on Wisconsin</td>
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<td>39. Managing leaves and yard trimmings</td>
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<td>40. Managing Your Land for Wild Turkeys</td>
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<td>41. National scenic trail Wisconsin: ice age trail</td>
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<td>42. Naturally Productive: Wisconsin’s Glacial habitat restoration area</td>
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<td>43. Nature resources for educators: explore the wonders of nature</td>
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<td>44. New tree planting</td>
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<td>45. Next Big Wave, The: visual tour of renewable energy resources (CD ROM)</td>
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<tr>
<td>46. On edge: managing edge for wildlife</td>
</tr>
<tr>
<td>47. Prairie open field habitats area home address for...</td>
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</tbody>
</table>
48. Private forestry assistance in Wisconsin
49. Proper tree pruning
50. Putting pen to paper: developing your wildlife management plan
51. Rabbitat: brush piles for wildlife
52. Rain garden: a household way to improve water quality in your community
53. Recycling and beyond
54. Recycling study guide
55. Renewable Energy: Clean power for Wisconsin (DVD)
56. Rethinking yard care
57. Seno: Woodland education center school programs
58. Skill builder workshop series 2005
59. So, what should I plant? Trees shrubs and vines with wildlife values
60. Sport fish and wildlife restoration: keeping our outdoor traditions alive
61. Spreading like wildfire: planning fire prevention as communities grow into wildlands
62. Test for drinking water from private wells
63. The Canada geese of Horicon marsh
64. The changing nature of the wildlife business
65. The fourth “R”: an action booklet for waste reduction and recycling in the classroom and school
66. The wealth of waterways: managing stream corridors for wildlife
67. This wide horizon: a habitat preserved
68. To cut or not to cut?: Managing your woodland for wildlife
69. Tree defoliation in forests and woodlots
70. US Fish and Wildlife service: Horicon National wildlife refuge
71. US fish and wildlife service: Horicon national wildlife refuge bird checklist
72. Warming Trends: What global climate change could mean for Wisconsin
73. Waste reduction: thinking more about less
74. Wetland and water habitats area home address for…
75. Wetland functional values
76. Wetlands, wonderlands
77. When nature center environmental education programs
78. Where’s the air? (activities and lessons on air pollution)
79. Who’s who of citizen-based monitoring on Wisconsin
80. Wildlife success stories
81. Wisconsin center for environmental education
82. Wisconsin DNR’s public wildlife recreation land
83. Wisconsin forest fire laws and regulations
84. Wisconsin forest resources education alliance
85. Wisconsin forestry: celebrating 100 years of forestry in Wisconsin
86. Wisconsin forests: questions and answers
87. Wisconsin K-12 energy education program: building energy literacy in K-12 schools
88. Wisconsin natural resources: Wisconsin’s land trusts
89. Wisconsin nature mapping: the geography of nature
90. Wisconsin state natural area program
91. Wisconsin state park system
92. Wisconsin wildlife primer: wildlife habits and habitat
93. Wisconsin year of water 2003
94. Wisconsin’s comprehensive planning legislation: what it means for wildlife
95. Wisconsin’s deer management program: the issues involved in decision-making
96. Wood duck nest boxes
UW-Stevens Point reference packets

Items to be checked out through UWSP with a description of each item (title, summary, grade level, length, and call number). Each packet is organized by activity guides, videos, books, and reference/background books.

1) Aquatics Systems (teal)
2) Biodiversity (pink)
3) Climate Change (salmon)
4) Energy (dark yellow)
5) Forest and Forestry (light green)
6) Human Populations (purple)
7) Land use (brown)
8) School sites (light yellow)
9) Solid Wastes/3 R’s (light blue)
10) Staff Favorites (grey)
To the teacher: Have the students draw a line from the item to the appropriate stack of recyclables.
From: "Rethinking Recycling", Oregon D.E.Q.
Sort it out before you set it out.

Circle the items that are trash.
Cross out all the recyclables and put them in the recycling area.
Color in can when complete.

From: "Here Today, Here Tomorrow", New Jersey D.E.P.
Recycling, like this maze, is not difficult, and once you're on the path to recycling, it's easy.
SECRET RECYCLABLES

Can you crack the code?

Hint: ZBEVNJNB is NEWSPAPER

Good Luck!

1. OWJVV
2. IDADP DTW
3. ATPBV
4. JWYITZI LJZV
5. LJPFRDJPF
6. JVNCJWA
7. IBAJW
8. WBJSBV
9. LJPV
Number Match

Draw a line to match the hint with its correct letter.
Can you get them all right?

1. Number of buyers of recyclable materials in Wisconsin.  
   A. 26

2. Percent of all paper that is recycled in the U.S.  
   B. 724

3. Percent of all paper recycled by Wisconsin.  
   C. 40

4. Number of metal cans used each year by a family of five.  
   D. 12

5. Number of trees used for paper each year by a family of five.  
   E. 2640

6. Pounds of solid waste thrown away by a family of five each year.  
   F. 17

7. Number of plastic containers used by a five person family in a year.  
   G. 358

8. Number of trees it takes to make a ton of paper.  
   H. 400

9. Amount of energy saved by recycling a ton of paper (gallons of oil).  
   I. 4599

10. The energy saved by recycling an aluminum can could keep a light bulb on for this many hours.  
    J. 47

Answers: 1-G; 2-C; 3-J; 4-E; 5-A; 6-I; 7-B; 8-F; 9-H; 10-D
Word Match

Draw a line to match the definition with its correct word. How many can you answer?

1. Recyclable, ground-up glass
   A. Paper
2. Changes organic materials into a soil-like mixture.
   B. Motor Oil
3. Half of all landfilled waste
   C. Cellulose insulation
4. A use for shredded newspapers
   D. Aluminum
5. A use for finely ground newspapers
   E. Composting
6. Most is imported from Australia and Jamaica; recycling saves 95% of the energy to process
   F. Plastics
7. Made from petroleum and natural gas
   G. Natural Resources
8. Wisconsin law requires communities to set up collection centers for this
   H. Cullet
9. Some states recycle 90 – 95% of these by having deposits on them.
   I. Animal Bedding
10. Our largest portion of household waste
   J. Yard Waste
11. If materials aren't recycled, they go here
   K. Landfills
12. If materials aren't recycled, they use up...
   L. Beverage Containers

Answers: 1-H, 2-E, 3-A, 4-I, 5-C, 6-D, 7-F, 8-B, 9-L, 10-J, 11-K, 12-G
SEARCH - A-WORD

Find and circle the 31 words in this activity. The words are found up, down and across.

Municipal Solid Waste
Solid Waste Management
Garbage
Anaerobic
Resource Recovery
Dump
Incinerate
Refuse Derived Fuel
Transfer Station
Sanitary Landfill
Litter
Source Separation
Trash
Biodegradable
Scrubber
Decompose
Solid Waste
Leachate
Composting
Aerobic
Landfill
Ecosystem
Waste Stream
Emissions
Energy Recovery Facility
Non Renewable Resource
Fly Ash
Natural Resource
Tipping Fee
Recycle
Bottom Ash

From; "Here Today, Here Tomorrow", New Jersey D.E.P.

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WORD SEARCH

Things That Can Be Recycled

IRON TIN CANS LEAVES
STEEL ALUMINUM CANS GLASS
BRASS CARS JARS
COPPER TIRES RAGS
ZINC PLASTICS PAPER
GOLD ASPHALT NEWSPAPER
LEAD CONCRETE CORRUGATED
METALS MOTOR OIL OFFICE PAPER

Can you find these words?

IRON STEEL BRASS COPPER ZINC GOLD LEAD METALS
TIN CANS ALUMINUM CANS CARS TIRES PLASTICS ASPHALT CONCRETE MOTOR OIL
LEAVES GLASS JARS RAGS PAPER OFFICE PAPER

WOOD
RECYCLING CROSSWORD PUZZLE

ACROSS
1. Recycling saves
2. ____ ____ is recycled into fuel.
3. Plastics _____ decompose.
4. Brown paper bags can be mixed in with _________ cardboard for recycling.
5. _____ should be rinsed, flattened, and have the paper labels removed for recycling.
6. Recycling reduces _____ pollution.
7. We _____ 99% of the plastics we buy.
8. Aluminum comes from the mineral _______.
9. Plastics ________ be recycled into food containers.
10. _____ and jars can be recycled.
11. Reducing, reusing and recycling solid waste will help save our ____ from landfills.
12. Curbside recycling is _____
13. We must _____ the amount of trash we produce.
14. Trees are a ________ natural resource.
15. _________ in plastics hamper the recycling process.

DOWN
1. Oil and metals are _______ natural resources.
7. Each Oregonian throws away 1600 pounds of _____ every year.
16. Portland metropolitan area landfills enough trash to fill the _______ every month.
17. Crushed glass prepared for recycling is called _______.
18. Another name for trash and garbage is _________.
19. It takes ________ trees to make one ton of paper.
20. A "tin" can is mostly _______ and can be recycled.
21. Recycling _______ will pick up recyclable materials monthly at curbside.

From: "Rethinking Recycling", Oregon D.E.Q.
RECYCLING CROSSWORD PUZZLE

ACROSS
1. Recycling saves
3. Plastic ______ is recycled into fuel.
4. Some paper can be mixed with ______ cardboard for recycling.
5. ______ should be cleaned, flattened, and have metal labels removed for recycling.
6. Recycling reduces ______ pollution.
7. Trashes come from the mineral bauxite.
8. Bottles ______ can be recycled.
9.______ and jars can be recycled.
10. Decreasing ______ and recycling solid waste will help save our environment.
11. Reducing ______ and recycling solid waste will help save our environment.
12. We must reduce ______ the amount of waste we produce.
13. Trees are a ______ natural resource.
14. ______ in plastics hampers the recycling process.

DOWN
1. Oil and metals are ______ natural resources.
2. Each Oregonian throws away 1400 pounds of ______ every year.
3. Portland metropolitan area landfills enough trash to fill the ______ every month.
4. Crushed glass prepared for recycling is called ______.
5. ______ time for trash and garbage is ______.
6. A ______ can be recycled ______ and can be recycled.
7. Recycling ______ will pick up recyclable materials weekly at curbside.

NATURAL SOURCES
MOTOR OIL
TIN CANS
HAZARDOUS
GARBAGE
BOTTLES
REDUCE
RENEWABLE
LOW

ACROSS
1. Recycling saves
3. Plastic______ is recycled into fuel.
4. Some paper can be mixed with ______ cardboard for recycling.
5. ______ should be cleaned, flattened, and have metal labels removed for recycling.
6. Recycling reduces ______ pollution.
7. Trashes come from the mineral bauxite.
8. Bottles ______ can be recycled.
9.______ and jars can be recycled.
10. Decreasing ______ and recycling solid waste will help save our environment.
11. Reducing ______ and recycling solid waste will help save our environment.
12. We must reduce ______ the amount of waste we produce.
13. Trees are a ______ natural resource.
14. ______ in plastics hampers the recycling process.

DOWN
1. Oil and metals are ______ natural resources.
2. Each Oregonian throws away 1400 pounds of ______ every year.
3. Portland metropolitan area landfills enough trash to fill the ______ every month.
4. Crushed glass prepared for recycling is called ______.
5. ______ time for trash and garbage is ______.
6. A ______ can be recycled ______ and can be recycled.
7. Recycling ______ will pick up recyclable materials weekly at curbside.
Help! Some very valuable things are on their way to the landfiil! Save them from being thrown away! Circle in blue the things which can be recycled. Circle in green the things which can be reused. Some may be both!

Did you find:
- newspaper
- cardboard
- bottles
- milk jugs
- old toys
- brush
- tin cans
- jars
- grocery bags
- margarine tub
- box
- motor oil
- plastic bags
- crayons
- pencils
- blank paper
- art paper
- aluminum plates

(P.S. There are some extra bonus words hidden here, too!
Can you find them? What do they tell you?)

From: "Rethinking Recycling", Oregon D.E.Q.
Objectives
Students will be able to
• explain that energy consumption includes
  products and materials they use (Part I); and
• develop a plan that outlines how they can save energy by reducing, reusing, or recycling items they normally throw away (Part II).

Rationale
The energy used to develop, transport, and market a product is often overlooked as a component of consumers' energy consumption. Having students learn about these “hidden” energy uses, and analyze ways to reduce the amount of waste these uses generate, introduces them to another aspect of energy conservation.

Materials
• Can of soda
• Materials needed for the following three optional student activity sheets:
  - Generating Less Household Waste: Reduce
  - Once Is Never Enough: Reuse
  - Something New from Something Old: Recycle
• Copies of Sample Decision-Making Grid (optional)

Background
As consumers and citizens, we should be aware of the flow of energy throughout the environment and within our industrial society. Just as a tree or human cannot grow without energy, human-created materials such as pencils, airplanes, school lunch bags, and television sets cannot be created or used without expending energy.

The total amount of energy needed to make and transport a product is called embodied energy. For example, the engine powering a steam shovel used to mine a metal consumes energy in the form of gasoline. The equipment used to fell a tree, whether powered by hand or by engine, consumes energy. The process of transporting the metal-bearing ore to a refining plant or milling the tree requires energy to power the machinery. Combining the processed metal and wood with other raw material to make a finished product draws on even more energy. All the energy used in these processes is used once and is unavailable for future use.

Even after the product is created, energy is used. Energy is needed to produce the packaging and to ship the product to the retailer. Selling the product involves energy use. Depending on the purpose of the product, the consumer may expend energy when using it. Finally, the product is thrown away, which also requires energy.

People in Wisconsin throw out everything from toothpaste tubes to old television sets, food scraps to plastic milk jugs, jelly jars to paper. If you add up all the waste from your house, from the store where you shopped, and from the restaurant where you ate, it would amount to five pounds (2.25 kg) per person of municipal solid waste thrown into the trash every day. Fortunately, Wisconsin residents recycle about 1.25 pounds (0.56 kg) of waste per day. If you multiply the remaining 3.75 pounds (1.69 kg) by 365 days per year, then by five million Wisconsin citizens, your results will show that Wisconsin citizens still throw away more than 3.4 million tons (3.06 million metric tons) of stuff each year!

When a product is thrown away, it is the end of the line for the energy flow history of the product. The embodied energy used to create the product is lost as waste heat and never available for use again. Clearly, we need to develop ways to reduce the amount of embodied energy used during production, to allow the saved energy to be used for alternative purposes. In addition, we should consider the energy that is stored within the product. Wood, plastics (made from petroleum), and glass all have energy stored...
within their chemical bonds. Wisconsin's trash contains enough energy to heat more than 300,000 homes a year.

So, what else can we do with waste besides send it to a landfill? The approaches most often recommended to decrease the amount of waste we generate are labeled the Three Rs (Reduce, Reuse, Recycle). See student pages for more information about these options. While people reduce, reuse, and recycle many products, some items should be used only once and then put into a landfill or incinerated. These items include hospital waste such as syringes.

Some communities in Wisconsin have built waste-to-energy plants to deal with solid waste materials. This approach involves using solid waste, specifically the chemical energy stored in the waste, as a fuel source. Waste is burned and the heat produced is used to generate electricity. Each ton of solid waste has the energy equivalent of 70 gallons (265 l) of gasoline — enough energy to drive a small car from coast to coast. However, toxic substances are often released into the air when waste products are burned, and burning also results in the production of a toxic ash. Another drawback to burning waste is that some of the materials that burn the best or contain the most stored energy (paper, plastic) are also the best candidates for recycling and reuse, resulting in greater embodied energy savings compared to the stored energy received from burning.

None of these approaches is the sole solution to our waste disposal problem. In 1990, Wisconsin passed Act 335, the Waste Reduction and Recycling Law, which banned certain items from Wisconsin's landfills and required communities to establish effective recycling programs. Wisconsin currently reuses, recycles, or composts more than 25% (by weight) of its municipal solid waste each year. These actions reduce the need for landfill space and help save energy, sending a message to manufacturers and waste disposal managers that we, as consumers, are serious about conserving energy resources for future generations.

**Procedure**

**Orientation**

Open a can of soda and take a sip of it. Ask students to identify ways you just used energy. If students do not mention the aluminum can and its contents, introduce the term embodied energy (the total energy required to produce and transport a product). Explain that large amounts of energy are needed to produce aluminum (about 98,000 BTU/lb.). (See _Aluminum Production_.)

Ask students what they normally do with an aluminum can after they are finished with it.

Students may say they recycle the can, and some may say they throw it away (especially if a recycling bin is unavailable).

Prompt students to consider things they throw away on a typical day or over a period of a week. It may be helpful to develop a chart (see _Inventory of Things Typically Thrown Away_) to categorize the trash (more than one category can be checked if applicable).

**Steps**

1. Share some of the Wisconsin trash statistics with students (see _Background_). Discuss the connection between energy and solid waste. Emphasize the following:
   - Each time something is produced, energy is required (embodied energy).
   - When products are bought and used inefficiently or tossed away prematurely, the energy that was used to produce the product is essentially wasted.
   - Many products contain stored energy (chemical energy) that is unavailable when the product enters a landfill.
2. Divide the class into small groups. Have the group select one product (and/or its packaging) from Inventory of Things Typically Thrown Away charts to analyze (see Orientation). If possible, students should choose a locally produced item. For example, bicycles are made in Waterloo; batteries and bologna in Madison; pens in Janesville; soy sauce in Walworth; shoes in La Crosse; beer in Milwaukee; glass in Burlington; and paper, cheese, and plastics in many Wisconsin towns.

3. Have students compile a report on the product that includes the following:
   • Raw materials used during production (optional)
   • Production steps and energy resources required to make the product (embodied energy)
   • Information about potential energy that is stored in the chemical bonds of the product

---

**Aluminum Production**

Which of these steps involve energy? (They all do!) The raw material for aluminum is bauxite. Nearly 99 percent of our bauxite is imported from countries such as Australia, Jamaica, and Guinea. Most bauxite is mined in open pits called strip mines. Trees and other plants, rocks, and soil are first cleared from the area. Then the bauxite ore is extracted from the earth and taken to processing centers.

After crushers mash bauxite ore into small bits, the ore is heated to remove as much water as possible. Then the ore goes to a refinery. At this stage, a waste product called red mud is left behind.

By going through a series of chemical reactions in a refinery, bauxite is refined into a fine white powder called alumina. The refining process also creates a waste called red mud, which is made of silica, iron oxides, and other impurities from the bauxite ore. Processing bauxite produces high volumes of red mud, for which there is currently no use. Additionally, the mud must be contained to keep it from contaminating water and other environmental resources.

Smelters or reduction plants transform white alumina powder into molten aluminum. First, the powder is dissolved in a hot, liquid salt solution in a large pot. Then an electrical current flows into the pot, causing aluminum to settle to the bottom, where it is removed.

This process makes producing aluminum very energy intensive.

Molten aluminum is almost always alloyed (mixed with other metals and elements) to make it stronger. Then it is poured into molds to form ingots. Ingots may be long rods, huge slabs weighing 20 tons (18,144 kg), or small bricks weighing only 4 pounds (1.8 kg).

Ingots are melted and turned into products. Huge slabs of aluminum are usually rolled into sheets of varying thickness for products such as aluminum foil, airplanes, and beverage cans. Smaller ingots of aluminum may be melted and poured into molds, creating tea kettles, automobile parts, and other products.

See also Aluminum from Raw Materials vs. Recycled Materials in the Student Book, page 249.

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**For Students**


**Related KEEP Activities:**

To help students appreciate how goods and services involve energy use within all community sectors, see K-5 Energy Sparks for Theme I: "Energy Use in Wisconsin." Advertising Energy can be used to help students analyze how commercials influence their purchasing habits. In addition to the waste reduction strategies described within the activity, students can look into those outlined in the Action Ideas.
Inventory of Things Typically Thrown Away

<table>
<thead>
<tr>
<th>Types of material</th>
<th>Composition of material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Paper</td>
</tr>
<tr>
<td>Durable goods</td>
<td></td>
</tr>
<tr>
<td>(products used three years or more; e.g., furniture, tires, appliances)</td>
<td></td>
</tr>
<tr>
<td>Nondurable goods</td>
<td></td>
</tr>
<tr>
<td>(products used three years or less; e.g., disposable items, paper, some clothing, food)</td>
<td></td>
</tr>
<tr>
<td>Packaging</td>
<td></td>
</tr>
</tbody>
</table>

- Energy-related problems associated with throwing away the product (should relate to embodied energy and/or stored energy)
- How creating the product may affect the environment (optional)

This report can be based on practical knowledge, background reading, or contacts with or visits to the manufacturer to obtain more information about the process.

Part II—Save Energy through Waste Management

1. Involve students in one or more of the following activities to introduce them to alternatives to throwing things away, often called the Three Rs (Reduce, Reuse, Recycle):

   - Generating Less Household Waste: Reduce
   - Once Is Never Enough: Reuse
   - Something New from Something Old: Recycle

2. Have students identify which approach(es) might work as alternatives to disposing of their product (they may also want to include other options such as choosing not to purchase, incinerating, landfilling, etc.). Instruct students to evaluate each alternative they identified and use the

Sample Decision-Making Grid

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Convenient</td>
</tr>
<tr>
<td>Reduce: buy ball point pens that are not packaged</td>
<td></td>
</tr>
<tr>
<td>Reduce/Reuse: Purchase fountain or cartridge pen.</td>
<td></td>
</tr>
<tr>
<td>Reduce: Contact manufacturer to ask for less packaging</td>
<td></td>
</tr>
<tr>
<td>Incinerate</td>
<td></td>
</tr>
<tr>
<td>Landfill</td>
<td></td>
</tr>
</tbody>
</table>
evaluation to select one approach. Students can use a decision-making grid to help decide (for more information see "A Decision-Making Model — A Tool for Analysis" in the Appendix).

**Closure**
Have each group conduct a presentation about their product (how it is made and used), focusing on the energy involved. The group should discuss how development and disposal of their product relates to energy use. Next, the group should present disposal alternatives they evaluated and chose (or did not choose, if landfilling was the only viable option). The summary of the presentation should emphasize how their chosen action helps conserve energy.

**Assessment**

**Formative**
- Can students explain the connection among energy use, prudent shopping, and waste disposal practices? (Part I)
- Are students able to provide examples of how to reduce, reuse, and recycle household waste? (Part II)

**Summative**
Challenge students to develop a classroom plan to address a waste generation problem. Most likely this plan will involve limiting the amount of paper that is used and thrown away. Their plan should report how much energy is used to make paper (from both virgin resources and recycled). Each of their proposed solutions should highlight the energy that could be saved by the action.
Generating Less Household Waste: Reduce

"Reduce" is one of the three Rs when it comes to addressing the solid waste problem. Reducing essentially means less waste in the first place. There are a variety of things consumers can do to reduce the amount of material they contribute to the waste stream; many of these focus on selective and prudent purchasing practices (see also *Once Is Never Enough: Reuse*).

One way a consumer can reduce waste generation is to avoid buying products that are excessively packaged. A large portion (around 35 percent) of the waste we generate is packaging. There are many benefits of packaging: fewer damaged goods, product preservation, and organizing and presenting contents. However, items can sometimes be overpackaged (such as wrapped in many layers of plastic and paper, large containers for small products, single-sized serving containers packaged together). Because energy is needed to produce packaging as well as to produce the product, many companies are making efforts to conserve energy by improving their packaging practices.

The following are other ways consumers can help reduce the amount of waste generated:

- Ask yourself, "Do I really need this item?"
- Buy long-lasting products rather than items that have a shorter life span and end up as waste sooner
- Buy goods in returnable or recyclable containers
- Invent new uses for old materials

Individuals can also contact the manufacturers of products they buy and persuade them to use less energy during the production process. Decreasing the number of steps or the materials needed to create a product or its packaging means less energy is needed to produce and transport materials. In other words, the product's embodied energy is reduced.

Saving time and money are among the many reasons industries strive to improve the efficiency of their production processes. The less energy they use, the less energy they have to pay for. Such practices are especially important as the price of energy increases. Paper production is one example of an industry that has reduced its energy use. The paper industry has decreased the amount of energy it needs to produce a ton of paper by 27 percent since 1972.

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Illustrating the Waste Alternative

1. Ask students to bring to class various containers used to package food. Have students classify the predominant type of material (glass, aluminum, steel, paper, etc.) used in the packaging. If a package is made out of different types of materials (like cardboard and plastic), have students separate the package into different materials.

Caution: Students may need to wear protective gloves and to use scissors.

2. For each package, instruct students to weigh each type of material.

3. Have students use the data from the chart on the next page to calculate how many kilocalories or kcal (1 kcal = 1,000 calories = 1 food Calorie) were used to produce the packaging. If more than one material was used in the packaging, they should determine the energy needed for each material and total the results.
### Generating Less Household Waste: Reduce (Continued)

<table>
<thead>
<tr>
<th>Material</th>
<th>kcal/lb</th>
<th>kcal/oz</th>
<th>kcal/gm</th>
<th>BtUs/lb</th>
<th>BtUs/gm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>5,131</td>
<td>321</td>
<td>11.4</td>
<td>20,373</td>
<td>44.9</td>
</tr>
<tr>
<td>Glass</td>
<td>1,918</td>
<td>120</td>
<td>4.2</td>
<td>7,611</td>
<td>16.6</td>
</tr>
<tr>
<td>Steel</td>
<td>3,724</td>
<td>233</td>
<td>8.3</td>
<td>14,778</td>
<td>32.6</td>
</tr>
<tr>
<td>Aluminum</td>
<td>24,837</td>
<td>1,552</td>
<td>54.7</td>
<td>98,560</td>
<td>217.1</td>
</tr>
<tr>
<td>Plastic</td>
<td>4,670</td>
<td>292</td>
<td>10.3</td>
<td>18,532</td>
<td>40.8</td>
</tr>
</tbody>
</table>


Example: Calculate how much energy was used to make a steel can that weighs 2 ounces.

\[
2 \text{ ounces steel can} \times \frac{233 \text{ kcal}}{\text{ ounce}} = 466 \text{ kcal} \quad \text{[466 kcal to produce a 2-oz. steel can]}
\]

4. Compare the amount of energy used to make the containers from the different packaging materials with the amount of energy in the packaged food. Ask students what they think about the energy values for the packaging and for the food.

5. Students can find similar food items packaged in different ways and compare the energy costs to package each type. For example, have students compare a six-pack of applesauce snack desserts to a glass jar of applesauce. How might these findings affect their purchasing decisions?
Once is Never Enough: Reuse

Another approach to generating less household waste is to throw less away. But what do you do with something after you use it? Use it again! This component of waste reduction, called Reuse, is often overlooked, but is perhaps the best alternative for saving energy and protecting resources. When you reuse something, that means energy is not needed to create a new product to replace the one that was thrown away. Here is a list of ideas to try:

- Buy products in returnable containers
- Reuse plastic or paper grocery bags (or buy a canvas bag and reuse it)
- Give old furniture, clothes, and household items to charities
- Buy furniture, clothes, and household items from thrift shops, charities, and yard sales
- Fix something instead of throwing it away
- Make creative crafts (bird feeders out of milk cartons, magazine storage containers out of cereal boxes)
- Carefully remove gift wrapping and reuse (or use the Sunday comics from the newspaper to wrap gifts)
- Use both sides of a sheet of paper

Illustrating the Waste Alternative


2. Have students identify the energy-consuming steps required at each stage of producing new clothes. Help students identify the steps that probably use nonrenewable resources such as coal or oil. Students may also identify other energy uses not included in the diagram (such as the consumer driving to and from the store).

3. Propose to students clothes can be reused instead of thrown away.

4. Have students discuss advantages and disadvantages of buying used clothes. Record their suggestions in a two-column chart on the chalkboard.
There is a way for people to throw away things without adding materials to the landfill. This is to throw things into a different stream: the recycling stream. Recycling is another one of the Three Rs listed as a solution for dealing with solid waste. Recycling involves taking discarded items and transforming or remanufacturing them into similar or different products.

Items that are commonly recycled include paper, steel, glass, aluminum, and plastic containers. Recycling saves energy because energy is not needed to locate, obtain, and process raw materials. However, there are alternative energy costs. The basic steps of recycling are separation of recyclable from non-recyclable materials, collection of materials, processing (breaking or melting materials into their basic material, such as paper into pulp), and remanufacturing. These steps, along with transportation to retailers, all use energy. Although recycling has its own energy costs and there are some pollution issues with recycling, there is evidence that recycling paper can save energy.

<table>
<thead>
<tr>
<th>Recycling 1 ton of</th>
<th>Saves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass</td>
<td>10 gallons of oil</td>
</tr>
<tr>
<td>Plastic</td>
<td>1,000 to 2,000 gallons of gasoline</td>
</tr>
<tr>
<td>Newspaper</td>
<td>100 gallons of gasoline</td>
</tr>
<tr>
<td>Aluminum</td>
<td>2,350 gallons of gasoline. This is equivalent to the amount of electricity used by the typical Wisconsin home over a period of ten years</td>
</tr>
<tr>
<td>Iron</td>
<td>1 ton of coal</td>
</tr>
</tbody>
</table>

Many states, including Wisconsin, are concerned about finding space to store solid waste and want to promote better use of our resources. Below is data on proportions of solid waste the United States generates and recovers through recycling and composting.

### Products Generated and Recovered in 1994

<table>
<thead>
<tr>
<th>Product</th>
<th>Generated</th>
<th>Recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper and Paperboard</td>
<td>81,300</td>
<td>28,730</td>
</tr>
<tr>
<td>Steel cans</td>
<td>2,920</td>
<td>1,550</td>
</tr>
<tr>
<td>Aluminum cans</td>
<td>1,710</td>
<td>1,120</td>
</tr>
<tr>
<td>Plastic packaging</td>
<td>9,490</td>
<td>710</td>
</tr>
<tr>
<td>Glass bottles and jars</td>
<td>12,070</td>
<td>3,110</td>
</tr>
<tr>
<td>Disposable diapers</td>
<td>2,980</td>
<td>negligible</td>
</tr>
<tr>
<td>Tires</td>
<td>3,690</td>
<td>560</td>
</tr>
</tbody>
</table>

Something New from Something Old: Recycle (Continued)

Illustrating the Waste Alternative
Provide students with a copy of Recycling Old Paper, in the Student Book, page 248. Help students understand that recycling paper avoids many of the energy-consuming steps needed to make paper from wood (cutting down trees, transporting to the mill, debarking the tree, turning the wood into pulp). Recycling paper also has energy costs because the paper needs to be separated and turned into pulp. Removing ink and other foreign materials and disposing of these materials requires energy as well and also affects the environment. Involve students in a debate in which they discuss the pros and cons of recycling paper. Invite speakers from a lumber company, a paper manufacturer, and a paper recycling plant to speak to the class or take students on a tour of such facilities. Have students look for the recycling symbol on recycled paper products and packaging. What could the prevalence of this symbol mean for energy and natural resource savings?

An alternative is to show students overhead transparencies of Aluminum from Raw vs. Recycled Materials, Student Book, page 249, and to compare energy uses between aluminum manufacturing and recycling.
New Versus Pre-Owned Clothing

Buying used clothes from consignment stores is an energy and money-saving alternative to buying new clothes. No new materials or energy go into producing used clothes, so buying quality second-hand items is a wise 3R’s choice.

New Clothing Pathway...

Cotton planting begins in mid-September through October

Cotton is harvested in late February through April with either a spindle picker or stripper harvester

Once the cotton has been harvested it is shipped to factories where laborers produce the clothing items we see in retail stores

The clothing products are available for purchase at market and retail stores

Clothing produced from the cotton yields is then shipped to the market and retail stores

Products produced by factory laborers are packaged and prepared for shipment

Dispose of clothing to landfill

PRE-Owned Clothing Pathway...

Consumer travels to market and retail stores to purchase energy saving, low input clothing items

Energy Efficiency and Clothing? List 6 ways in which pre-owned clothing is an energy saving alternative to buying new clothes.
Here Is What You Will Need

- Paper to be recycled (Newspaper, scraps of construction paper, facial tissue, and paper towels will work. Avoid glossy paper. Notebook paper may also be difficult to use.)
- Water
- Blender, egg beater, or mixer
- Piece of window screen (slightly larger than the size you want the paper to be)
- Tub, basin, or cake pan (larger than the window screen)
- Liquid starch (optional—this helps strengthen the paper)
- Materials to decorate paper, such as dried flowers, pine needles, pieces of construction paper (optional)
- 3 or 4 pieces of blotting paper or towels
- Rolling pin
- Iron (optional)

Directions

1. Tear the paper into tiny pieces. Decide if you want to mix colors or keep paper mainly white (a small piece of construction paper adds a lot of color).

2. Soak the torn paper in hot water for at least an hour (the longer the better). If you used newspaper, you may want to rinse it to remove some of the ink.

3. Fill the blender about half full of water and add the soaked paper; blend until it’s a smooth pulp mixture, adding more water as necessary (the finer the mixture, the smoother your paper will be). You may add a few tablespoons of liquid starch (optional).

4. Put the window screen on the bottom of the tub, basin, or pan.

5. Pour the pulp mixture over the screen and carefully lift the screen and allow excess water to drain. Place the screen on a blotter or towel. You can add decorations at this time.

6. Cover the screen and paper with another piece of blotting paper or towel and use a rolling pin to squeeze out the water.

7. Carefully remove the recycled paper from the screen and lay it flat on another piece of blotting paper or towel to dry (or leave the paper on the screen until it is nearly dry). Make sure the new paper remains flat. You can also sandwich the paper between two sheets of blotting paper or towel and iron it until it is dry.

Use the paper to send a letter to a friend!
Steps in Making Aluminum Products from Raw vs. Recycled Materials

**Steps in Making Aluminum Products from Raw Materials**

1. **Open Pit Mining.** Bauxite ore is loaded into trucks.
2. **Processing Plant.** Bauxite is crushed and washed.
3. **Refinery.** Chemicals are used to refine bauxite into alumina.
4. **Smelter.** Alumina is melted. Other metals are added to molten aluminum to strengthen it.
5. **Molds.** Molten aluminum is poured into molds of cylinders, sheets or squares.
6. **Products.** The castings are remelted, hammered, or rolled into various items.

**Steps in Making Recycled Aluminum Products**

1. **Recycling Center.** Aluminum is collected and crunched into bales.
2. **Melting Furnace.** The baled aluminum is melted.
3. **Molds.** Molten aluminum is poured into molds to form sheets, blocks and cylinders.
4. **Products.** The castings are reshaped into useful items.

**Recycled Aluminum Reduces:**
- *Water Consumption by 95%*
- *Energy Use by 95%*
- *Air Pollutants by 95%*

Illustrations adapted from Florida State University, Energy & Environmental Alliance, Institute of Science and Public Affairs. Connections: Energy, Environment, Economics, and Education Working Together 5, no. 1 (1996): 5. Used by permission. All rights reserved.

KEEP Student Book | theme IV: managing energy resource use | Don't Throw Away Energy
This project can be assigned at the beginning, middle, or end of a unit related to the development of energy resources. It can also be the energy unit, where students use the research and debate process to teach themselves and classmates how energy resources are developed. Basic information students need to learn about resource development can be obtained from the *Energy Resources Fact Sheets*. Students will probably need to research information to prepare for the debate, so additional time may be needed. Students can also gain knowledge and skills about energy resource development by participating in other KEEP activities.

**Grade level:** 6-8

**Subject Areas:** Language Arts (Communication, Debate), Science (Ecology, Environmental, Physical), Social Studies (Geography, Government)

**Setting:** Classroom, library, and community

### Objectives

Students will be able to
- describe what is involved in developing energy resources to generate electricity;
- critically analyze the advantages and disadvantages of various energy resources; and
- use persuasive arguments to present and defend an energy resource.

### Rationale

A debate-oriented discussion encourages students to become independent thinkers. Students are challenged to conduct practical research and to answer questions, analyze information, and draw their own conclusions. Through this activity, students will gain knowledge needed to make prudent energy choices.

### Materials

- Writing utensils and paper
- Reference materials related to energy resource development (including *Energy Resources Fact Sheets* from the Student Book)
- Copies of the following pages from the Student Book:
  - *The Energy Debate: Which Resource Is Best?*, page 144
  - *The Project Proposal Form*, page 146
  - *Project Components for Research and Preparation*, page 147
  - *Project Components for the Proposal Presentation/Debate Phase*, page 148
  - *Proposal/Presentation Recording Sheet*, page 150
  - *Evaluation Criteria*, page 151
- Other materials needed by students to prepare and give their presentations

### Background

The aim of the theme Developing Energy Resources is for students to learn what is involved in acquiring the energy they use. Energy comes from many sources and is found in many forms. This wide range of form and scale lends itself to a diversity of applications. Energy is used for heating, for fuel, to sustain life, to move objects, to generate electricity, etc.

Classroom debates provide students with a motivating and constructive format that encourages them to research what is involved in developing these energy resources. Through the debating process, students are to defend, explain, and analyze what they think about a topic such as developing energy resources. Although students will be having fun, they also will be enhancing important communication, critical thinking, and decision-making skills.

This activity is based on the premise that students are responsible for their own and their classmates’ learning. Students may use a “The Energy Learning Log” to keep track of their research. This log can be maintained much like a portfolio where students can file important information related to their energy resource. (See the Appendix for further information about “Energy Learning Logs.”)

### Procedure

**Orientation**

Present students with one of the following scenarios, depending on which is more relevant to your area.

- Utility forecasters have determined that the demand for electricity by their customers will increase over the next ten years. Although the utility’s conservation programs will offset some of the increased demand, they will not completely eliminate the need for more electricity. To meet the increase in demand not covered by conservation, the utility has determined that a power plant or other means of generating electricity must be built.
- The local utility owns a 60-year-old, inefficient, coal-fired power plant. The utility decides that this outdated plant is not worth fixing and plans to shut it down. To maintain the supply of electricity customers need, the utility needs to build a new power plant or find other means of generating electricity.

Keep Activity Guide | Theme II: Developing Energy Resources | Energy Debate

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Hand out copies of "The Energy Debate: Which Resource is Best?" for discussion. Throughout this project, stress that this exercise is not a contest or competition. The primary objective is for all students to learn facts about each resource’s advantages and disadvantages. Accurate portrayal of the content as well as effective use of persuasive arguments should be emphasized.

Steps
1. Introduce students to project objectives, evaluation criteria, and time considerations; share and discuss the Project Components for the two phases of this project. Students can add their own criteria to the list.

Remind students that the proposal and presentation are their own, but you will help them clarify their content or the main points in their argument as needed.

2. Divide the class into groups and assign each group an energy resource. Energy Resources Fact Sheets in the Student Book have been provided on the following resources: solar, wind, oil, coal, natural gas, hydropower, nuclear energy, and biomass fuels. Because of time limitations, it may be best to have the class focus on four to six of these resources. However, alternate resources can be added to the list if desired.

An alternative to assigning each group one resource is to have them select their own. Randomly assigning resources may avoid disputes among groups, but students may be concerned if they have to represent a resource they do not care for. Tell students there will be opportunities to express their resource preference. Stress the benefits to knowing what the “other side” thinks. Explain that understanding the strengths and weaknesses of alternative viewpoints provides ammunition that can be used to enhance the argument they support. If students feel strongly for or against a resource, it may be best to allow them to choose which resource they want to represent.

Group size will depend on the number of resources chosen, class size, and the extent of the research. Four students in a group is usually the most manageable and productive. This exercise can also be an individual project, but group work allows students to share responsibilities and learn to work cooperatively.

3. Identify the different responsibilities of the group project, and have the groups meet to assign roles; a variety of tasks must be accomplished to make this project successful. These responsibilities are included on The Energy Debate: Which Resource Is Best? handout. Recommendations for the number of students needed for each task are included in the description of the responsibilities. Below are additional considerations for planning the presentation.

Panel Members: The panel (people who listen to each group’s presentations and decide which resource to use) can be composed of teachers, students, or a combination. The students can be from another class, a separate group within the class, or can be composed of one member from each energy resource group. If the panel is formed as a separate group at the project’s onset, make sure they have things to do while the other groups are preparing their presentations (see “Preparing the Panel” below). This is especially true if the groups have a week or two to prepare. If the panel consists of a student from each energy resource group, it can be formed the day before the presentations.

Moderator for the Presentation: The moderator can be one of the panel members or you can take this role. The moderator monitors the discussion and makes sure presentations keep within time limits. Group members and panelists must be instructed not to speak unless acknowledged by the moderator. The moderator also keeps the discussion moving. If argument of trivial points continues for an extended period,
the moderator simply asks that the participants proceed to another point (e.g., "I think we've exhausted this issue; let's go on to another"). One problem with you serving as the moderator is that students may be tempted to address you rather than each other during the debate (see "Your Role" below).

4. Allow groups to meet to complete the necessary research and prepare their proposals and presentations (following instructions on Project Components Activity Sheets). One of the first things groups should do is decide their research strategies. If you plan to use activities within KEEP's Activity Guide or other resources, share the agenda with students to make them aware which concepts will be addressed when.

Encourage students to complete The Project Proposal Form near the beginning of the information-gathering phase. Plan a brief meeting with each group to help them clarify their presentation ideas. Point out the strengths of the draft proposal first. Then identify shortcomings and possible alternatives. This is also a good time to discuss strategies for gathering additional information about their resource and to correct any misinformation (See Energy Resources Fact Sheets, in the Student Book). Have students revise The Project Proposal Form as needed.

5. Conduct the presentation/debate: The actual presentation (debate-oriented discussion) can be set up in any fashion. One suggested format is found on the Project Components for the Proposal Presentation/Debate Phase. If this option is used, make sure the groups understand the procedures on this sheet.

Time Allotments: Prior to handing out the Project Components for the Proposal Presentation/Debate Phase sheet to students, figure out how much time will be needed for the presentations and for questions and answers. Suggestions for dividing up the time are provided. Most likely more than one class period will be needed.

Preparing the Panel: A day or two before the presentation, organize a group of Panel Members (see Panel Members under responsibilities of the group project, Step 3). The panel should develop questions they want to ask each of the groups. They can be asked to complete other tasks such as drafting a protocol for presentations, establishing guidelines for decision making, or developing a rating scale. It is important that the panel takes their role seriously, because they will set the atmosphere for the discussion.

Setting the Stage: Treat the actual day for the presentations as significant. Students can be encouraged to dress formally. Set up the room so that each group has a specified location, and make name tags or placards. The panel should be positioned so that they can see each group.

Your Role: Let the students see that you are keeping copious notes during the presentations, but keep a moderately low profile. Avoid having the participants direct their remarks to you. Instruct speakers to steer statements to the panel or other groups. If, after this instruction, participants continue speaking to you, avoid eye contact with them by looking down. They will gradually direct their comments elsewhere.

6. Make the Decision: After the presentations, allow the panel an allotted amount of time to make a decision. They should also develop a formal statement explaining the rationale for their choice. Depending on class time and structure, groups can be allowed to ask clarifying questions about the panel's decision, rationale, or both.
Closure
Following the decision, provide feedback to the groups and the panel. Most of this feedback should be positive and specific, in order to shape future discussions. Negative comments should be avoided, but can be given as a general comment for the entire class. The feedback period is an appropriate time to correct any misinformation presented. If the students prepared adequately and you met with them prior to their presentation, misinformation will rarely be presented; however, if it does happen, it should be corrected in a matter-of-fact manner.

Throughout this process, help students to understand that there is not a clear "winner" when it comes to choosing a resource. Chances are the panel had difficulty choosing one resource because each resource has advantages and disadvantages. Ask them to share their decision-making processes and challenges with the class.

Assessment
Formative
• Did students work together cooperatively in groups?
• What strategies did they use to gather information about their resource?
• How seriously did they prepare for the presentation/debate?

Summative
• Have the class create a bulletin board or display providing facts about how each resource is developed, and summarizing advantages and disadvantages.
• The Evaluation Criteria sheet provides agree/disagree scales to evaluate the groups’ research, organization, and the presentation/debate.

The Energy Debate: Providing Insight for Future Investigations. During this project, students probably discovered various issues related to resource development and use. Encourage students to make note of these for future investigation. Specifically note issues addressed by activities in the themes “Effects of Energy Resource Development and Managing Energy Resource Use.”

Credits:

The procedure for this activity based on Using Taking Sides In the Classroom: Methods, Systems, and Techniques for the Teaching of Controversial Issues. Copyright © 1987 by the Dushkin Publishing Group, a unit of Brown & Benchmark Publishers, a division of Times Mirror Higher Education Group, Inc., Guilford, CT 06437. Reprinted by permission. Taking Sides® is a registered trademark of the Dushkin Publishing Group.
Introduction
You have just learned of a hypothetical but possible scenario about choosing an energy source for a new power plant or other means of generating electricity. You will be working in groups, where each group represents a firm that develops a particular energy resource for electricity generation. Your task is to convince the utility that your energy resource is the best choice for generating electricity. If your proposal is accepted, the utility will build a power plant or other means of generating electricity that uses your energy resource. Fulfilling the proposal will meet the needs of the utility’s customers, and your group will live comfortably for the rest of your lives on the profits you will earn.

Purpose of Project
The purpose of this project is for your group to design, present, and defend a proposal that states why a certain energy resource is ideal for generating electricity. Ultimately, the purpose of this project is for you to learn the basic facts and advantages and disadvantages of each energy resource.

Group Responsibilities
To complete this project, there are various tasks that need to be accomplished. The two main tasks are (1) gathering and organizing information about an energy resource (see Project Components for Research and Preparation) and (2) designing and conducting a presentation (see Project Components for the Proposal Presentation/Debate Phase). The group can work together on each responsibility or certain group members can be made accountable for specific tasks. The following is a description of suggested titles and responsibilities for group members.

Organizer
The Organizer should be one student, with an assistant if the group size permits. The Organizer is the group leader. She or he works with the Researchers to decide what additional information needs to be gathered and meets with the Presenters to develop the proposal and presentation. The Organizer is also responsible for maintaining communications between the Researchers and the Presenters. It is recommended that a filing system, such as an “Energy Learning Log,” be developed to record and organize the researched information. Your teacher will inform you if this approach is to be used.

Researchers
One or two students will be responsible for locating and recording information needed. Their aim is to provide the Presenters with important information they can use to support the proposal. The bulk of their research will focus on their assigned or chosen resource; however, they should also obtain information about the other resources. See Project Components for Research and Preparation for more details about job responsibilities.

Presenters
One to three students will be Presenters. At least one student should work closely with the Organizer and Researchers to design the presentation, making sure it is thorough, accurate, and well-organized. One student can be assigned to prepare speaker-support materials such as charts, graphs, and photographs. See Project Components for the Proposal Presentation/Debate Phase for more details about job responsibilities.
The Presenters have specific responsibilities during the actual presentation:

One student, the Prover, announces the group’s proposal and provides supporting information. This student must present relevant research to back up the statements made in the proposal. She or he must have good knowledge of the resource. The Prover may have prepared notes but should be advised that the presentation is a conversation, not a reading experience.

A second student, the Challenger, is responsible for leading the arguments against the other groups. His or her research may be limited to reading the Energy Resources Fact Sheets on other resources, but he or she will be required to listen well, think on his or her feet, discern logical flaws and opinions that are disguised as facts, and question the empiricism of quoted materials.

Panel Members
The Panel Members represent planners from the utility who listen carefully to the groups’ presentations and decide which energy resource should be used to generate electricity. See The Proposal/Presentation Recording Sheet for keeping track of the advantages and disadvantages of each resource. The panel should meet to discuss this sheet and decide if it should be adapted to evaluate other aspects of the presentations (see Project Components for the Proposal Presentation/Debate Phase).
The Project Proposal Form

Instructions
Complete The Project Proposal Form and meet with the teacher to discuss research and presentation plans and strategies.

Proposal Statement

Overview of Presentation

Description of Diagrams, Charts, and Graphs Supporting the Energy Resource

Prepared Questions about Other Resources

Anticipated Questions Posed by Other Groups, and Answers to Those Questions

Optional: The true opinion of your group or group members about the use of the resource in a power plant.
Instructions
To help you create a comprehensive and organized presentation, you'll need to know your facts. You will also need a system to quickly locate facts during the presentation. A carefully developed filing system, such as an “Energy Learning Log,” will serve as a vital resource for your presentation. Your teacher will inform you if “Energy Learning Logs” will be used.

Gathering Facts
Carefully read the Energy Resources Fact Sheet for your resource. Use the Energy Resources Fact Sheet and your prior knowledge to address the project components listed below. Decide what additional information needs to be gathered (this includes information needed to answer questions not addressed in the Energy Resources Fact Sheet and other references that can confirm answered questions). Some of the information you need to know about your resource may be presented during class activities. Researchers need to pay close attention to these activities and record relevant information. Sources for information about your energy resource include: class activities, encyclopedias, interviews, your local utility, journal articles, letters, newspaper articles, reference books, surveys, and trade books.

Organize Researched Information
A filing system, such as an “Energy Learning Log,” can be divided into sections based on the project components listed below. The system can include notes, diagrams, data tables, etc. NOTE: Always cite your information source and compile a bibliography, including relevant class activities. Your teacher will tell you how detailed the bibliography should be, but you will most likely need to cite the author, title, and date of publication. If the source is an interview or letter, state the person’s name and title.

Project Components
Basic Background Information about the Resource
• Type of energy resource
• Where it can be found
• Where (geographically) the energy resource is currently used to generate electricity
• Reserves: how long supplies will last
• End uses other than generating electricity

Overview of What Electricity Is and How the Resource Is Developed for Electricity Generation
• How the resource is obtained
• How the resource is processed
• Transportation considerations
• What type of power plant or other means of generating electricity is needed

Reasons Why the Resource Is Preferable to Other Resources
• Advantages of the energy resource
• Costs of producing electricity
• Disadvantages of other resources

Reasons Why the Resource Is Not Preferable to Other Resources
• Disadvantages of the energy resource
• Environmental impact
• Advantages of other resources
Instructions
Following are the components of the proposal and presentation/debate phase. Your teacher will give you time allotments and tell you if there are any variations to this format. Keep careful notes on other presentations. During the discussion, be considerate of each other. Attacks should not be made on personal attributes of the participants but on the merits of the prepared presentations and the ideas put forth on the issue. Speak only when called upon by the moderator. Pay attention to the time and HAVE FUN!!

Project Components
The proposal and presentation/debate consists of five stages:

1. Announcement of the Proposal (Prover)
2. The Presentation (Prover)
3. Clarifying Questions (asked by Panel Members, answered by Prover)
4. Free-Form Discussion/Debate (Challenger and Prover)
5. Position Restatement and Conclusion (Prover)

Announcement of the Proposal
In the first stage, the Provers announce the proposal for their group. Each student should complete her or his announcement within one minute.

The Presentation
In the second stage, the Provers use their presentation to clarify the position of their group. The presentation should concisely and creatively cover the researched project components. The main emphasis of the presentation should be why the group’s resource is the best for the utility. The time allotted for your presentation will depend on the number of groups and the total time available for this activity (approximately a third of the total time allotted for the entire presentation/debate).

Time allotted for each presentation: ___________

Clarifying Questions
At the end of the presentation stage, the panel can ask clarifying questions. These questions are answered by the Prover with assistance from other group members. Depending on time, the groups may ask clarifying questions of each other. It is important to understand what is meant by a clarifying question. The purpose of these questions is to ensure a clear understanding. Clarifying questions are often phrased as

“What do you mean by...”
or
“Are you saying that ...”

Questions that challenge or argue a point should be reserved for the Discussion/Debate stage. However, this phase allows each group to begin pinning down the other group as to the specifics of their position. Time allotted for these questions is usually quite short, perhaps five minutes.

Time allotted for questions: ___________

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Energy Debate | theme II: developing energy resources | KEEP Student Book
**Discussion/Debate**

During this stage, the groups question each other, looking for strengths and weaknesses in each others' arguments and citing disadvantages of other groups' resources. Most of the questions asked will be put forth by the Challengers. The Prover is responsible for answering most of the questions. The rest of the group should be available to coach and back up these speakers. The panel interjects questions as needed. Their questions are designed to help them make a decision rather than find fault. They may want to ask one or two questions that all groups should answer. Allow about half of the total time for the presentation/debate session for this stage.

Time allotted for discussion/debate: __________

**Position Restatement and Conclusion**

During this last stage, the Provers restate their proposal. Proposals may be revised to reflect outcomes of the discussion. Again, each group is allowed about one minute.
The Proposal/Presentation
Recording Sheet

Group Name

Energy Resource Represented

Summary of Proposal

Facts about Resource

Advantages of Resource

Disadvantages of Resource

Other Comments

Each panelist will need one copy of this form for each group presenting.
If the groups are using this form, they will also need one copy for each group presenting.
Objectives
Students will be able to
• provide an overview of the theories behind global climate change;
• identify at least two different viewpoints about global climate change; and
• write an objective paper about the opinions of different people involved in the global climate change debate.

Rationale
Differing opinions about an environmental problem make the problem an issue. The issues concerning global climate change are frequently in the news. Encouraging students to investigate all sides of this issue (or any other that results from our energy use) helps them to make objective and thoughtful decisions.

Materials
• Copies of the following from the Student Book:
  - Some Basics about Global Warming and Climate Change, page 231 (optional)
  - Global Climate Change Viewpoint Form, page 233
• Copies of the Resources for this activity (optional)

Background
“It now seems probable that human beings have succeeded in achieving a momentous and unwanted accomplishment—inadvertent alteration of the planet’s climate.”

T. R. Karl
Senior Scientist, NOAA’s National Climactic Data Center

“Given the history of such environmental scares—over all of human history—my guess is that global warming is likely to be another transient concern.”

Julian L. Simon
Economist, University of Maryland

“The risks of climate change pose the most critical and pervasive environmental threats ever to the security of human community and to life as we know it.”

Kofi Annan
UN Secretary General

“A crucial point gets lost in the debate: Global warming, if it were to occur, would probably benefit most Americans. Even if the pessimists are right and it would, on net, harm Americans, the curse of capping the greenhouse gas emissions would be much worse. . . . Global change is inevitable; warmer is better; richer is healthier.”

Thomas Gale Moore
Senior Fellow, Hoover Institute

These are just some of the viewpoints surrounding the issue of global warming. One can find varying viewpoints around just about any issue, including those that result from energy use. People have varying viewpoints because they or the organizations they represent have different values and perspectives regarding resource management.

To better understand environmental issues such as global warming, it is helpful to analyze the viewpoints surrounding the issue. Investigating the viewpoints involves research, observation, and critical thinking skills.

The global warming debate has been in the news for several years and has been the focus of international conferences. Initially, the debate focused on projected outcomes of an enhanced “greenhouse effect” (accelerated increases of carbon dioxide and other gases to the atmosphere). Some scientists projected marked increases in global temperatures, while others thought there would be little effect. Today, there is general acceptance that greenhouse gases will affect global climates, but disagreements continue about how imminent and extreme the changes will be. This disagreement leads
Greenhouse Misconceptions

There’s a hole in the ozone and the sun shines through the hole and heats the air. This is one of several misconceptions associated with the greenhouse effect and global warming. Many students think that our planet is heating up because too many of the sun’s rays were reaching Earth. One of the biggest obstacles to understanding the greenhouse effect is its name; the image of greenhouse glass probably attributes to students envisioning a layer of gas that traps solar heat. However, given that is unlikely for the name to change, educators need to take the extra steps to ensure students are able to differentiate between the greenhouse effect as it relates to the atmosphere versus the building structure designed to facilitate plant growth. Prior to studying the greenhouse effect, global warming, or the ozone layer it is important to elicit student ideas. After assessing students’ current conceptions, teachers can help students to understand that greenhouse gases are part of the atmosphere that blankets the planet, rather than a layer of gases way up in the sky. Understanding that we are surrounded by greenhouse gases and that these gases absorb the sun’s heat can also help students appreciate how the atmospheric effect (more popularly known as the greenhouse effect) keeps our planet warm and sustains life.

to debates on how societies should alter their energy use practices to reduce greenhouse gases or if more research is needed before actions are taken (see “Going on a Carbon Diet” in the Extensions for an overview of actions individuals can take to reduce their atmospheric contributions).

Some Basics about Global Warming and Climate Change is a fact sheet developed by the Wisconsin Energy Bureau. This background information serves as a foundation for further investigations regarding different viewpoints that surround global climate change.

Procedure

NOTE: This activity focuses on the issues surrounding global warming or climate change. The activity can be adapted to investigate any environmental issue.

Orientation

Write the words global warming on the board and ask students what they have heard or know about this topic. Note their responses. Underline any comments that relate to energy use.

Survey students to ascertain their opinions about the subject. Ask students if they think there is agreement about the existence, cause, and effects of global warming. Help students to understand that there are disagreements about this problem and they are going to learn about the varying viewpoints.

Provide students with a basic understanding of global warming and climate change. (See Some Basics about Global Warming and Climate Change; lecture on basic points or have students read on their own. See “Read and Explain Pairs” in the Appendix for a cooperative reading strategy.) Make sure students understand that the “greenhouse effect” itself is necessary to maintain temperatures that sustain life (see Greenhouse Misconceptions).

Tell students that there is scientific consensus that the amount of carbon dioxide and other greenhouse gases in the atmosphere is increasing. There is increased acceptance that this increase will affect our climate. However, there is not agreement on what this change will be. Many scientists prefer the term global climate change because this expression encompasses many of the effects, including warming, that could result from increased greenhouse gases in our atmosphere. Even when there is agreement about what kind of climate change may occur, there is disagreement about the gravity of the change and whether the benefits of slowing the change will outweigh the associated costs.

Steps

1. Tell students that they are going to investigate different people’s opinions about how we should respond to the possible results of an enhanced greenhouse effect. The responses may vary from “nothing; there isn’t a problem” to “implement federal regulations that limit the use of automobiles in urban areas.”

2. Discuss sources where students can find more information about global climate change. Students should mention the Internet, journal articles, news reports, and books. Invite the school librarian to speak to the class about researching information. See Resources for a limited list of publications; see the KEEP Web site for links to global climate change pages.

3. Have students work in pairs or groups of three to investigate the various viewpoints.
involved in this issue. The groups can designate responsibilities for each member. For example, one student can be responsible for looking at Web sites and newspapers. Another student can research journal articles and books. Students can use various strategies to research viewpoints. Following is one approach:

- Each group should find at least six sources of information on global climate change (or global warming). Allot about a week for students to research the information. Out of class assignments may be necessary.
- Ask the group to select two sources to investigate further. At this time, they can share their choices with you to make sure a diversity of resources is being investigated.
- Have students use the Global Climate Change Viewpoint Form to summarize their findings. Review the different parts of the form. The "Viewpoint" is a one-sentence summary that succinctly states the author's opinion. Students should use "Additional or supplementary information" to explain the reasoning or background behind the viewpoint. Ideally, students should cite scientific facts that were referenced within the source. The "Source" includes reference information to help the reader find the information, but it also identifies who authored the resource. (Knowing if the author is a member of a certain organization or receives funding from a particular agency can provide insight into motivations or influences behind the viewpoint presented).
- Everyone in the group should read all the sources, but each group member can be responsible for drafting the Global Climate Change Viewpoint Form for one of the sources. They should then meet as a group and share their work and edit and revise the form together.

4. After the groups have investigated at least two different sources of viewpoints about global climate change, have each group present their findings to the class.

5. When students finish their presentations, have them post the Global Climate Change Viewpoint Form on the wall. Challenge the class to group similar or related viewpoints together. They can create a chart similar to

Resources:


"Climate Change: Can we meet the Challenge?" (Special Issue). Green Teacher — Education for Planet Earth 51 (Spring 1997).


“Turning Up the Heat: Global Warming and Climate Change” (Special Issue). EE News. Environmental Education in Wisconsin 14, no. 3 (Spring 1998).


---

<table>
<thead>
<tr>
<th>Viewpoints that think there is not a problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viewpoints that state we may benefit from climate change</td>
</tr>
<tr>
<td>Global Climate Change</td>
</tr>
</tbody>
</table>

the one above, where "Global Climate Change" is in the center and the viewpoints are grouped around the center.

**Assessment**

**Formative**
- Did students use effective research strategies to identify a variety of different viewpoints about global climate change?
- By reading students' Global Climate Change Viewpoint Forms, can the reader quickly understand the viewpoint of the source?
- Were students able to group similar viewpoints together?

**Summative**
- Have students write an informative article about global climate change and the various viewpoints involved. Encourage students to be objective and not to favor any viewpoint. Discuss the challenges with developing a paper of this format and the strategies they use to remain impartial. They can submit the article to the school newspaper or their local paper.

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**Closure**

Have students summarize the various opinions presented in the Viewpoints diagram. Were they aware of these different viewpoints before they conducted this research? Why do students think there are varying opinions?

Ask students to present their own viewpoints (compare to the survey conducted in the Orientation). Do they find themselves agreeing with one or more of these viewpoints? Generate a list of questions about what else they would like to know about the greenhouse effect before they form an opinion. See Extensions for suggested approaches to further investigate the viewpoints.

Have students examine their energy use in relation to carbon dioxide production (their "carbon diet"). See Extensions for suggested approaches to further explore this issue.
Extensions

The Viewpoints diagram can be used by the class for a variety of future investigations. Following are a few ideas:

- Assign values to the varying viewpoints. See Value Descriptors in the Student Book on page 241.
- Research the organizations or writers who authored the sources. Contact the organizations and ask for copies of the mission statement, board of directors, and other projects. How might the philosophy or values of the organization influence its viewpoint?
- Analyze the various viewpoints for bias and fairness. Do the authors represent certain organizations? What are their backgrounds? Do the authors' viewpoints favor a certain political or economic philosophy? What data do the authors reference to support their views? Did they collect the data themselves or reference other sources? What are these sources (government organizations, private groups, research agencies)? Does the data support the authors' viewpoints? Could there be more than one interpretation?

Climate Change in the Past

This Long-Term Variations of Global Temperature and Atmospheric Carbon Dioxide graph was created from readings from a 10-centimeter-wide, 2,083-meter-long ice core from Vostock, Antarctica.

What relationship do students see between CO₂ concentrations and temperature change? The current atmospheric CO₂ level is 360 ppm, (compared to the 275 ppm recorded by the ice core for the year 200 AD). What do students think about this current increase compared to 1700 years ago? What other questions can students generate about this graph?

Long-Term Variations of Global Temperature and Atmospheric Carbon Dioxide


**Related KEEP Activities:**
Prior to this activity, you may want to have students explore sources of greenhouse gases. Some of these emissions are described in "Dirty Half Dozen." "Energy Efficiency Measures" provides ways to save energy (and produce less carbon). Students can use strategies in the activity "Energy Futures" to investigate various scenarios of climate change.

### Observed (Actual) Global Average Temperature Change

<table>
<thead>
<tr>
<th>Year</th>
<th>Changes in Global Average Temperature (degrees Celsius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1890</td>
<td>0.00</td>
</tr>
<tr>
<td>1900</td>
<td>0.18</td>
</tr>
<tr>
<td>1910</td>
<td>0.20</td>
</tr>
<tr>
<td>1920</td>
<td>0.22</td>
</tr>
<tr>
<td>1930</td>
<td>0.43</td>
</tr>
<tr>
<td>1940</td>
<td>0.54</td>
</tr>
<tr>
<td>1950</td>
<td>0.48</td>
</tr>
<tr>
<td>1960</td>
<td>0.43</td>
</tr>
<tr>
<td>1970</td>
<td>0.40</td>
</tr>
<tr>
<td>1980</td>
<td>0.55</td>
</tr>
<tr>
<td>1990</td>
<td>0.56</td>
</tr>
</tbody>
</table>

**Graph of Atmospheric CO₂ Concentrations**

[Graph showing atmospheric CO₂ concentrations from 1890 to 1990]
Temperature and Carbon Dioxide
Find out if there is a connection between global temperature changes and carbon dioxide concentrations in the atmosphere. Plot the actual average global temperature data from the table on the previous page onto the CO₂ graph. Draw a line connecting the data points graphed. Ask students to examine the data carefully. Does the data support the conclusion that increasing CO₂ emissions are responsible for the temperature increase during the past 110 years? What are some other phenomena (natural and human-made) that might explain the increases in temperature? What other information do they think they need to answer these questions?

Going on a Carbon Diet
The increase in greenhouse gases is related directly or indirectly to energy use. We often talk about climate change, however, without acknowledging that any strategy to slow climate change might require us to change our energy use behaviors. If their electricity comes from a power plant that burns coal, they need to consider use of many appliances as adding greenhouse gases to the atmosphere (an approximate value is that every kilowatt-hour of electricity produces 1.6 pounds of CO₂). Help students adapt the calculations from the activity "At Watt Rate?" to interpret results in terms of carbon rather than dollars. If they ride in or drive a car they are directly involved in adding carbon gases to the air. What activities would they be or not be willing to cut back on to help reduce their carbon diet? (See Action Ideas: "Energy Efficiency Measures" in the Energy Sparks section for a list of ideas.)

Credits:
Some Basics about Global Warming and Climate Change adapted from Wisconsin Energy Bureau, P.O. Box 7868, Madison, WI 53707.

The procedure for “Viewpoints” is adapted from “Perspectives” pages 397-399 in the Project WET Curriculum and Activity Guide. Bozeman, Mont: The Watercourse and the Western Regional Environmental Education Council, 1995.


Greenhouse Effect, Global Warming, Climate Change: What do these terms mean?
For most of human history, changes in the earth's climate resulted from natural causes that usually took place over hundreds or thousands of years. But today, human activities are beginning to affect our climate in serious and immediate ways, intensifying the "greenhouse effect."

The greenhouse effect is the natural phenomenon that keeps the earth at the right temperature for life to flourish. The sun's enormous energy warms the earth's surface and its atmosphere. As this energy radiates back toward space as heat, a portion is absorbed by a delicate balance of heat-trapping gases in the atmosphere, among them carbon dioxide, which creates an insulating layer. This insulating layer functions much like the glass windows of a greenhouse and elevates temperatures here on earth. Without it, the earth could not sustain life.

Human contributions to greenhouse gases have led to an "enhanced greenhouse effect" often referred to as global warming. As the concentration of greenhouse gases grows, more heat is trapped by the atmosphere and less escapes back into space. This increase in trapped heat alters atmospheric processes and their interaction with the oceans and the land. The climate, the product of that interaction, changes as well, causing altered weather patterns that bring unexpected rain or dry spells; sudden, severe storms; and temperature changes. The term climate change is used to describe this interconnected chain of events.

What causes climate change?
Scientists have concluded that human activities are contributing to climate change by adding large amounts of heat-trapping gases to the atmosphere. Our fossil fuel use is the main source of these gases. Every time we drive a car, use electricity from coal-fired power plants, or heat our home with oil, we release carbon dioxide. Since preindustrial times, the atmospheric concentration of carbon dioxide has increased 32 percent from about 275 ppm to 364 ppm (in 1997).
Over that same period, the amount of atmospheric methane, a potent greenhouse gas, has risen 145 percent. Sources of methane include agricultural activities and decaying garbage in our landfills. If emissions of greenhouse gases continue to grow, carbon dioxide concentrations will approach twice their preindustrial level by the end of the twenty-first century.

How do we know it's happening?
Temperature is one sign of global climate change. The ten warmest years this century have occurred since 1980. However, temperature is only one indicator. Studies show that during the last century an increase in precipitation worldwide has also occurred. These two phenomena—along with a decrease in the amount of snow that covers the northern hemisphere, a simultaneous decrease in Arctic sea ice, continued melting of alpine glaciers, and a rise in sea level—are all consistent with global warming.

How much warmer is our Earth likely to become?
The 1995 report from the Intergovernmental Panel on Climate Change projects that Earth's average temperature will increase 1.8 degrees to 6.3 degrees Fahrenheit in the next 100 years. This increase is in addition to the increase of 0.5 degrees to 1.1 degrees Fahrenheit that has already occurred since 1880. Scientists predict that even if we stop emitting heat-trapping gases now, the climate won't stabilize for many decades because of the gases we've already sent into the atmosphere.

Would a temperature increase of one or two degrees really change the global climate?
Even a modest rise of temperature could have dramatic effects. In the last 10,000 years, Earth's average temperature hasn't varied by more than 1.8 degrees Fahrenheit. Temperatures only 5 degrees to 9 degrees Fahrenheit cooler than those today resulted in the last Ice Age, in which the Northeast was covered by one kilometer of ice.

Even though a 2 degree to 3 degree Fahrenheit increase may not seem like a lot, this temperature rise is happening at the most rapid rate of change in recorded history. It is this rapid rate of change that people, plants, and animals may not be able to adjust to.

An increase of a few degrees won't generally make for pleasantly warmer temperatures around the globe, either. Some regions may be affected more than others. Some may receive less rainfall, with severe impacts on agriculture and forests. Others may lose coastal wetlands through rises in sea level. Agriculture in low-lying areas, such as along the Mississippi River, could be severely affected by floods. Scientists predict that continued global warming is likely to result in

- a rise in sea level between 6 and 37 inches and consequent coastal flooding;
- severe stress on forests, wetlands, and other ecosystems;
- damage to human health as mosquitoes and other insects spread diseases over larger geographical areas; and
- disruption of agriculture through changes in temperature and water resources.

What is the best source of scientific information on climate change?
In 1988, the United Nations Environment Programme and the World Meteorological Organization set up the Intergovernmental Panel on Climate Change (IPCC) to examine the most current scientific information on global warming and climate change. More than 2,500 of the world's leading climate scientists, economists, and risk-analysis experts from 80 countries contributed to the panel's most recent report, Climate Change 1995: The IPCC Second Assessment Report. These scientists worked together to determine what this information indicates about the global climate and about the impact of human actions on it. In this report the panel concluded that "the balance of evidence suggests that there is a discernible human influence on global climate."
Global Climate Change Viewpoint Form

Viewpoint
Write a one or two sentence summary of the information in this source.

Additional or supplementary information

Source
Author or organization:
Title (of article or webpage):
Title of book or journal:
Date:
Other reference information (Web site address or volume number):
Objectives
Students will be able to
• identify factors that influence home and business owners to use renewable energy; and
• discuss the pros and cons of using renewable energy resources to meet current and future energy needs.

Rationale
Interpreting reasons why people choose to use renewable energy enhances student abilities to make their own energy choice decisions.

Materials
• Copy of the Renewable Energy Influences Chart (optional)
• Copies of the following pages from the Student Book:
  - Contacting and Interviewing Home and Business Energy Users, page 250
  - Sample Survey for Renewable Energy Home or Business Owners, page 252
  - Analyzing the Results of Interviews, page 253
  - What Home and Business Owners Have to Say about Using Renewable Energy, page 254 (optional)

Background
A growing number of people in Wisconsin use the sun to heat their homes and businesses at night. How can this be? Are they able to make the sun shine at night? No. Many of these home and business owners have houses and buildings that are designed to store the sun's heat during the day and reradiate it throughout the evening. Other homes and businesses burn firewood. Wood contains stored energy from the sun (trees convert solar energy to chemical energy through the process of photosynthesis). Some homeowners and business owners use sunlight to generate electricity, or they may use the wind, which is a renewable energy resource created by the sun.

that are constantly replaced. Examples of renewable energy resources that are used for home heating and electricity include solar, wind, biomass (wood), and hydropower (falling water). In Wisconsin, about four percent of the energy consumed by residents comes from renewable resources; most of this energy (80 percent) is from wood, and the rest is solar. For information on each of the renewable energy resources and how they can be used in homes and businesses, see the Fact Sheets in Student Book. Many factors influence people to choose renewable energy resources. The Renewable Energy Influences Chart identifies several of these influences.

Today's technological advancements have developed more efficient means of harnessing and using renewable energy sources, and these sources are gaining increasing popularity. They offer us alternatives to nonrenewable energy sources, such as nuclear (which has safety and disposal issues), oil, coal, and natural gas (which can cause acid rain and may contribute to the overall warming of Earth's atmosphere known as the greenhouse effect). Existing renewable energy installations are making significant contributions to the U.S. energy supply, and research activities are demonstrating the far-reaching impact that a greater reliance on renewable energy sources could have on our country's energy security. In addition, ongoing and planned research offers still more possibilities.

Procedure
Orientation
Ask students to list energy resources used to heat and power their homes. If they say electricity, determine which energy resources are used to generate the electricity. Have students identify which resources are renewable and which are nonrenewable. Add renewable resources, such as solar energy, wind, and hydropower, to the list if they are not mentioned.
**Resources:**

For Teachers
American Solar Energy Society (ASES), 2400 Central Ave., G-1, Boulder, Colo., 80301. Phone: (303) 443-3130. Contact ASES about their national tour of homes that use renewable energy.


Midwest Renewable Energy Association (MREA), www.the-mrea.org. Contact MREA about a tour of homes that use renewable energy in Wisconsin.


Complementary Activities

Videocassette. A documentary on how Soldier’s Grove, Wisconsin, became a “solar town.”

For Students

Review or have students research different ways renewable energy is used in household heating and other activities (see Background).

**Steps**

1. Tell students that a number of homes and businesses in Wisconsin that use renewable energy resources as their primary energy source.

2. Ask students to list reasons why they think people chose to use renewable energy. To help students analyze information from within the *Renewable Energy Influences Chart* as well as from the *Values Descriptors* in the Student Book, page 241.

<table>
<thead>
<tr>
<th>Influence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Already in place</td>
<td>Uses renewable energy resources because the home or business already had renewable energy use apparatus when purchased.</td>
</tr>
<tr>
<td>Desire for independence</td>
<td>May not want to depend on a large corporation for energy.</td>
</tr>
<tr>
<td>Distance from utility</td>
<td>Decided to use renewable energy resources because it was impractical and unfeasible to travel any other way or to change something existing to buy more efficient equipment.</td>
</tr>
<tr>
<td>Economic</td>
<td>Argues that nonrenewable are cheaper because they are outdated. When the real costs and impacts of fossil and nuclear fuels are considered, renewables become much more expensive. Using renewable energy requires they spend more than those who use fossil fuel, but they become more cost-effective as long-term users improve.</td>
</tr>
<tr>
<td>Environmental and human health</td>
<td>Because Wisconsin imports 94 percent of its energy (petroleum, natural gas, coal, and nuclear fuels), advocates supporting the Wisconsin economy by buying technologies that use resources found in Wisconsin such as wood, water, wind, and sunlight.</td>
</tr>
<tr>
<td>Interest in technology</td>
<td>Maintains that fossil fuels pollute the environment and nuclear resources are dangerous.</td>
</tr>
<tr>
<td>Proximity of resource</td>
<td>Enjoys trying out new things and making changes to the structural and functional workings of his home or business.</td>
</tr>
<tr>
<td>Sustainable development</td>
<td>Uses renewable energy resource because it is available within the local environment that is, the proximity of a resource (such as wood on property to be used in a wood burning stove) makes it a good option.</td>
</tr>
<tr>
<td>Cultural/religious</td>
<td>Points out that nuclear and fossil fuels are nonrenewable, and will eventually run out. Believes with proper management and efficient use, renewable resources are essentially limitless.</td>
</tr>
<tr>
<td>Values</td>
<td>Desires maintaining the traditional way of doing things.</td>
</tr>
</tbody>
</table>
4. Hand out and discuss Contacting and Interviewing Home and Business Energy Users and Sample Survey for Renewable Energy Home or Business Owners. Decide if this project will be done in small groups or as a class. NOTE: If this activity will be repeated several years in a row, you may want to encourage students to locate new home and business owners each year. Ask the home or business owners if they mind being contacted yearly, or save the interview results from the first year to be used by students in the next class.

- If this activity is a class project, the whole class locates one business or home. In this case only a few students will be directly involved in finding someone to interview. Unless the whole class plans to take a field trip to the home or business, sending the home or business a survey in the mail may work better than having only one student conduct the interview. The class can work together to develop the survey and analyze the results.

- If this activity is a group project, each group should locate a different home or business to interview. Group members can be responsible for specific tasks. Duties include locating homes or businesses that use renewables, developing or adapting the survey form, contacting the home or business owner, and setting up and conducting the interview. The group should work together to analyze the results; however, one student can be chosen to present the results to the class.

5. Give students a deadline for contacting the home or business owners and conducting the interviews.

6. After the interviews are completed, hand out and discuss Analyzing the Results of Interviews. Have students use this activity sheet to analyze the results of the interviews. Closure

Revisit the Renewable Energy Influences Chart developed earlier in the activity. Have students present the results of their analysis, identifying which influences on the chart were most prevalent or how the chart needed to be adjusted to better represent what they learned.

Ask students if they would use renewable energy resources to heat or cool their home or business. Students’ reasons for their reasoning can be used to evaluate their understanding of the activity and assist students in choosing to use renewable energy resources (see Assessment).

Assessment

Formative
- How efficiently did students conduct and complete the interview?
- To what extent did students carefully analyze the results of the interview?

Summative
Have students predict the percentage of homes and business owners who will use renewable energy resources for heat and electricity 20 years from now. What about in 50 or 100 years? Students can defend their predictions in a debate.

Extension
Tap into national or statewide tours of model homes. Every summer, during the Midwest Renewable Energy Fair, the Midwest Renewable Energy Association conducts a tour of homes. The American Solar Energy Society organizes the National Tour of Solar Homes. See Resources for contact information.

Credits:

Related KEFP Activities:
The Activity "At What Rate?" can be used to orient students to the ways they use electricity in the home. In many parts of the country, activity students understand how most citizens in Wisconsin get their electricity and heat (see "Fuel That Power Plant," "Harnessing Nuclear Energy," "Electric Motors and Generators," and "So You Want to Heat Your Home?""). Other complementary activities include "Shoebox Solar Cooker" and "The Miracle of Solar Cells." Have students project the likelihood of more homes using renewable energy resources: through the activity "Energy Futures," Students can organize a tour of homes that use renewable energy or participate in an established tour. (Midwest Renewable Energy Association, www.themrea.org)
1. **Locate people in your community.** Your teacher may give you the name of a business or home owner who uses renewable energy resources, or you may already know of one. Otherwise, try contacting any of the following to get a list of people to call:
   - Chamber of Commerce
   - Realtors
   - Your local utility
   - Parents, other adults, and friends
   - One of the following organizations:

   - **Arrow Electric**
     280 E. Ferman Avenue
     Oshkosh, WI 54901
     (920) 426-4963

   - **Artna Renewable Energy**
     9784 County Road K
     Amherst, WI 54406
     (715) 824-3982

   - **Chamber of Commerce**
     7556 Deer Road
     Oshkosh, WI 54902
     (920) 437-7102

   - **Realtoirs**

   - **Your local utility**

   - **Parents, other adults, and friends**

   - **One of the following organizations:**

     - **Renew Wisconsin**
       222 South Hamilton Street
       Madison, WI 53703
       (608) 255-4044

     - **Midwest Renewable Energy Association**
       9784 County Road K
       Amherst, WI 54406
       (715) 824-3982

     - **Artna Renewable Energy**
       9784 County Road K
       Amherst, WI 54406
       (715) 824-3982

     - **One of the following organizations:**

       - **Tenney Sheltor Construction**
         3608 County Road ZZ
         Amherst Junction, WI 54406
         (715) 677-4289

       - **Lake Michigan Wind and Sun**
         1015 County U
         Sturgeon Bay, WI 54235
         (715) 743-0456

       - **Midwest Renewable Energy Association**
         9784 County Road K
         Amherst, WI 54406
         (715) 824-3982

       - **Renew Wisconsin**
         222 South Hamilton Street
         Madison, WI 53703
         (608) 255-4044

       - **Public Service Commission of Wisconsin**
         P.O. Box 7854
         Madison, WI 53707 7854
         (608) 266-5481

   2. **Develop the survey.** See *Sample Survey for Renewable Energy or Business Owners* for some ideas.
3. Contact the home or business owner. You can contact this person by making a phone call or by sending a letter. A phone call is more likely to provide an immediate response. Prior to contact, develop a script of what you will say. Following is a sample script.

Hello, my name is ___________. I'm calling from ___________ school. We are doing a project on renewable energy in our community. I was informed that your (home/business) uses renewable energy. Is this correct? (If yes, continue. If no, thank them for their time and hang up). I was wondering if you would be interested in being interviewed to help us learn why you use renewable energy. May I interview you?

If they say yes, either inform them of the type of interview you plan to conduct or ask if they prefer a phone interview, a face-to-face interview, or a survey through the mail. If they say no, thank them for their time and hang up.

Phone interview. If your plan is to conduct a phone interview, ask the person if this is a convenient time to continue with the survey questions. If this is not a convenient time, arrange a different time to call.

Face-to-face interview. If you plan to visit a home or business, you will need to make travel arrangements and necessary get directions.

Mail survey. If you conduct a mail survey, you will need to develop a cover letter to send with the survey (see Template for a Cover Letter for ideas.) You may want to call business or home owners first to secure cooperation. Rephrase the last sentence of the phone script as follows:

"Would you complete a short survey that we will mail to you about your (home/business)?"

If they say yes, confirm their address and thank them for their time. If they decline, thank them for their time and hang up.

Conduct the interview/survey. Speak clearly and slowly, take careful notes. You may want to ask permission to tape record the interview. Be considerate of their time. If this is a mail survey, provide the respondent with an envelope and a self-addressed, stamped envelope. Send a thank you letter within a week after the interview is completed or the survey is returned.

Template for a Cover Letter

Name of home or business owner
Address

Dear Mr. or Ms. _________:

We are surveying home and business owners who use renewable energy resources. The purpose of the survey is to learn why people choose to use renewables. We would appreciate it if you would complete and return the enclosed survey within the next two weeks (an envelope has been provided). If you have any questions or would like further information, do not hesitate to call. Thank you for your assistance; we look forward to your response.

Sincerely,

Your name(s)
Address
Phone number
Sample Survey for Renewable Energy
Home or Business Owners

Home or business owner's name: ____________________________ 
Address: ________________________________________________ 
Date of interview: ________________________________________ 

a) Which renewable energy resource(s) do you use in your home or business? Circle those that apply.

Solar:  
- Water heater
- Photovoltaic
- Passive solar design
- Other: ____________________________

Hydro:  
- Privately owned hydroelectric generator
- Other: ____________________________

Wind:  
- Windmill
- Other: ____________________________

Biomass:  
- Wood (space heating)
- Other: ____________________________

b) Why did you decide to use renewable energy resources in your home or business?

c) What, if any, adjustments to your lifestyle have you made to live/work comfortably in your home or business? Which do you like? Which do you find inconvenient?

d) How would you respond if someone said to you: “I’ve often thought about using renewable energy resources, but ____________________________”
(Fill in the blank with one or more reasons you’ve heard or can think of why people don’t use renewables. Then provide a response for each reason.)

e) Is there anything else you would like to add?

*Remember to thank the person for taking the time to answer these questions. If this survey is to be mailed, be sure to include a cover letter (see Template for Cover Letter) and to remove this and the previous sentence from their copy.
1. Was this person identified as a home owner, a business owner, or both? Is the identification correct? If not, in which group should the individual be placed?

2. Describe the community in which this person lives (large city, small town, rural, suburban, etc.).

3. Which renewable energy resource(s) does this person use?

4. What influenced the person to use renewable energy in their home or business? Try to match responses to influences listed in the chart. If necessary, add new categories to the list.

5. Compare these influences to results of other interviews conducted by class members or found in the What Home and Business Owners Have to Say about Using Renewable Energy handout. Summarize three main reasons that influence people to use renewable energy in their homes or businesses.

6. What do you think of these influences? How do they apply to you or your family?
Respondent number 1

a) Which renewable energy resource(s) do you use in your home or business? Check those that apply.

Solar:
- Water heater
- Photovoltaic
- Passive solar design
- Other: __________

Hydro: Privately-owned Hydroelectric generator
- Other: __________

Wind:
- Wind turbine
- Windmill
- Other: __________

Biomass: Wood (space heating)
- Other: __________

Other: __________

Why did you decide to use renewable energy resources in your home or business?

Environmental impact of energy choices.
Economic impact of energy choices.
Aesthetic impact of energy choices.

c) What, if any, adjustments to your lifestyle have you made to live/work comfortably in your home or business? Which do you like? Which do you find inconvenient?

We sometimes have to think about the consequences of our use choices which I think is good. I find it morally inconvenient to leave the responsibility for our consumer choices to succeeding generations.

8) How would you respond if someone said to you, “I’ve often thought about using renewable energy resources, but I can’t afford it.”

Because of our artificially low energy cost in the U.S., it’s likely that renewable energy is more affordable now than it will be in a future of diminished resources and increased population.
a) Which renewable energy resource(s) do you use in your home or business? Check those that apply.

Solar: Water heater
Photovoltaic
Passive solar design
Other: _______________________

Wind: Wind turbine
Windmill
Other: _______________________

Hydro: Privately-owned Hydroelectric generator
Other: _______________________

Biomass: Wood (space heating)
Other: Wood heated hot tub
Other: _______________________

b) Why did you decide to use renewable energy resources in your home or business?

1. Use of non-renewable energy sources causes air pollution, water pollution, acid rain, acid mine run-off, destroys animal habitats, and depletes the world’s resources.
2. Nuclear power is not a good alternative. We have no way to dispose of nuclear waste. It is dangerous and causes many human health problems.
3. The home that we bought did not have power wires running into it. This was the final incentive to put our beliefs into action by using solar cells to generate our electricity.

c) What, if any, adjustments to your lifestyle have you made to live/work comfortably in your home or business? Which do you like? Which do you find inconvenient?

1. We have switched to compact fluorescent bulbs for our lights. Since we supply all of our energy needs, we need to be as conservative as possible. These lights use one fourth the energy of regular bulbs. They put out the same amount of light—we like them.
2. We do not have an electric alarm clock by the bed. Instead we use one that runs on batteries. It works fine and never loses power.
3. We don’t heat the waterbed. Instead we layer blankets underneath the sheets. I miss the warm bed, but would have stopped using the heater anyway because of the Electric Magnetic Field (EMF) problem.
We heat the house with a wood stove in the basement. There are things that I like and dislike about this.

**Pros of using wood**
- Renewable resource.
- The heat feels good, not like forced air.
- Chopping and stacking wood is good exercise.

**Cons of using wood**
- There is a lot of dust and bark to continually clean up.
- Can't just turn up the thermostat when you are cold; need to work for heat.
- I feel bad about cutting trees, so I try to replant some each year to make up for my wood consumption.

**d)** How would you respond if someone said to you: “I’ve often thought about using renewable energy resources, but they don’t work in this climate.”

We get 100% of our energy (electrical) from our own power system. With the proper combination of P.V. cells and battery storage, you can make enough electricity to meet your household needs. If renewables don’t work in Wisconsin, then why am I able to do this?

**e)** Is there anything else you’d like to add?

Our use of oil, coal, and nuclear fuels is one of the major environmental concerns facing the planet. We have the technology to change to more environmentally friendly energy source. All we need now is the commitment of individuals, businesses, and the utilities.
Respondent number 3

a) Which renewable energy resource(s) do you use in your home or business? Check those that apply.

<table>
<thead>
<tr>
<th>Solar:</th>
<th>Hydro:</th>
<th>Biomass:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water heater✓</td>
<td>Privately-owned Hydroelectric generator</td>
<td>Wood (space heating)✓</td>
</tr>
<tr>
<td>Photovoltaic✓</td>
<td>Other:</td>
<td>Other: Masonry stove</td>
</tr>
<tr>
<td>Passive solar design✓</td>
<td></td>
<td>Other: Sun oven</td>
</tr>
<tr>
<td>Other: solar hydronic heating system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wind:</th>
<th>Other:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind turbine</td>
<td>Other:</td>
</tr>
<tr>
<td>Windmill</td>
<td>1000 watt wind generator</td>
</tr>
</tbody>
</table>

b) Why did you decide to use renewable energy resources in your home or business?

1. I am very much opposed to the use of nuclear power for electricity generation. When I built my house it was not yet clear if more nuclear power plants might be built and I did not want the addition of the electrical needs for my house to be part of an electrical utilities argument for the need for another nuclear generator.
2. I believe a responsibly cared for renewable energy home is easier on the environment.
3. It’s fun. I enjoy the process of making my home more energy efficient and environment friendly.

c) What, if any, adjustments to your lifestyle have you made to live/work comfortably in your home or business? Which do you like? Which do you find inconvenient?

When my electrical system was small, just 75 watts of Photovoltaics to charge a single pair of batteries, I was only able to use lights and a radio. I learned quickly to turn off any light I wasn’t using. At that stage and a couple years later when my system was large enough to handle refrigeration I became very aware of the weather, specifically sunny versus cloudy days. I tended to concentrate tasks that take electricity (laundry and vacuuming) to sunny days. I still do, but mostly out of habit now. With the addition of more P.V. panels and the wind generator I seldom worry about running low on electrical power now. In the wintertime, sunny days do still make a difference. On sunny days there is no need to add wood to the fire in the stove, the passive and active solar heating systems keep the house nice and warm.

d) How would you respond if someone said to you: “I’ve often thought about using renewable energy resources, but it is so expensive.”

Start small. Buy just a few P.V. panels instead of trying to replace all your utility energy with renewable energy - just replace some. Or, start with a solar water heater which will save you money in the long run. When building a new house using a passive solar design just makes sense and does not have to be more expensive than a traditional design.
Respondent number 4

a) Which renewable energy resource(s) do you use in your home or business? Check those that apply.

Solar: Water heater✔
Photovoltaic
Passive solar design✔
Other: 
Hydro: Privately-owned Hydroelectric generator
Other: 
Wind: Wind turbine✔
Windmill
Other: 
Biomass: Wood (space heating)✔
Other: 
Other: 

b) Why did you decide to use renewable resources in your home or business?

_Village ordinance that requires buildings in Solar Town receive at least 50% of heat from the sun._

c) What, if any, adjustments to your lifestyle have you made to live/work comfortably in your home or business? Which do you like? Which do you find inconvenient?

_None._

d) How would you respond if someone said to you: “I’ve often thought about using renewable energy resources, but it doesn’t work; there’s not enough sun in the winter.”

_I have used solar energy in my business since 1982. My system requires only one and one-half hours of sun and can be operated manually. I do have backup during periods of 30-50 degrees below zero._

e) Is there anything else you’d like to add?

_There is a group from the University of Illinois that comes out yearly to look over my building and system. I would be happy to talk with any group and show them my building plans, etc._

Wonder Bar and Grill
Soldiers Grove, WI 54655
Respondent number 5

a) Which renewable energy resource(s) do you use in your home or business? Check those that apply.

Solar: Water heater ✔️ Photovoltaic ✔️ Passive solar design ✔️ Other: ___________

Wind: Wind turbine ✔️ Windmill ✔️ Other: ___________

Hydro: Privately-owned hydroelectric generator ✔️ Other: ___________

Biomass: Wood (space heating) ✔️ Other: furnace

b) Why did you decide to use renewable energy resources in your home or business?

1. Our environment.
2. Our children.
3. Efficiency.

c) What, if any, adjustments to your lifestyle have you made to live/work comfortably in your home or business? Which do you like? Which do you find inconvenient?

This is a business. We have to adjust the temperature from the solar wall and woodstove so the food does not spoil. And we have to make sure we are not too cold or hot.

d) How would you respond if someone said the following to you: “I’ve often thought about using renewable energy resources, but it’s very expensive.”

Over the long run it pays, and the environment is spared to be passed on to our children and their children.

e) Is there anything else you’d like to add?

We have run this business on solar and wood for over twenty years. It’s been very rewarding.

KEEP Student Book | theme IV: managing energy resource use | Why Use Renewable Energy?
Objectives
Students will be able to
• define demand, supply, and equilibrium price and quantity;
• read, interpret, and draw graphs depicting demand and supply curves, and determine energy prices from these curves; and
• identify the conditions that cause a shortage or surplus of an energy resource.

Rationale
Investigating the relationship between the supply, demand, and price of energy resources helps students understand how energy prices are set, how different conditions cause prices to change, and how changes in energy prices affect the household budgets of Wisconsin citizens.

Materials
• Graph paper
• Blank overhead transparencies (optional)
• Markers (optional)
• Overhead transparency of Demand Curve for Gasoline, Student Book, page 225
• Overhead transparency of Supply Curve for Gasoline, Student Book, page 226
• Copies of Supply and Demand Activity Sheet, Student Book, page 227
• Copies of Ms. Sene’s Dilemma, Student Book, page 230 (optional)

Background
The corner service station posts a large sign that reads "$1.32 per gallon" for regular unleaded gasoline. A utility bill lists a rate of 5.9 cents per kilowatt-hour for electricity and 58 cents per therm for natural gas. An ad in a local newspaper offers firewood for sale at a cost of $85 per cord. Energy prices, like the prices of other goods and services, are pieces of information that tell people how much money they must pay for a certain amount of fuel or other energy source.

How are energy prices determined? Clues that help answer this question often come in the form of environmental and sociopolitical events associated with changes in energy prices. An unusually cold winter drives up the cost of heating oil, natural gas, and propane. An economic embargo against a foreign oil-producing nation is lifted, and gasoline prices decrease some months later. Events like these indicate how market forces cause changes in energy prices. From such changes, economists have discovered two fundamental relationships that describe how energy prices (and the prices of other goods and services) are set. These relationships are known as the laws of demand and supply.

The law of demand states that, other things being equal or constant, decreasing the price of a good or service increases the quantity of the good or service demanded by consumers. In other words, the price of a good or service is inversely related to the quantity demanded. For instance, if gasoline prices decrease, the quantity of gasoline demanded increases, and vice versa. This relationship can be demonstrated by showing drivers a range of gasoline prices and then asking them how much gasoline they would be willing to buy each week at each price. Drivers would likely respond by saying that the lower the price of gasoline, the more gasoline they would buy. This information can be summarized in a table called a demand schedule (see example chart on the next page) or on a graph called a demand curve (see Demand Curve for Gasoline). The law of demand holds true not only for drivers buying gasoline, but also for consumers buying any kind of goods or services, including other energy sources.

In some cases, the quantity of gasoline purchased by customers may not vary much with changes in gasoline prices. For instance, customers who must commute to school or work during the week may buy approximately the same amounts of gasoline over a certain range of prices. In these cases, the customers’ demand for gasoline is said to be inelastic. However, the quantity of gasoline demanded by customers will change if the range of gasoline prices is large enough. Many customers...
Resources:
For Teachers

Complementary Activities

Related KEEP Activities:
Several activities in this guide address the economics of energy development and consumption. Use "Energy Devalue" to introduce concepts found in this activity. "At Watt Rate" helps students understand how much energy they use. Follow this activity with "Reading Utility Bills," "Reading Utility Meters," and the Energy Cost Analysis Sheets in "The Cost of Using Energy." Use "Energy Futures" to have students envision how future societies will use energy resources.

Demand Schedule for Gasoline

<table>
<thead>
<tr>
<th>Price of Gasoline ($/gallon)</th>
<th>Quantity of Gasoline Purchased Each Week per Driver (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$4.00</td>
<td>5</td>
</tr>
<tr>
<td>$3.00</td>
<td>8</td>
</tr>
<tr>
<td>$2.00</td>
<td>12</td>
</tr>
<tr>
<td>$1.50</td>
<td>15</td>
</tr>
<tr>
<td>$1.00</td>
<td>19</td>
</tr>
<tr>
<td>$.50</td>
<td>25</td>
</tr>
</tbody>
</table>

who must commute will drive less or use alternative transportation if they cannot afford high gasoline prices. On the other hand, the demand for certain goods and services may vary greatly with changes in prices. In such cases, demand is said to be elastic. An item that may exhibit elastic demand is music compact discs (CDs), where the quantity of CDs consumers purchase tends to be sensitive to changes in CD prices.

The phrase "other things being equal or constant" is stated as part of the law of demand so that variations only in price and quantity are considered rather than prices of related goods or services or consumer tastes over a short period of time. All these factors may complicate and obscure the relationship between the price and the quantity demanded. Yet these factors also change demand. How? They shift the entire demand curve to the right or left of its original position. For example, a rise in the income of drivers will usually shift the demand curve for gasoline to the right. Drivers may then buy 30 gallons of gasoline per week instead of 25 gallons at $0.50 per gallon, 24 gallons instead of 19 at $1.00 per gallon, and so on. On the other hand, a decrease in drivers' income will usually shift the demand curve to the left, meaning that drivers would buy less gasoline at each price than they did before.

The demand for goods and services is not enough to set prices at a single value; producers or suppliers of goods and services are also involved. Like in the law of demand, in the law of supply a relationship exists between the price of a good or service and the quantity that suppliers are willing to produce. This law of supply states that, other things being equal or constant, increasing the price of a good or service increases the quantity produced. In other words, the price of
Supply Schedule

<table>
<thead>
<tr>
<th>Price of Gasoline ($/gallon)</th>
<th>Quantity of Gasoline Purchased Each Week per Driver (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$4.00</td>
<td>23</td>
</tr>
<tr>
<td>$3.00</td>
<td>21</td>
</tr>
<tr>
<td>$2.00</td>
<td>17</td>
</tr>
<tr>
<td>$1.50</td>
<td>15</td>
</tr>
<tr>
<td>$1.00</td>
<td>12</td>
</tr>
<tr>
<td>$.50</td>
<td>8</td>
</tr>
</tbody>
</table>

A good or service is directly related to the quantity supplied. For example, a service station owner would be willing to sell more gasoline at a higher price. This behavior can be summarized in a table called a supply schedule (above) or on a graph called a supply curve (see Supply Curve for Gasoline). The law of supply is not as obvious as the law of demand. For instance, large manufacturers can produce products more cheaply at higher quantities than smaller manufacturers can. However, in this case other things are not equal or constant. Large manufacturers are able to offer products at large quantities and lower prices by investing in new and improved equipment, retraining their workforce, and improving production processes. The law of supply holds these factors constant over a short period of time. This means manufacturers must use their present equipment, employees, and production processes to supply goods and services. Producing greater quantities while keeping these factors constant increases the costs that manufacturers must bear and causes them to increase prices. Like changes in the factors affecting demand, changes in these and other factors, such as the cost of production or the number of manufacturers producing the same product, cause the entire supply curve to shift to the right or left of its original position.

Working together, the laws of demand and supply show how prices are set when consumers and producers interact. An equilibrium price and quantity arises when, for a given price, the quantity demanded by consumers is equal to the quantity supplied by producers. This relationship can be seen by placing the Demand Curve for Gasoline graph over the Supply Curve for Gasoline graph. The demand and supply curves for gasoline meet at an equilibrium price of $1.50 per gallon and an equilibrium quantity of 15 gallons each week per driver. Changes in the factors affecting demand and supply result in changes in the equilibrium price and quantity. See Examples of Supply and Demand Curve Shifts.

A surplus arises when the supply of a good or service exceeds its demand at a given price. In the gasoline example, a surplus of five gallons per driver occurs at a price of $2.00 per gallon. Larger surpluses occur at higher prices. Temporary surpluses may occur because of overproduction and may be alleviated by cutting prices, reducing the quantity of goods and services being produced, or reducing the number of suppliers.

When demand exceeds supply, a shortage of a good or service arises. In the gasoline example, a shortage of seven gallons per customer occurs at a price of $1.00 per gallon. Larger shortages occur at lower prices. Shortages may occur because of underproduction and may be alleviated by raising prices, increasing the quantity of goods and services being produced, or increasing the number of suppliers. When shortages persist, suppliers may be forced to limit the quantity of the product being sold by rationing it, or they may be forced to sell their product on a first-come, first-served basis.

The laws of supply and demand provide a straightforward yet powerful way to explain how energy prices are set and how they change. Think about them the next time you see the price of gasoline on a sign posted by the corner service station.
Procedure
Orientation
Ask students if they know the current price of gasoline in dollars per gallon. Then ask them how this price was determined. If any students drive, ask them to estimate how many gallons of gasoline they buy each week at the current price. List their responses on the chalkboard.

Steps
1. Re-create the table to the right on the chalkboard. Include the current price of gasoline in the table and the quantity of gasoline students generally buy at that price (from Orientation). Write 10 gallons if students do not know how much they buy.

2. Using the current price and quantity of gasoline as reference points, ask students how much gasoline they would purchase per week at each price. Place this information in the quantity column. You may prefer to ask students who drive to provide quantity information, although most students should be able to provide estimates that decrease as the price increases. NOTE: Some students may say that they would have to drive less and buy less gasoline per week for the change in prices shown on the table. If so, point out that their demand is inelastic. Then ask these students if they would purchase the same amount of gasoline for prices higher than $4.00 per gallon. Note their responses.

3. Tell students that the table you're using is called a "demand schedule" and have them state the relationship between the price and the quantity of gasoline purchased per week. Have students plot a curve on graph paper or on overhead transparencies using the data from the demand schedule table.

4. Show students the overhead of the Demand Curve for Gasoline and have them compare this curve to the one they plotted. Point out that these curves are called "demand curves." Have students become familiar with the Demand Curve for Gasoline by having them read a few prices corresponding to chosen quantities of purchased gasoline, and vice versa. As an option, you may want to have students create a demand schedule table on paper or on overhead transparencies using data from the Demand Curve for Gasoline and compare their demand schedule to the one on the chalkboard.

5. Ask students if demand curves like the one shown on the overhead transparency could be used to describe the demand for other fuels, other energy sources, or other goods and services. Have students sketch graphs of demand curves of energy sources such as wood, electricity, natural gas, propane, heating oil, or other goods and services as examples.

6. Challenge students to summarize the law of demand. Discuss the law of demand with students and point out that the law assumes that all factors (such as income, availability of substitutes, etc.) except price remain unchanged over a short period of time (see Background).

7. Ask students to predict factors that could change the demand for gasoline. Some factors are listed below:
   - Changes in income
   - Changes in automobile efficiency
   - Substitution of other forms of transportation for driving, such as taking a bus or a commuter train, walking, bicycling, or joining a car pool
   - Substitution of automobiles that use other fuels or energy sources, such as diesel, propane, or electricity

Discuss with students whether these factors would shift the demand curve to the right or left of its original position.

8. Show students the overhead transparency of the Supply Curve for Gasoline. Have students become familiar with it by having them read a few gasoline prices corresponding to chosen quantities of supplied gasoline, and vice versa. As an option, you may want to have students create a supply schedule table on paper or on overhead transparencies using data from the Supply Curve for Gasoline.

9. Define the law of supply. Ask students if supply curves like the one shown on the overhead transparency could be used to describe the supply of other fuels, other energy resources, or other goods and services. Discuss the law of supply with students and point out that the law assumes that all factors (such as changes in the cost of production, changes in the number of producers, etc.) except price remain unchanged over a short period of time (see Background).
10. Ask students to predict factors that could change the supply of gasoline. Some factors are listed below:

- New discoveries of crude oil
- A decline in the amount of oil produced from oil fields
- Adoption of new technologies to produce gasoline more efficiently
- Changes in the number of companies producing gasoline
- Changes in the number of oil-producing nations
- Wars or economic embargoes involving oil-producing nations

Discuss with students whether these factors would shift the supply curve to the right or left of its original position. NOTE: Some students may mistakenly mention factors that change the demand instead of the supply for gasoline. Point out the difference between these factors. It may also help to ask students to imagine that they are service station owners or producers of gasoline before asking them to consider factors that could change the supply of gasoline.

11. Ask students if either the demand curve or the supply curve alone is sufficient to determine the price of gasoline. Point out that demand and supply must interact in some way to create an equilibrium (market) price and quantity. Have students suggest ways that the overhead transparencies of the Demand Curve for Gasoline and the Supply Curve for Gasoline can be arranged to arrive at the equilibrium price and quantity for gasoline. (The equilibrium price and quantity occurs at the point where the two curves intersect.)

12. Direct students to find the quantities of gasoline demanded and supplied at a price above the equilibrium price ($2.00, for example). Have students define the term surplus using this example and determine the surplus quantity of gasoline (quantity supplied minus quantity demanded). Ask students for reasons why surpluses occur and how they may be alleviated (see Background).

13. Direct students to find the quantities of gasoline demanded and supplied at a price below the equilibrium price ($1.00, for example). Have students define the term shortage using this example and determine the amount of the shortage of gasoline (quantity demanded minus quantity supplied). Ask students for reasons why shortages occur and how they may be alleviated (see Background).

Closure

Hand out the Supply and Demand Activity Sheet. Discuss answers to the questions with the class after students have completed the activity sheet.

Ask students to gather recent news articles that have reported on changes in energy prices. Have them identify the reasons given for the price changes, and discuss how these reasons might affect the demand and supply curves for the fuels or energy sources mentioned in the articles.

Assessment

Formative

- Were students able to find a general relationship between price and quantity demanded (the law of demand)?
- Can students state the law of supply?
- Can students show how factors affecting demand and supply result in changes in price and quantity?
- Can students explain what is meant by an equilibrium price and quantity?
- Can students explain how shortages and surpluses arise between buyers and sellers, and how they may be alleviated?

Summative

- Have students apply their understanding of supply and demand curves to the price and quantity of other energy resources such as electricity, natural gas, propane, coal, etc.

- Hand out copies of Ms. Sene's Dilemma and have students answer the questions. Discuss answers with the class. (You may want to have a class discussion of Question 7 rather than letting students answer this question on their own first.)

Extensions

Have students interview gasoline station owners, propane dealers, or a local utility representative to find out how energy prices are set and what factors can cause them to change. Students could then show how the price information they obtained is related to the laws of supply and demand.

Encourage students to investigate gasoline supply and demand in Europe and other parts of the world, and find out why gasoline prices are often higher in other countries than in the United States.

Have students investigate the effects of taxes, government subsidies, and government price controls on the supply and demand of energy sources.

Have students investigate how gasoline and other energy prices have changed since the beginning of the 1970s. The investigation can include the following points:

- The relationship between events such as the energy crisis of 1973-1974 and sudden increases in energy prices
- How energy prices in the 1970s compare to today's prices when adjusted for inflation
- Predicting energy prices 25 years from now using past price data
Examples of Supply and Demand Curve Shifts

Increase in Income Shifts Demand Curve to the Right: Equilibrium Price and Quantity Increase

<table>
<thead>
<tr>
<th>Price of Gasoline ($ per gallon)</th>
<th>Quantity of Gasoline (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2.00</td>
<td>15</td>
</tr>
<tr>
<td>$1.50</td>
<td></td>
</tr>
</tbody>
</table>

A Surplus of 5 Gallons per Customer Occurs at a Price of $2.00 per Gallon $(17 - 12 = 5)$

Increase In Gasoline Production Cost Shifts Supply Curve to the Left: Equilibrium Price Increases, Equilibrium Quantity Decreases

<table>
<thead>
<tr>
<th>Price of Gasoline ($ per gallon)</th>
<th>Quantity of Gasoline (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.00</td>
<td>12</td>
</tr>
<tr>
<td>$1.50</td>
<td>15</td>
</tr>
</tbody>
</table>

A Shortage of 7 Gallons per Customer Occurs at a Price of $1.00 per Gallon $(12 - 19 = -7)$
Supply and Demand Activity Sheet Answers

Answers

1. As the price per barrel of oil decreases, the number of barrels of oil demanded per week increases. The law of demand states that, other things being equal or constant, decreasing the price of a good or service increases the quantity of the good or service demanded by consumers. Assuming that other factors are constant, decreasing the price of a barrel of oil increases its demand, which is consistent with the law of demand.

2. Factors that could change the demand for oil include
   - changes in income of people buying gasoline and other oil-derived products;
   - changes in automobile efficiency and the efficiencies of other technologies that use oil as a fuel;
   - substitution of other forms of transportation for driving;
   - substitution of automobiles that use other fuels; and
   - colder or warmer than normal winters, and their effect on the amount of heating oil used.

3. The table shows how the factors in Question 2 shift the demand curve.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Increases or Decreases Demand</th>
<th>Shifts Demand Curve to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Income</td>
<td>Increases Demand</td>
<td>Right</td>
</tr>
<tr>
<td>Decreased Income</td>
<td>Decreases Demand</td>
<td>Left</td>
</tr>
<tr>
<td>Increased Efficiency</td>
<td>Decreases Demand</td>
<td>Left</td>
</tr>
<tr>
<td>Decreased Efficiency</td>
<td>Increases Demand</td>
<td>Right</td>
</tr>
<tr>
<td>Substitutions of Other Form</td>
<td>Decreases Demand</td>
<td>Left</td>
</tr>
<tr>
<td>of Transportation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Substitution of Automobile</td>
<td>Decreases Demand</td>
<td>Left</td>
</tr>
<tr>
<td>That Uses Other Fuels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colder Than Normal Winter</td>
<td>Increases Demand</td>
<td>Right</td>
</tr>
<tr>
<td>Warmer Than Normal Winter</td>
<td>Decreases Demand</td>
<td>Left</td>
</tr>
</tbody>
</table>

4. As the price per barrel of oil increases, the number of barrels of oil supplied per week increases. The law of supply states that, other things being equal or constant, increasing the price of a good or service increases the quantity of the good or service produced by producers. Assuming that other factors are constant, increasing the price of a barrel of oil increases its supply, which is consistent with the law of supply.

5. Factors that could change the supply of oil include
   - new discoveries of crude oil;
   - a decline in the amount of oil produced from oil fields;
   - changes in the number of companies producing oil;
   - changes in the number of oil-producing nations; and
   - wars or economic embargoes involving oil-producing nations.
### Supply and Demand Activity Sheet Answers Continued

<table>
<thead>
<tr>
<th>Factor</th>
<th>Increases or Decreases Demand</th>
<th>Shifts Demand Curve to the...</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Crude oil Discoveries</td>
<td>Increases Supply</td>
<td>Right</td>
</tr>
<tr>
<td>Decline in Oil Production</td>
<td>Decreases Supply</td>
<td>Left</td>
</tr>
<tr>
<td>Increase in Number of Companies Producing Oil</td>
<td>Increases Supply</td>
<td>Right</td>
</tr>
<tr>
<td>Decrease in Number of Companies Producing Oil</td>
<td>Decreases Supply</td>
<td>Left</td>
</tr>
<tr>
<td>Increase in Number of Oil-Producing Nations</td>
<td>Increases Supply</td>
<td>Right</td>
</tr>
<tr>
<td>Decrease in Number of Oil-Producing Nations</td>
<td>Decreases Supply</td>
<td>Left</td>
</tr>
<tr>
<td>War or Economic Embargo Involving Oil Producing Nations</td>
<td>Decreases Supply</td>
<td>Left</td>
</tr>
</tbody>
</table>

6. The table above shows how the factors in Question 5 shift the supply curve.

7. The two sketches of the supply and demand curve graphs show a market equilibrium price of $18 and a quantity of 2,600 barrels of oil.

8. Increases in demand shift the demand curve to the right, while the supply curve does not change its position. The result is an increase in both the equilibrium price and quantity.

   Decreases in demand shift the demand curve to the left, while the supply curve does not change its position. The result is a decrease in both the equilibrium price and quantity.

9. Increases in supply shift the supply curve to the right, while the demand curve does not change its position. The result is an increase in equilibrium quantity and a decrease in equilibrium price.

   Decreases in supply shift the supply curve to the left, while the demand curve does not change its position. The result is a decrease in equilibrium quantity and an increase in equilibrium price.
Supply and Demand Activity Sheet Answers Continued

Surplus and Shortage Table

<table>
<thead>
<tr>
<th>Price Per Barrel</th>
<th>Surplus or Shortage?</th>
<th>By How Many Barrels?</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1</td>
<td>Shortage</td>
<td>-9,000 (100 - 9,100)</td>
</tr>
<tr>
<td>$4</td>
<td>Shortage</td>
<td>-7,000 (300 - 7,300)</td>
</tr>
<tr>
<td>$8</td>
<td>Shortage</td>
<td>-5,000 (700 - 5,700)</td>
</tr>
<tr>
<td>$12</td>
<td>Shortage</td>
<td>-3,300 (1,000 - 4,300)</td>
</tr>
<tr>
<td>$16</td>
<td>Shortage</td>
<td>-1,000 (2,100 - 3,100)</td>
</tr>
<tr>
<td>$18</td>
<td>Equilibrium</td>
<td>0</td>
</tr>
<tr>
<td>$20</td>
<td>Surplus</td>
<td>1,000 (3,100 - 2,100)</td>
</tr>
<tr>
<td>$24</td>
<td>Surplus</td>
<td>3,300 (4,300 - 1,000)</td>
</tr>
<tr>
<td>$28</td>
<td>Surplus</td>
<td>5,000 (5,700 - 700)</td>
</tr>
<tr>
<td>$32</td>
<td>Surplus</td>
<td>7,000 (7,300 - 300)</td>
</tr>
<tr>
<td>$36</td>
<td>Surplus</td>
<td>9,000 (9,100 - 100)</td>
</tr>
</tbody>
</table>

10. Shortages of oil occur for prices that are below the equilibrium price. Surpluses occur for prices that are above the equilibrium price.

11. The price of oil would be expected to rise because a shortage of oil corresponds to its price being lower than the equilibrium price. Raising prices would reduce the demand for oil until an equilibrium price is reached.

12. The price of oil would be expected to fall because a surplus of oil corresponds to a price higher than the equilibrium price. Lowering prices would increase the demand for oil until an equilibrium price is reached.
Ms. Sene's Dilemma Answers

Answers

1. The equilibrium price and quantity for gasoline sold at Kero's gasoline station is $1.00 and 400 gallons of gasoline.

2. The quantity demanded for Kero's gasoline after the nearby station's price drop is 360 gallons. Kero now has 40 gallons of gasoline left at the end of one week after the price drop. The extra amount of gasoline is called a surplus.

3. Kero now has 50 customers. Since each customer now buys 11 gallons of gasoline, the total amount of gasoline they demand is 550 gallons.

4. Kero now has a shortage of 150 gallons per week.

5. The 97 cents per gallon Kero now charges for gasoline is not an equilibrium price because at this price, the quantity demanded by customers (550 gallons) exceeds the quantity Kero supplies (400 gallons), which results in a shortage. For an equilibrium price, the quantity demanded must equal the quantity supplied.

6. Should Kero ration gasoline among her 50 customers, each would get eight gallons of gasoline per week (400 gallons divided by 50 customers).

7. Possible solutions to Kero's problem:
   - Reconsider gasoline rationing. Each customer would then get slightly less than ten gallons of gasoline per week. Rationing would allow all her customers to have some gasoline. However, she might lose a few customers.
   - Serve customers on a first-come, first-served basis. This approach is similar to rationing except not all her customers would get gasoline.
   - Buy more gasoline from a high-cost supplier and try to cut some of her other business costs.
   - Buy higher priced gasoline at a loss and hope that competitors will raise prices soon. This solution would be a good one only if Kero were sure that other gas stations were also losing money and were likely to raise prices soon. Kero can try this solution for only a short time because she can't stay in business for long without making a profit.
Demand Curve for Gasoline

Price of Gasoline
($ per gallon)

Quantity of Gasoline Purchased Each Week
per Driver (gallons)
Supply Curve for Gasoline

Price of Gasoline ($ per gallon)

Quantity of Gasoline Purchased Each Week per Driver (gallons)
Introduction
Try these exercises to see how the laws of supply and demand work together to set oil prices.

Law of Demand
A demand schedule for oil is given below.

On a piece of graph paper, sketch a demand curve based on this demand schedule. The price per barrel should be shown on the vertical axis of the graph, while the barrels demanded per week (quantity) should be shown on the horizontal axis.

<table>
<thead>
<tr>
<th>Price per Barrel</th>
<th>Barrel Demanded per Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>$36</td>
<td>100</td>
</tr>
<tr>
<td>$32</td>
<td>300</td>
</tr>
<tr>
<td>$28</td>
<td>700</td>
</tr>
<tr>
<td>$24</td>
<td>1,000</td>
</tr>
<tr>
<td>$20</td>
<td>2,100</td>
</tr>
<tr>
<td>$16</td>
<td>3,100</td>
</tr>
<tr>
<td>$12</td>
<td>4,300</td>
</tr>
<tr>
<td>$8</td>
<td>5,700</td>
</tr>
<tr>
<td>$4</td>
<td>7,300</td>
</tr>
<tr>
<td>$1</td>
<td>9,100</td>
</tr>
</tbody>
</table>

Questions
1. State the relationship between the price per barrel of oil and the barrels demanded per week. Explain how this relationship obeys the law of demand.

2. List three factors that could change the demand for oil.

3. For each factor listed in Question 2, state whether it would shift the demand curve to the right or left. Give reasons why the demand curve shifted the way it did.
Law of Supply and Market Equilibrium

A supply schedule for oil is given below. Sketch a supply curve, based on this supply schedule, onto the demand curve graph you sketched earlier.

Questions

4. State the relationship between the price per barrel of oil and the barrels supplied per week. Explain how this relationship obeys the law of supply.

<table>
<thead>
<tr>
<th>Price per Barrel</th>
<th>Barrel Demanded per Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1</td>
<td>100</td>
</tr>
<tr>
<td>$4</td>
<td>300</td>
</tr>
<tr>
<td>$8</td>
<td>700</td>
</tr>
<tr>
<td>$12</td>
<td>1,000</td>
</tr>
<tr>
<td>$16</td>
<td>2,100</td>
</tr>
<tr>
<td>$20</td>
<td>3,100</td>
</tr>
<tr>
<td>$24</td>
<td>4,300</td>
</tr>
<tr>
<td>$28</td>
<td>5,700</td>
</tr>
<tr>
<td>$32</td>
<td>7,300</td>
</tr>
<tr>
<td>$36</td>
<td>9,100</td>
</tr>
</tbody>
</table>

5. List three factors that could change the supply of oil.

6. For each factor listed in Question 5, state whether it would shift the supply curve to the right or left. Give reasons why the supply curve shifted the way it did.

7. Find the market equilibrium price and quantity for oil. (Hint: look at the point where the supply and demand curve intersect.)

8. Use one of the factors from your answer to Question 2 to explain how a change in the demand for oil would change the market equilibrium price and quantity of oil.

9. Use one of the factors from your answer to Question 5 to explain how a change in the supply of oil would change the market equilibrium price and quantity of oil.
Surplus and Shortage

Using the graph of the supply and demand curves you made for oil and using the oil demand and supply schedules, determine whether a surplus or shortage of oil exists for each of the prices listed in the table below. Some entries are already shown.

**Questions**

10. State the relationship between the price of oil above and below the equilibrium price and the existence of a shortage or surplus.

<table>
<thead>
<tr>
<th>Price per Barrel</th>
<th>Surplus or Shortage?</th>
<th>By How Many Barrels?</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1</td>
<td>Shortage</td>
<td>-9,000 (100 - 9,100)</td>
</tr>
<tr>
<td>$4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$18</td>
<td>Equilibrium</td>
<td>0</td>
</tr>
<tr>
<td>$20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$28</td>
<td>Surplus</td>
<td>5,000 (5,700 - 700)</td>
</tr>
<tr>
<td>$32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. If a shortage of oil existed, would you expect the price of oil to rise or fall? Explain.

12. If a surplus of oil existed, would you expect the price of oil to rise or fall? Explain.
Ms. Kero Sene owns a gasoline station. She regularly receives 400 gallons of gasoline each week from her distributor. At the existing price of $1.00 per gallon, her 40 regular customers each bought ten gallons per week. Therefore, at this price, the weekly quantity demanded for gasoline at Kero’s was 400 gallons each week and the weekly quantity supplied was 400 gallons.

1. What is the equilibrium price and quantity for gasoline sold at Kero’s gasoline station?

Kero had been charging $1.00 per gallon of gasoline, about the same as other stations in town. Therefore, regular customers spent an average of $10 each per week, and Kero received revenue of $400 per week. Then one day, another nearby station lowered its gasoline price by two cents a gallon. Kero lost four regular customers.

2. What is the quantity demanded for Kero’s gasoline after the price drop by the nearby station? How many gallons of gasoline does Kero have left over at the end of one week after the price drop? What is the extra amount of gasoline called?

In order to get her customers back, Kero lowered her price to 97 cents per gallon. Her customers returned but so did ten new customers, and her loyal customers all decided they would drive more. Now each customer averaged 11 gallons per week in purchases.

3. How many customers does Kero now have, and what is the total amount of gasoline they demand?

4. Kero now has a shortage of how many gallons per week?

5. Is Kero’s charge of 97 cents per gallon now an equilibrium price for gasoline? Explain.

In order to increase her quantity of supply, Kero would have to pay a lot more to bring gasoline from a distant distributor. She could not afford this, but she did not want to leave some of her customers without gasoline. She believed she had two choices: to ration gasoline by limiting the amount of gasoline each of the 50 customers could buy every week, or to raise the price to 98 cents per gallon, the price that the other stations now charged.

6. If Kero’s gasoline is rationed among 50 customers, how many gallons would each customer get per week?

She decided that rationing may make some customers angry, so she raised the price to 98 cents. Her new customers then went elsewhere and she had the original 40 customers again. However, they were buying slightly more than the ten-gallon average that they bought at the $1.00 price. There was still a shortage of gasoline.

7. What are the possible solutions to Kero’s problem? Discuss advantages and disadvantages of each.
Objectives
Students will be able to
• describe the fuel efficiency of an automobile;
• identify practices and habits to improve a car's energy efficiency; and
• relate fuel efficiency to environmental protection.

Rationale
Monetary and environmental costs are important things to consider as a car owner, driver, or passenger. An energy efficient car can help save money and reduce some of the ways cars damage the environment.

Materials
Copies of the following pages from the Student Book:
• Calculating Miles per Gallon, page 223
• Survey of Vehicle Maintenance, page 224

Background
Many people's daily routines involve travel. We commute to school and work. We go to a store or a shopping mall to buy things. We run errands to the dry cleaner, post office, and photocopy shop. We travel to restaurants, movie theaters, scout meetings, and sporting events. We visit friends and relatives.

Although the number of destinations we travel to may seem too numerous to keep track of, we can easily describe the types of transportation we use. The first that comes to mind is the automobile. Overall, automobiles and other private motor vehicles (minivans, campers, motorcycles, and pickup trucks) are the dominant means by which we travel from one place to another. According to the Wisconsin Department of Transportation, "virtually all short-range rural trips, more than 90 percent of urban trips, and about 90 percent of all long-range trips are made in private motor vehicles." In addition, the number of miles driven each year per automobile in Wisconsin has increased from 9,770 miles (15,758 km) in 1980 to 13,100 miles (21,129 km) in 1995—a 34 percent increase. For some of us, automobiles are the only means of getting to our daily destinations.

Despite their dominance, automobiles are only one form of transportation that we use. Buses take us to school, to work, and between cities and towns within Wisconsin. Bicycling and walking are popular ways to commute within cities and towns. Airplanes carry us to business meetings and vacation destinations beyond our state's borders. Boats, bicycles, snowmobiles, and off-road motor vehicles are frequently used for recreational travel.

Transportation is a major energy user in Wisconsin, comprising 26 percent of total energy use in the state. Energy use by transportation has grown by 19 percent from 1980 to 1995. Nearly all the energy used for transportation comes from one energy resource—petroleum—which is used to make gasoline, diesel fuel, and jet fuel. Although alternative energy resources for transportation exist, their use is limited by current technical, economic, and institutional factors. Becoming aware of how energy is used by transportation, especially automobiles, is therefore an important first step toward learning how to use this energy efficiently.

Another consideration when driving cars is environmental costs. Every gallon of gasoline that is burned emits about 20 pounds of carbon dioxide into the atmosphere. Automobiles are the primary source of greenhouse gases, such as carbon dioxide, that could result in global climate change (for more information about greenhouse gases and global warming see the activity "Viewpoints"). Car emissions produce sulfur dioxide and nitrogen oxides that cause acid rain. Car exhaust helps create the smog and contributes to the ozone alerts that often plague much of southeastern Wisconsin. Traffic creates...
sound pollution that affects human and environmental health. There are many environmental costs associated with oil production used to produce gasoline (such as drilling impacts, oil spills, waste disposal). In addition to how car production and use affect the environment, building the roads we use to drive cars destroys habitat and adds pollutants to the air, land, and water.

There are many ways car production and use can be managed to save money and to be less damaging toward the environment. One of the first steps is to make sure a car uses fuel efficiently (see also Action Ideas: “Energy Efficiency Measures” in the Energy Sparks Section). Energy-efficient cars save money and reduce air pollution. The less gasoline that is used means less money spent at the gas pump. Likewise, the less gasoline that is burned means less that has to be produced and less carbon dioxide that gets released into the atmosphere. Over the years, many car companies have worked to make their automobiles more fuel efficient.

Individuals can support the efforts of manufacturers and their representatives to build cars that have less impact on the environment. We can also be responsible to make sure the car we own runs efficiently. The fuel efficiency of motor vehicles used by family members can be checked directly by calculating the number of miles per gallon (mpg) the vehicle gets between trips to the service station. The mpg figure indicates how many miles the vehicle can travel on one gallon of gasoline. The higher the mpg figure, the more efficiently the vehicle uses energy.

Government regulations dictate the kind and quantity of emissions that are allowable. The most fuel-efficient automobiles currently on the market achieve overall mileages of over 39 miles per gallon on the highway, where fuel efficiency is the greatest. On the other hand, certain sport utility vehicles, sports cars, and large luxury cars may achieve overall mileages of less than 13 mpg. Overall, fuel efficiency ratings for automobiles in Wisconsin have increased substantially – from 15.2 mpg in 1980 to 21.6 mpg in 1994. However, fuel efficiencies have leveled off in recent years due to the increased popularity of pickup trucks, sport utility vehicles, and larger automobiles, which have lower fuel efficiencies.

Although the type of vehicle we drive is the main factor determining its fuel efficiency, other factors can cause efficiency to vary. City driving in stop-and-go traffic results in lower fuel efficiency than highway driving. Driving habits and how well the vehicle is maintained can also cause noticeable variations in fuel efficiencies. Inflating the tires to the proper pressure, tuning up the engine, aligning the wheels, and changing the oil and oil filter are maintenance measures that can contribute to increased vehicle efficiency.

In addition to checking fuel efficiency and properly maintaining their motor vehicles, individuals have other ways to help their cars be less damaging to the environment and to save money as well. Thoughtful planning when running errands can cut down on the fuel we use. For example, making a list before shopping can prevent subsequence trips to the store to pick up forgotten items. Avoid wasted trips by making phone calls prior to leaving the home to make sure your destination is open and has the item you’re seeking. Citizen groups can work with city planners to make sure new roads do not harm sensitive ecosystems. We should also become aware of how we travel on a day-to-day basis, and explore using alternative means of transportation to meet our travel needs. Walking, bicycling, carpooling, riding a school bus, and using public transit are alternatives that not only

**Resources:**

For Teachers


**Complementary Activities**


*KEEP Activity Guide | theme III: effects of energy resource development | Driving Reasons*
get us to our destinations, but can save us money, reduce traffic congestion, decrease air emissions, and improve energy efficiency as well.

**Procedure**

**Orientation**

Take a quick survey of how students arrived to school (how many walked, drove, were driven, took the bus, etc.). Have students compare the types and amount of fuel used by each mode of travel. Focus on the number of automobiles driven to school. Ask students if they are familiar with the term fuel efficient and if they know what it means. Do they think they drive or ride in fuel-efficient cars? Discuss ways students think they can learn if they drive an energy-efficient car. Note their answers.

**Steps**

1. Provide students with copies of *Calculating Miles per Gallon* and discuss the steps students should follow to figure out how many miles their or their family's car gets to the gallon. Also hand out copies of the *Survey of Vehicle Maintenance*. Instruct students to take the activity sheet home and fill in the information and complete the calculations. Encourage them to have an adult family member assist them.

2. Have the class report their findings in a data table such as the one below. NOTE: You may want to collect and enter the data yourself to protect student privacy. Discuss similarities and differences. What other information do students think they would need in order to analyze variations?

3. Have students figure out how much gasoline they'll use in a year. They can base this calculation on how many miles they'll commute to school (and work) over a year's time (total the mileage per day and multiply it by the number of days they drove a year), or they can use an estimate of 13,000 miles per year (an average mileage for annual travel). Instruct them to divide the total (commuting mileage or 13,000 miles) by their car's fuel efficiency to determine the amount of gasoline used.

4. Tell students to calculate how much they'll spend on gasoline by multiplying the gallons of gasoline they'll use in a year by the average cost of gasoline. What do students think about this cost? If gasoline was $.50 more expensive, how much would they spend?

5. Discuss other costs besides money that result from driving their cars. Inform students that for every gallon of gasoline they drive, their car produces nearly 20 pounds of carbon dioxide. Have them calculate how many pounds of carbon dioxide they'll produce in a year. What do they think about this amount?

**Closure**

Ask students to reconsider how they travel to school and around town. What suggestions do they have for reducing the amount of energy used (like walking, carpooling, using public transportation)? Encourage students to explore ways they can improve their car's fuel efficiency (see also Action Ideas: "Energy Efficiency Measures" in the Energy Sparks section). Refer to the *Survey of Vehicle Maintenance*. Ask students to think how this information can help a car use less gasoline. Students may be interested in setting up a quick experiment to compare how far an inflated ball rolls compared to one that has lower air pressure. Make sure students use a consistent test to compare the balls. For example, they may want set up a ramp and release the balls at the same point and measure how far they roll. Encourage students to talk to a car mechanic about the importance of car maintenance.

**Data Table for Class's Fuel Efficiency**

<table>
<thead>
<tr>
<th>Year</th>
<th>Make and Model</th>
<th>Miles per Gallon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Assessment

Formative

- How accurately did students complete the Calculating Miles per Gallon activity sheet and the Survey of Vehicle Maintenance?
- Did students correctly use their calculated fuel efficiency to determine their fuel costs?
- How extensively did students consider ways to increase their car’s energy efficiency?

Summative

Have students look through a Consumer Reports Buying Guide or similar source and identify a car they would consider purchasing. Ask them to write an essay explaining to what extent fuel efficiency influenced their decision and why.

Challenge students to compare the energy usage and environmental impacts of various forms of transportation, including specific automobiles such as sport utility vehicles, bicycles, trains, buses, walking, and airplanes. Ask them to speculate about which forms of transportation are the most energy efficient (that is, use the least energy per person per mile traveled).

Extensions

Have students plot road construction taking place in the community. Encourage them to find out the reasons and plans for the construction. If there are any projected construction sites, have students investigate the plans and attend city council meetings to learn about any issues involved. Invite a city planner to speak to students about considerations in road design.

Have students interview older citizens about how the streets looked in the past and design a map for what they think future roads will look like.

Students may have seen or heard of hybrid cars and electric vehicles. Contact the Midwest Renewable Energy Association to find out more about solar and electric vehicles (www.the-mrea.org).

Invite students to design a car of the future. They should consider the automobile’s aerodynamics, safety, and fuel source.
In this section you will calculate the fuel efficiency in miles per gallon (mpg) of the motor vehicle you or your family uses. If you own or regularly use a vehicle, calculate the mpg for that vehicle. Otherwise, calculate the mpg for the vehicle that your family uses the most. NOTE: The terms motor vehicle and vehicle refer to cars, station wagons, minivans, campers, motorcycles, pickup trucks, and other motorized vehicles.

1. Write down the year, make, and model of your vehicle. ___________________________________________

2. The next time you or someone in your family buys fuel for the vehicle, fill the fuel tank completely. If you have a trip odometer, set it to zero. Otherwise, record the beginning odometer reading in Box A below.

<table>
<thead>
<tr>
<th>Ending odometer reading</th>
<th>A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning odometer reading</td>
<td>B.</td>
</tr>
<tr>
<td>Number of miles driven (Difference in odometer readings)</td>
<td>C.</td>
</tr>
<tr>
<td>Number of gallons of fuel</td>
<td>D.</td>
</tr>
</tbody>
</table>

3. When you or someone in your family again buys fuel, fill the fuel tank completely. Record the number of gallons of fuel bought in Box D. If you have a trip odometer, record the number of miles it shows in Box C. Otherwise, record the ending odometer reading in Box A.

4. If you have a trip odometer, go to Step 5. Otherwise calculate the number of miles driven by subtracting the beginning odometer reading from the ending odometer reading.

5. Calculate the fuel efficiency of the vehicle in miles per gallon (mpg) by dividing the number of miles driven by the number of gallons of fuel bought. Record your answer in the box below. NOTE: To get a more accurate fuel efficiency figure, repeat these calculations several times and find the average mpg (add the sum of all the calculations together and divide the total by the number of times you figured your car’s mpg).

| Miles Per Gallon | City Driving | Highway Driving |

6. Circle whether the vehicle you calculated fuel efficiency for was used for city driving or highway driving. City driving represents stop-and-go driving at an average speed of 20 miles per hour, with the vehicle spending approximately 18 percent of its time idling (not moving while the engine is running) at stoplights and stop signs. The vehicle does not actually have to be driven in a city to meet these conditions. Highway driving represents driving on a mix of rural and interstate highways at an average speed of 48 miles per hour with very few stops.

7. If the vehicle was used for both city and highway driving, estimate the percentage of each.

   City ________ %     Highway ________ %
Check to see if the tires of the vehicle are properly inflated by measuring the pressure of each tire and comparing it to the manufacturer's recommended tire pressures. Measure tire pressure when the tires are cold. The tires are cold when the vehicle has been parked for some time or has only been driven at low speeds for a short distance.

Use a tire pressure gauge to measure tire pressure. See if someone in your family has a pressure gauge or borrow one from a service station. A pressure gauge is sometimes found on the handle of the air pump at a service station. Tire pressure is measured in pounds per square inch (psi). Most cars have tire pressure ranges from 28 to 32 psi, while the tire pressures for other vehicles will vary. Recommended tire pressures may be listed on the sides of the tires themselves or in the owner's manual for the vehicle.

The following procedures are recommended for improving fuel mileage and for properly maintaining the tires and engine. Record the month and year when this maintenance was last performed on the vehicle.

a) Today's date


b) Date of last wheel alignment


c) Date of last engine oil and oil filter change


d) Date of last engine tune-up


Driving Reasons | theme III: effects of energy resource development | KEEP Student Book

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Objectives

Students will be able to
- read and interpret information from electric and natural gas bills; and
- analyze a year's worth of utility bills to determine an occupant's energy use patterns.

Rationale

Recognizing and interpreting electricity and natural gas use patterns by reading utility bills makes students aware of how people use energy at home and can lead students to develop sound strategies for managing energy use.

Materials

- Copies of the following pages from the Student Book:
  - Example Utility Bill, page 197
  - Example Utility Bill Questions, page 198
  - Reading a Set of Utility Bills, page 200
  - Utility Bills for One Year, page 203
  - Analyzing Energy Use Patterns Using Utility Bills, page 209
- Graph paper

Background

NOTE: See A Guide to Reading Utility Bills for definitions of electricity and natural gas energy units and for a detailed description of billing information. Also see Analyzing Energy Use Patterns Using Utility Bills.

Once a month, the local electric and natural gas utilities send out bills reminding consumers that the energy they use is not free. Customers respond by writing a check for the amount due and sending it in the return envelope. Beyond that, many customers do not give their utility bills much thought. However, the utility bill contains a great deal of valuable information for the customer.

One important piece of information found on a utility bill is the amount of electricity or natural gas used. Electric and natural gas use is determined by reading a meter located at the customer's home or business. Electric meters directly measure electric energy use in units of kilowatt-hours (kWh). Natural gas meters, however, do not directly measure the amount of energy in the gas that is used. Instead, they measure the volume of the gas in units of hundred cubic feet (abbreviated as ccf, where the first "c" stands for the Roman numeral one hundred) or thousand cubic feet (abbreviated as mcf, where the "m" stands for the Roman numeral one thousand). Natural gas meters measure volume because different sources of natural gas contain slightly different amounts of energy per unit of volume. After the volume of natural gas is measured, the amount of natural gas energy used is calculated by multiplying the volume by natural gas energy units called therms. This calculation is shown on the bill.

Other important pieces of information found on a utility bill are electric and natural gas rates. The rate is the cost of the electricity or natural gas per unit of energy. Electric rates are expressed in dollars (or cents) per kilowatt-hour, and natural gas rates are expressed in dollars (or cents) per therm. Electric and gas rates are often made up of at least two separate rates—one rate covers the utility's cost of generating or purchasing and obtaining each unit of energy and the other rate covers the cost of handling these units of energy within the utility's service territory. Utilities determine these rates based on the costs they must pay to provide electric or natural gas service plus their profit margin. Rates change over time, and utilities may change the way they report their rates as well.

The total cost for electric and natural gas service is calculated using energy use and rate information. In addition, the utility often includes a monthly customer charge to cover the cost of providing and reading meters, maintaining electric and natural gas lines, and processing bills. Other billing...
Information includes meter reading dates, bill payment due dates, the customer’s account number, and heating or other weather-related information.

Billing information may be reported differently by different utilities; there is no standard format. Bills may also differ from customer to customer. Some customers may only use electricity, a few may only use natural gas, and others may have special rates or provisions associated with their service. Businesses and industries generally use much more energy than residential customers and as a result, usually purchase electricity and natural gas at lower rates.

Comparing a set of utility bills can reveal a great deal of information about how a consumer uses energy over the course of a year. For instance, billing information can show whether a natural gas customer uses this fuel to heat his or her home, or whether an electric customer uses air conditioning during the summer. Billing information can also show whether a customer has made improvements in energy efficiency. If a natural gas customer adds insulation to an attic or replaces an old natural gas furnace with an energy-efficient one, the results will show up on the bill as reduced natural gas use. Billing information can also show when a customer has increased his or her energy use, and may suggest actions that can be taken to avoid similar increases in the future.

Procedure
Orientation
Begin by asking students how much they think their families pay per month for electricity or natural gas. Do they think their families pay a lot of money for these energy sources? How much might students pay for electricity or natural gas if they had a home of their own?

Ask students if they are familiar with electric and natural gas rates. If not, discuss the meaning of a rate by using examples of prices per unit of measure that students may be familiar with. These examples might include the price per pound for produce or the price per gallon of gasoline. Have students suggest other costs or prices that are expressed as rates. Discuss with students the reasons why understanding electric, natural gas, and various other rates is important and useful.

Steps
1. Use the information from “Electricity and Natural Gas Units” in A Guide to Reading Utility Bills to review the definitions of a kilowatt-hour, cubic foot, and therms with the class.

2. Hand out copies of the Example Utility Bill. Ask students to work with a partner and challenge each team to list the most information found on the bill. Tell them there are more than 30 things they can tell from a bill. Refer to A Guide to Reading Utility Bills to identify items students should find. Alternatively, challenge students to answer the questions from Example Utility Bill Questions.

3. Hand out copies of Reading a Set of Utility Bills and Utility Bills for One Year. Have students complete the chart in Part I. Hand out graph paper and instruct students to graph the data. See suggestions below for setting up the graph.

Suggested Graph
4. Ask students to generate a list of observations about the graph and infer reasons for the shape of the lines. Refer to Analyzing Energy Use Patterns Using Utility Bills for suggestions.

5. Have students complete Part II and answer the questions on Reading a Set of Utility Bills.

Closure
Ask students why it is a good idea to keep a set of utility bills from previous months or years instead of throwing them away. Discuss with students the ways they can use the information from a set of utility bills to manage future electricity and natural gas use.

Assessment
Formative
- Can students properly locate billing information on the utility bills?
- Are students able to accurately answer the questions on Example Utility Bill Questions and Reading a Set of Utility Bills?

Summative
Have students analyze energy use patterns from a set of utility bills they brought from home, or those provided from elsewhere, using Analyzing Energy Use Patterns Using Utility Bills.

Related KEEP Activities:
This activity complements "Reading Utility Meters" and "The Cost of Using Energy." Energy Cost Analysis Sheets found in "The Cost of Using Energy" may be used to provide additional cost exercises that use information found on utility bills. Prior to this activity, you may want to have students complete one of the surveys from "At What Rate?" Information from this activity supplements "Energy Prices: Laws of Supply and Demand." Show students activities in Energy Efficiency Measures in the Energy Sparks section to learn ways they can reduce their utility bills.

Credits:

To incorporate both graphing and problem-solving, ask all students to bring in utility bills from a specific month. The students should also record the age and square footage of their home and the number of people living in the house. Divide students into teams and ask each team to graph some of the data collected. Each student team should create one XY scatter graph that shows how energy consumption varies based on one other variable. (See example graph above.) Student graphs should include:

- Total electric consumption for the month, by number of people in the household
- Total gas consumption for the month, by number of people in the household
- Total electric consumption for the month, by the home's square footage
- Total gas consumption for the month, by the home’s square footage
- Total electric consumption for the month, by the age of the house
- Total gas consumption for the month, by the age of the house

Ask each student group to look for patterns in the data they graphed. For example, does the size of the household seem to be related to the level of gas consumption? Ask all students to compare the various graphs to identify which information seems to be the best predictor of energy use. Talk to students about some of the possible reasons for their findings. Use the energy bills to calculate energy intensity for each household and then compare this number across the households.

Use the formula

\[
\text{Energy Intensity} = \frac{\text{Energy Used (Btu) during the month}}{\text{Heating Degree Days} \times \text{Square footage of the house}}
\]

This formula usually yields numbers in the 2 to 20 range. A house scoring "2" has a low energy intensity—it uses little energy per square foot. Alternatively, a house that scores 20 has a high energy intensity; this house uses a lot of energy per square foot (which probably means the house is very "leaky"—a lot of heat escapes to the outside). Students should compare their energy intensity scores. Ask students to suggest reasons for the differences in their scores. Reasons might include the age of each house, the style of housing, number of occupants, whether residents are home during the day, whether residents set back the heat in their homes at night and while they are gone during the day (either manually or with a setback thermostat).

Utility bills provide a good starting point to explore the energy used by various household appliances. Challenge students to develop a list of the items that use the most gas and electricity in their homes. Remind students to think about items that operate seasonally (like air conditioning). Ask students to find out whether these appliances are powered by gas or electricity or some other source at their house. Explore with students how the energy consumption of these appliances helps shape the overall energy use of their home. (See Analyzing Energy Use Patterns Using the Utility Bills for more details.)
A Guide to Reading Utility Bills

Introduction
Utility bills may show information and use terms and abbreviations that may be unfamiliar. The purpose of this guide is to make this information more clear.

The first part of this guide includes definitions of electricity and natural gas units commonly found on utility bills. The second part describes information found on typical bills from a Wisconsin utility, like the Example Utility Bill and the set of Utility Bills for One Year. This section can also be used to read bills from other Wisconsin utilities and customers. Be aware that bills from other utilities may look different, may report some of the information differently, or may include extra information that applies to a particular customer. If you have questions about information found on a particular bill contact the utility that generated the bill.

Electricity and Natural Gas Units

Kilowatt-Hour (kWh)
Electrical energy is measured in kilowatt-hours. One kilowatt-hour is equal to the amount of energy produced by ten 100-watt incandescent light bulbs turned on for one hour. It is also equal to 3,413 British thermal units (Btu) of energy. One Btu of energy will raise the temperature of a pound of water one degree F. A Btu is also approximately equal to the energy produced by one lit match.

Kilowatts (kW)
A kilowatt is a unit of power. Power is the rate at which energy is produced or used per unit of time (or more accurately, the rate at which energy is converted from one form to another per unit of time). For example, ten 100-watt incandescent light bulbs (one kilowatt) produce light and heat at a rate ten times faster than one 100-watt incandescent light bulb. One kilowatt also equals about one and one-third horsepower.

Cubic Feet (cf)
The volume of natural gas is measured in cubic feet. A cubic foot is the volume enclosed by a cube with edges that are one foot long. Since cubic feet are small units, natural gas is usually measured in units of hundred cubic feet (abbreviated as ccf, where the first “c” stands for the Roman numeral one hundred) or thousand cubic feet (abbreviated as mcf, where the “m” stands for the Roman numeral one thousand).

Therm
The energy contained in natural gas is often measured in therms. One therm of natural gas contains 100,000 Btu of energy.

Abbreviations that appear either on the Example Utility Bill or the Utility Bills for One Year are:
- kW = kilowatt
- kWh = kilowatt-hour
- ccf = cubic feet
- mcf = thousand cubic feet
- Btu = British thermal unit
- °F = degree Fahrenheit
- °C = degree Celsius
- cc = cubic centimeter
- L = liter
- mmHg = millimeter of mercury
- $ = dollar
- % = percent

Natural Gas Service (Numbers 1-15)
1. The number of days between meter readings is 29 days.
2. The day the natural gas meter was last read was November 16, 1993 (11/16).
3. The previous date the natural gas meter was read was October 18, 1993 (10/18).
4. The latest reading of the natural gas meter was 6216.
I. The previous reading of the natural gas meter was 6095.

6. The meter multiplier (1.000) is the number that meter readings are multiplied by to convert the readings to hundreds of cubic feet (ccf). In this case the meter measures ccf so the meter multiplier is 1.000. Some meters measure thousands of cubic feet, and in those cases meter readings are multiplied by a multiplier of 10.

7. The usage in ccf—the amount of natural gas used from 10/18 to 11/16—equals 121 hundred cubic feet (ccf). This amount is found by taking the latest meter reading and subtracting the previous meter reading and then multiplying the difference by the meter multiplier (8218 - 6095 = 121 x 1.000 = 121).

8. The therm factor is a multiplier that adjusts for the amount of energy (or the heat content) of the fuel. One hundred cubic feet (1 ccf) of natural gas equals approximately 100,000 Btu or 1 therm. The therm factor adjusts for cases when the energy in the fuel is more or less than this. The therm factor varies from month to month between a value slightly below 1.000 to a value slightly above 1.000.

9. The total natural gas energy used in therms is 122 therms. This total is equal to 121 ccf multiplied by the therm factor of 1.007 (121 x 1.007 = 122). The utility bills the customer on the basis of therms used, which means customers pay for the amount of energy they use, rather than the volume of natural gas used.

10. The customer charge for natural gas service is $0.1644 per day. Since there are 29 days in this billing period, the total charge is $4.77. This charge covers the cost of making natural gas service available to the customer. It includes the cost of meters, meter reading, connecting natural gas pipelines to customers, and billing and record keeping expenses. This is a fixed cost, regardless of how much (or little) natural gas a customer uses during the month.

11. The natural gas distribution charge ($0.2116 per therm) covers the costs that the local utility incurs in handling the natural gas inside its service territory. Handling efforts include depressurizing the gas, adding odor, and getting the gas to the customer. This charge is based on the volume of natural gas used.

12. The administrative charge ($0.0080 per therm) covers the utility's costs that are associated with purchasing natural gas for its customers. Utilities purchase natural gas on a competitive basis from sources around the country. This charge is based on the volume of natural gas used.

13. The service charge ($0.2213 per therm) is the cost that the local utility pays for the natural gas, including the costs associated with bringing the gas to the utility's service territory from the wellhead. This charge is based on the volume of natural gas used.

14. State and county sales tax is applied to energy bills. The utility calculates a subtotal (in this case $58.57) and multiplies the subtotal by the local sales tax rate (here 5.50%) to calculate the sales tax—$3.22.

15. The total cost of the natural gas service for the billing period is $61.79 ($4.77 + $25.82 + $0.98 + $27.00 + $3.22 = $61.79).

Electric Service (Numbers 16-27)

16. The number of days between meter readings is 29 days.

17. The day the electric meter was last read was November 16, 1993 (11/16).

18. The previous date the electric meter was read was October 18, 1993 (10/18).

19. The latest reading of the electric meter was 7282 kilowatt-hours.

20. The previous reading of the electric meter was 7040 kilowatt-hours.
21. The meter multiplier (1.000) is the number that meter readings are multiplied by to convert the readings to kilowatt-hours (kWh). In this case the meter measures kWh so the meter multiplier is 1.000. Some meters measure tens or hundreds of kWh, and in those cases meter readings are multiplied by a multiplier of 10 or 100, respectively.

22. The amount of electricity used from 10/18 to 11/16 is equal to 242 kilowatt-hours. This amount is found by taking the latest meter reading and subtracting the previous meter reading (7282 - 7040 = 242).

23. The customer charge for electric service is $0.1644 per day. Since there are 29 days in this billing period, the total charge is $4.77. This charge covers the cost of making electric service available to the customer. It includes the cost of meters, meter reading, connecting electric lines to customers, and billing and record keeping expenses. This is a fixed cost, regardless of how much (or little) electricity a customer uses during the month.

24. The electric distribution charge ($0.0168 per kWh) covers the costs that the local utility incurs in handling the electricity inside its service territory. Handling efforts include reducing the voltage and getting the electricity to the customer. This charge is based on the volume of electricity used.

25. The electricity service charge ($0.0572 per kWh) is the local utility’s charge for generating the electricity and transmitting it from the power plant to the customer’s community. This charge is based on the volume of electricity used. In Wisconsin, electricity service charges tend to vary between winter and summer. The charges are higher in the summer (when electric consumption is at a peak due to air conditioning loads) and lower in the winter. The winter rate for bills in this activity is $0.0572 and the summer rate is $0.0673. NOTE: The utility in this example generates its own electricity so there is no administrative charge for electricity. As the electric utility industry restructures, administrative charges may become more common.

26. State and county sales tax is applied to energy bills. The utility calculates a subtotal (in this case $22.68) and multiplies the subtotal by the local sales tax rate (here 5.50%) to calculate the sales tax—$1.25.

27. The total cost of electric service for the billing period is $23.93 ($4.77 + 4.07 + 13.84 + 1.25 = $23.93).

Other Parts of the Bill (Numbers 28-32)

28. The next scheduled reading date is December 17, 1993 (12/17). This is the next date when both the natural gas and the electric meter will be read by a meter reader.

29. The customer’s account number is 008756. This is the number the utility uses to keep track of this customer. If the customer has a question about her bill, it is likely she will need to use this number when talking with the utility.

30. The utility charged the customer $65.18 for energy in the previous month and the customer paid this bill so there is no outstanding balance.

31. This is a fee that all utilities in Wisconsin collect to help fund the Public Benefits Program, Focus on Energy (www.focusonenergy.com). Focus on Energy is a public-private partnership offering energy information and services to energy utility customers throughout Wisconsin. The goals of this program are to encourage energy efficiency and use of renewable energy, enhance the environment, and ensure the future supply of energy for Wisconsin.

32. The total cost of both natural gas and electric service is equal to $85.72 ($61.79 + $23.93 = $85.72).

33. December 14, 1993 (12/14/93) is the date when the bill is due and must be paid.
<table>
<thead>
<tr>
<th>Service Address Number</th>
<th>Customer</th>
<th>Next Scheduled Meter Reading</th>
<th>Account Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515 Residential Lane</td>
<td>Nancy Smith</td>
<td>12/17</td>
<td>008756</td>
</tr>
</tbody>
</table>

| Previous Account Balance | $65.18 |
| Payment Received, 11/04/93 | $65.18 |
| Balance Forward | $0.00 |

<table>
<thead>
<tr>
<th><strong>Reading Dates</strong></th>
<th><strong>Readings</strong></th>
<th><strong>Gas Only</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residential Gas Service</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>11/16</td>
<td>10/18</td>
</tr>
<tr>
<td>Customer Charge</td>
<td>29 days at $0.1644</td>
<td>$4.77</td>
</tr>
<tr>
<td>Distribution Service</td>
<td>122 Therms at $0.2116</td>
<td>$25.82</td>
</tr>
<tr>
<td>Gas Supply Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administrative Charge</td>
<td>122 Therms at $0.0080</td>
<td>$0.98</td>
</tr>
<tr>
<td>Natural Gas Service Charge</td>
<td>122 Therms at $0.2213</td>
<td>$27.00</td>
</tr>
<tr>
<td>State &amp; County Tax</td>
<td>$58.57 at 5.50%</td>
<td>$3.22</td>
</tr>
<tr>
<td>Gas Subtotal</td>
<td>$61.79</td>
<td></td>
</tr>
</tbody>
</table>

| **Residential Electric Service** | | |
| 29 | 11/16 | 10/18 | 7282 | 7040 | 1.000 | 242 kWh |
| Customer Charge | 29 days at $0.1644 | $4.77 |
| Distribution Service | 242 kWh at $0.0168 | $4.07 |
| Electricity Service | 242 kWh at $0.0372 | $13.84 |
| State & County Tax | 242 kWh at 5.50% | $1.25 |
| Non-taxable Customer Charge | $4.20 |
| Electric Subtotal | $38.33 |

Total Charges for Service this Month: $89.92
Account Balance: $89.92

Date Due: 12/14/93
Account Balance: $89.92

Example Utility Bill Key
# Reading a Set of Utility Bills Answers

## Part I

<table>
<thead>
<tr>
<th>Bill #</th>
<th>Monthly Period and Year (dates from - to)</th>
<th>Total Natural Gas Use (therms)</th>
<th>Total Cost of Natural Gas ($)</th>
<th>Total Electricity Use (kilowatt-hours)</th>
<th>Total Cost of Electricity ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/18/94 - 2/16/94</td>
<td>243 therms</td>
<td>$118.07</td>
<td>220 kWh</td>
<td>$22.21</td>
</tr>
<tr>
<td>2</td>
<td>2/16/94 - 3/17/94</td>
<td>159 therms</td>
<td>$78.99</td>
<td>232 kWh</td>
<td>$23.15</td>
</tr>
<tr>
<td>3</td>
<td>3/17/94 - 4/18/94</td>
<td>98 therms</td>
<td>$51.14</td>
<td>173 kWh</td>
<td>$19.06</td>
</tr>
<tr>
<td>4</td>
<td>4/18/94 - 5/16/94</td>
<td>42 therms</td>
<td>$24.30</td>
<td>177 kWh</td>
<td>$18.66</td>
</tr>
<tr>
<td>5</td>
<td>5/16/94 - 6/16/94</td>
<td>14 therms</td>
<td>$11.89</td>
<td>455 kWh</td>
<td>$45.74</td>
</tr>
<tr>
<td>6</td>
<td>6/16/94 - 7/19/94</td>
<td>15 therms</td>
<td>$12.70</td>
<td>618 kWh</td>
<td>$60.56</td>
</tr>
<tr>
<td>7</td>
<td>7/19/94 - 8/17/94</td>
<td>14 therms</td>
<td>$11.54</td>
<td>663 kWh</td>
<td>$63.86</td>
</tr>
<tr>
<td>8</td>
<td>8/17/94 - 9/19/94</td>
<td>11 therms</td>
<td>$10.85</td>
<td>549 kWh</td>
<td>$54.44</td>
</tr>
<tr>
<td>9</td>
<td>9/19/94 - 10/18/94</td>
<td>21 therms</td>
<td>$14.80</td>
<td>191 kWh</td>
<td>$19.95</td>
</tr>
<tr>
<td>10</td>
<td>10/18/94 - 11/15/94</td>
<td>60 therms</td>
<td>$32.77</td>
<td>198 kWh</td>
<td>$20.32</td>
</tr>
<tr>
<td>11</td>
<td>11/15/94 - 12/15/94</td>
<td>147 therms</td>
<td>$73.89</td>
<td>220 kWh</td>
<td>$22.38</td>
</tr>
<tr>
<td>12</td>
<td>12/15/94 - 1/18/95</td>
<td>208 therms</td>
<td>$102.64</td>
<td>251 kWh</td>
<td>$25.50</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,032 therms</td>
<td>$543.37</td>
<td>3,947 kWh</td>
<td>$395.83</td>
<td></td>
</tr>
</tbody>
</table>

## Part II

Rates

1. Total winter rate in dollars per kWh: $0.0168 + $0.0572 = $0.074

2. Total summer rate in dollars per kWh: $0.0168 + $0.0673 = $0.0841

3. Total natural gas rate in dollars per therm: $0.4409
Answers to Questions
(Part II)

1. The highest natural gas use was 243 therms from 1/18/94 to 2/16/94 (Bill 1). The lowest natural gas use was 11 therms from 8/17/94 to 9/19/94 (Bill 8). The highest natural gas use was 22 times greater than the lowest natural gas use.

2. The highest electricity use was 663 kWh from 7/19/94 to 8/17/94 (Bill 7). The lowest electricity use was 173 kWh from 3/17/94 to 4/18/94 (Bill 3). The highest electricity use was about 3.8 times greater than the lowest electricity use.

3. The occupants used natural gas to heat the house because gas usage was well over four times greater during the winter months than during the summer months. Electricity usage was lower during the winter than during the summer.

4. There is a good chance that the occupants used air conditioning to cool the house during the summer, because overall monthly electricity usage increased significantly during the summer.

5. In addition to a natural gas furnace, the occupants most likely have appliances that use natural gas, because small amounts of natural gas were used during the summer when space heating was not used. The appliances they might have include a natural gas water heater, stove, or clothes dryer, or a combination of these appliances.

Challenge Questions

1. Total natural gas rate from Bill 1 is:
   $0.4409 per therm.
   6 therms x $0.4409 / therm = $2.65

2. Winter electric rate from Bill 1 is $0.074 per kWh.
   13 kWh x $0.074 / kWh = $0.96

3. 100 watts x 1 kilowatt = 0.1 kilowatt
   1000 watts
   For July: 0.1 kilowatt x 3 hours x 31 days = day
   9.3 kilowatt-hours (kWh)
   9.3 kWh x $0.0841 / kWh = $0.78

   For October: 0.1 kilowatt x 4 hours x 31 days =
   12.4 kilowatt hours (kWh)
   12.4 kWh x $0.074 / kWh = $0.92

   It cost less to have the light bulb on in July than it did in October.

4. First Model:
   70 kWh / month x $0.074 / kWh x 4 months (1/18 - 5/16) = $20.72
   70 kWh / month x $0.0841 / kWh x 4 months (5/16 - 9/19) = $23.55
   70 kWh / month x $0.074 / kWh x 4 months (9/19 - 1/18) = $20.72
   Total cost = $20.72 + $23.55 + $20.72 = 64.99

   Second Model:
   60 kWh / month x $0.074 / kWh x 4 months (1/18 - 5/16) = $17.76
   60 kWh / month x $0.0841 / kWh x 4 months (5/16 - 9/19) = $20.18
   60 kWh / month x $0.074 / kWh x 4 months (9/19 - 1/18) = $17.76
   Total cost = $17.76 + $20.18 + $17.76 = $55.70

   Money saved by the second model refrigerator over an entire year:
   Cost to operate first model - Cost to operate second model
   = $64.99 - $55.70 = $9.29

   Calculate the total cost of each refrigerator, over a 17-year life.
   60 kWh model will cost: $652 to purchase and $55.70/year for 17 years
   70 kWh model will cost: $589 to purchase and $64.99/year for 17 years

   60 kWh model: $652 + $55.70 x 17 = $1,598.90
   70 kWh model: $589 + $64.99 x 17 = $1,693.83

   The model using 60 kWh is a better bargain in the long run.
<table>
<thead>
<tr>
<th>Service Address</th>
<th>Customer</th>
<th>Next Scheduled Meter Reading</th>
<th>Account Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515 Residential Lane</td>
<td>Nancy Smith</td>
<td>12/17</td>
<td>008756</td>
</tr>
</tbody>
</table>

Previous Account Balance: $65.18
Payment Received, 11/04/93: $65.18 CR
Balance Forward: $0.00

### Residential Gas Service

<table>
<thead>
<tr>
<th>Reading Dates</th>
<th>Readings</th>
<th>Gas Only</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Days</td>
<td>Present</td>
<td>Previous</td>
<td>x Present x Constant Use x Therm Factor</td>
</tr>
<tr>
<td>29 11/16 10/18 6216</td>
<td>6095</td>
<td>1.000</td>
<td>121 CCF 1.007</td>
</tr>
<tr>
<td>Customer Charge</td>
<td>29 days at $0.1644</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution Service</td>
<td>122 Therms at $0.2116</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas Supply Service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administrative Charge</td>
<td>122 Therms at $0.0080</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas Service Charge</td>
<td>122 Therms at $0.2213</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State &amp; County Tax</td>
<td>$58.97 at 5.50%</td>
<td></td>
<td></td>
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<tr>
<td>Gas Subtotal</td>
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### Residential Electric Service

<table>
<thead>
<tr>
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<th>Readings</th>
<th>Gas Only</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Days</td>
<td>Present</td>
<td>Previous</td>
<td>x Present</td>
</tr>
<tr>
<td>29 11/16 10/18 7282</td>
<td>7040</td>
<td>1.000</td>
<td>242 KWH</td>
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<tr>
<td>Customer Charge</td>
<td>29 days at $0.1644</td>
<td></td>
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</tr>
<tr>
<td>Distribution Service</td>
<td>242 KWH at $0.0168</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity Service</td>
<td>242 KWH at $0.0572</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State &amp; County Tax</td>
<td>$22.68 at 5.50%</td>
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</tr>
<tr>
<td>Non-Taxable Customer Charge</td>
<td></td>
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<tr>
<td>Electric Subtotal</td>
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</tr>
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</table>

Total Charges for Service this Month: $89.92

Account Balance: $89.92

DATE DUE: 12/14/93
AMOUNT DUE: $89.92
PLEASE PAY BY DUE DATE TO AVOID LATE PAYMENT CHARGES: $89.92
Example Utility Bill Questions

Instructions: Answer the following questions using the Example Utility Bill.

1. On what date was the natural gas meter most recently read?
2. What was the present reading of the natural gas meter for the date in Question 1?
3. On what date was the natural gas meter previously read?
4. What was the previous reading of the natural gas meter for the date in Question 3?
5. How many days went by between natural gas meter reading dates?
6. How many hundred cubic feet (ccf) of natural gas were used?
7. What is the difference between the present and previous natural gas meter readings?
   Does your answer equal your answer to Question 6?
8. How many therms of natural gas were used?
9. What is the monthly customer charge for natural gas equal to?
   Does it depend on the amount of natural gas the customer used?
10. Three natural gas rates are shown on this bill: the distribution charge, the administrative charge, and the natural gas service charge.
    What are the three rates?
11. What is the total natural gas rate for this bill?
    (Hint: add the three rates you listed in your answer to Question 10.)
12. What is the total amount the customer paid for natural gas?
13. On what date was the electric meter most recently read?
14. What was the present reading of the electric meter for the date in Question 13?

15. On what date was the electric meter previously read?

16. What was the previous reading of the electric meter for the date in Question 15?

17. How many days went by between electric meter reading dates?

18. How many kilowatt-hours (kWh) of electricity were used?

19. What is the difference between the present and previous electric meter readings? Does your answer equal your answer to Question 18?

20. What is the monthly customer charge for electricity equal to? Does it depend on the amount of electricity the customer used?

21. Two electric rates are shown on this bill: the distribution service and the electricity service. What are the two rates? What is the total electric rate?

22. What is the total amount the customer paid for electricity?

23. How much is the total for both electric and natural gas service?

24. By what date must the bill be paid?
**Reading a Set of Utility Bills**

**Introduction**
You have been given a set of *Utility Bills for One Year* that show how two adults living in a single family house used electricity and natural gas. The bills cover a one-year period from January 18, 1994, through January 18, 1995. You need to find out:

- how much electricity and natural gas were used by the occupants each month;
- how much they paid for electricity and natural gas each month;
- what their electricity and natural gas use patterns were like throughout the year; and
- the electricity and natural gas rates they paid.

**Part I**
Fill in the table below using information from the *Utility Bills for One Year*.

<table>
<thead>
<tr>
<th></th>
<th>Date</th>
<th>Use</th>
<th>Electricity Cost</th>
<th>Natural Gas Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/18/94 - 2/16/94</td>
<td>243 therms</td>
<td>$118.07</td>
<td>$22.21</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL**

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*Reading Utility Bills for One Year*

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Part II
Find the electricity and natural gas rates the occupants paid from the *Utility Bills for One Year* by filling in the rate information requested below.

**Rates**

1. Total winter rate for electricity, in dollars per kilowatt-hour from Bill 1.
   (Add the electric distribution service and the electricity service rates)

2. Total summer rate for electricity, in dollars per kilowatt-hour from Bill 5.
   (Add the electric distribution service and the electricity service rates)

3. Total natural gas rate in dollars per therm from Bill 1.
   (Add the distribution service rate to the administrative charge and the natural gas service charge to get the combined rate.)

**Questions**
Use the *Utility Bills for One Year* and the information you filled into the table in Part 1 to answer the following questions.

1. During which period was natural gas use the highest? During which period was natural gas use the lowest? How many times greater was the highest natural gas use compared to the lowest natural gas use?

2. During which period was electricity use the highest? During which period was electricity use the lowest? How many times greater was the highest electricity use compared to the lowest electricity use?

3. Did the occupants use natural gas or electricity to heat the house? Explain.

4. Did the occupants use air conditioning to cool the house? Explain.

5. Do you think the occupants have any appliances that use natural gas? Explain. What kind of appliances might they have?
Challenge Questions

1. Suppose a dryer used six therms of natural gas energy during the period shown on Bill 1. How much did it cost to run the dryer?

2. The total amount of electricity used by a 200-watt color television while watching all the regular season Green Bay Packer games is equal to about 13 kilowatt-hours. How much did the electricity cost to watch all the games? Use the winter electric rate from Bill 1 to get your answer.

3. A 100-watt light bulb is turned on for an average of three hours a day in July and for an average of four hours a day in October. Calculate and compare the total cost of having the light bulb on in July and in October. Which month had the lowest cost? Make sure you use the correct electric rates corresponding to July and October.

4. Suppose you wish to buy a new refrigerator and you've narrowed your choice to two models. The first model uses 70 kilowatt-hours of electricity per month and the second model uses 60 kilowatt-hours of electricity per month.
   - How much money would you save in electricity costs over an entire year if you bought the second model refrigerator instead of the first? Make sure you use the electric rates corresponding to the winter and summer months in your calculations.
   - If the 60 kWh refrigerator costs $652 and the 70 kWh model costs $589 and if we assume that the refrigerators will both last 17 years, which model is the best bargain?

5. The sample bills are from 1994. They do not include a Non-Taxable Customer Charge. This bill item was included beginning in 2000. Find out the purpose of this charge.
   (Hint: Visit the Focus on Energy Web site, www.focusonenergy.com)
## Utility Bills for One Year

### Bill 1

<table>
<thead>
<tr>
<th>Service Address</th>
<th>Customer</th>
<th>Account Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515 Residential Lane</td>
<td>Nancy Smith</td>
<td>008756</td>
</tr>
</tbody>
</table>

Previous Account Balance: $196.18
Payment Received, 02/02/94: $196.18 CR
Balance Forward: $0.00

<table>
<thead>
<tr>
<th>ReadiDg Dates</th>
<th>Residential Gas Service</th>
<th>Residential Electric Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gas</td>
<td>Amount</td>
</tr>
<tr>
<td>29 01/16</td>
<td>2074</td>
<td>1.000 243 CCF 1.004 243 Therms</td>
</tr>
<tr>
<td>Customer Charge</td>
<td>$115.91 at 5.004</td>
<td>$115.91 at 5.004</td>
</tr>
<tr>
<td>Distribution Service</td>
<td>$24.3 Therms at $0.219</td>
<td>$24.3 Therms at $0.019</td>
</tr>
<tr>
<td>Gas Supply Service</td>
<td>$0.0080</td>
<td>$0.0080</td>
</tr>
<tr>
<td>Natural Gas Service Charge</td>
<td>$5.87</td>
<td>$5.87</td>
</tr>
<tr>
<td>State &amp; County Tax</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Gas Subtotal</td>
<td>$140.28</td>
<td>$140.28</td>
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</table>

Account Balance: $140.28

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### Bill 2

<table>
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<th>Service Address</th>
<th>Customer</th>
<th>Account Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515 Residential Lane</td>
<td>Nancy Smith</td>
<td>008756</td>
</tr>
</tbody>
</table>

Previous Account Balance: $140.28
Payment Received, 03/02/94: $140.28 CR
Balance Forward: $0.00

<table>
<thead>
<tr>
<th>Reading Dates</th>
<th>Residential Gas Service</th>
<th>Residential Electric Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gas</td>
<td>Amount</td>
</tr>
<tr>
<td>29 04/18</td>
<td>2074</td>
<td>1.000 159 CCF 1.004 159 Therms</td>
</tr>
<tr>
<td>Customer Charge</td>
<td>$115.91 at 5.004</td>
<td>$115.91 at 5.004</td>
</tr>
<tr>
<td>Distribution Service</td>
<td>$24.3 Therms at $0.219</td>
<td>$24.3 Therms at $0.019</td>
</tr>
<tr>
<td>Gas Supply Service</td>
<td>$0.0080</td>
<td>$0.0080</td>
</tr>
<tr>
<td>Natural Gas Service Charge</td>
<td>$5.87</td>
<td>$5.87</td>
</tr>
<tr>
<td>State &amp; County Tax</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Gas Subtotal</td>
<td>$140.28</td>
<td>$140.28</td>
</tr>
</tbody>
</table>

Account Balance: $140.28

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**PLEASE REMEMBER TO PAY YOUR BILLS ON TIME TO AVOID LATE FEES!**

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### Bill 3

<table>
<thead>
<tr>
<th>Service Address</th>
<th>Customer</th>
<th>Meter Reading</th>
<th>Account Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515 Residential Lane</td>
<td>Nancy Smith</td>
<td>05/16</td>
<td>008756</td>
</tr>
</tbody>
</table>

**Previous Account Balance**: $102.14

**Balance Forward**: $0.00

**Gas Only**

<table>
<thead>
<tr>
<th>Number of Days</th>
<th>Residential Gas Service</th>
<th>Customer Charge</th>
<th>Distribution Service</th>
<th>Gas Supply Service</th>
<th>Administrative Charge</th>
<th>Natural Gas Service Charge</th>
<th>State &amp; County Tax</th>
<th>Gas Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>04/18 03/17 7170</td>
<td>98 Therms at $0.2116</td>
<td>98 Therms at $0.0080</td>
<td>98 Therms at $0.2213</td>
<td>98 Therms at $0.0080</td>
<td>$19.07 at 5.50%</td>
<td>$19.06</td>
<td>$21.69</td>
</tr>
</tbody>
</table>

**Total Charges for Service this Month**: $70.20

**Account Balance**: $70.20

**Date Due**: 05/16/94

**Amount Due**: $70.20

**Please Pay by Due Date to Avoid Late Payment Charges**

### Bill 4

<table>
<thead>
<tr>
<th>Service Address</th>
<th>Customer</th>
<th>Meter Reading</th>
<th>Account Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515 Residential Lane</td>
<td>Nancy Smith</td>
<td>05/16</td>
<td>008756</td>
</tr>
</tbody>
</table>

**Previous Account Balance**: $70.20

**Balance Forward**: $0.00

**Gas Only**

<table>
<thead>
<tr>
<th>Number of Days</th>
<th>Residential Gas Service</th>
<th>Customer Charge</th>
<th>Distribution Service</th>
<th>Gas Supply Service</th>
<th>Administrative Charge</th>
<th>Natural Gas Service Charge</th>
<th>State &amp; County Tax</th>
<th>Gas Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>04/18 03/17 9984</td>
<td>173 KWH at $0.0168</td>
<td>173 KWH at $0.0572</td>
<td>173 KWH at $0.0168</td>
<td>173 KWH at $0.0168</td>
<td>$17.69 at 5.50%</td>
<td>$19.06</td>
<td>$24.39</td>
</tr>
</tbody>
</table>

**Total Charges for Service this Month**: $43.05

**Account Balance**: $43.05

**Date Due**: 06/14/94

**Please Pay by Due Date to Avoid Late Payment Charges**

### Reading Utility Bills

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**Bill 5**

**Service Address:** 1515 Residential Lane  
**Customer:** Nancy Smith  
**Next Scheduled Meter Reading:** 07/19  
**Account Number:** 008756

- **Previous Account Balance:** $1.05  
- **Payment Received:** 06/06/94  
- **Balance Forward:** $0.00

<table>
<thead>
<tr>
<th>Number of Days</th>
<th>Present Reading</th>
<th>Previous Reading</th>
<th>Constant Use</th>
<th>Therms Factor</th>
<th>Therms</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Residential Gas Service</td>
<td>31 06/16 05/16 726</td>
<td>7212</td>
<td>1.000 14 CCF 1.007</td>
<td>14 Therms</td>
<td></td>
<td>$5.10</td>
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<tr>
<td>Customer Charge</td>
<td>31 days at $0.1644</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$5.10</td>
</tr>
<tr>
<td>Distribution Service</td>
<td>14 Therms at $0.2116</td>
<td></td>
<td></td>
<td></td>
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<td>$2.96</td>
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<td>Gas Supply Service</td>
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<td>$0.11</td>
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<td>Natural Gas Service Charge</td>
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<td>State &amp; County Tax</td>
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<td>$6.20</td>
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<td><strong>Gas Subtotal</strong></td>
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<td></td>
<td></td>
<td>$11.89</td>
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</table>

| Residential Electric Service | 31 06/16 05/16 9716 | 9621 | 1.000 455 KWH | | | $57.63 |
| Customer Charge | 31 days at $0.1544 | | | | | $5.10 |
| Distribution Service | 157 KWH at $0.0156 | | | | | $2.48 |
| Electricity Service | 455 KWH at $0.0185 | | | | | $8.32 |
| State & County Tax | 511.27 at 5.00% | | | | | $6.20 |
| **Electric Subtotal** | | | | | | $45.74 |

**Total Charges for Service this Month:** $57.63

**Account Balance:** $57.63

**DATE DUE:** 07/14/94  
**AMOUNT DUE:** PLEASE PAY BY DUE DATE TO AVOID LATE PAYMENT CHARGES  
**$57.63**

**Bill 6**

**Service Address:** 1515 Residential Lane  
**Customer:** Nancy Smith  
**Next Scheduled Meter Reading:** 08/17  
**Account Number:** 008756

- **Previous Account Balance:** $57.63  
- **Payment Received:** 07/06/94  
- **Balance Forward:** $0.00

<table>
<thead>
<tr>
<th>Number of Days</th>
<th>Present Reading</th>
<th>Previous Reading</th>
<th>Constant Use</th>
<th>Therms Factor</th>
<th>Therms</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Residential Gas Service</td>
<td>31 07/19 06/16 726</td>
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<td>1.000 14 CCF 1.007</td>
<td>14 Therms</td>
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<td>Customer Charge</td>
<td>31 days at $0.1644</td>
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<td></td>
<td></td>
<td></td>
<td>$5.10</td>
</tr>
<tr>
<td>Distribution Service</td>
<td>14 Therms at $0.2116</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$2.96</td>
</tr>
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</tr>
<tr>
<td>Administrative Charge</td>
<td>14 Therms at $0.0000</td>
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<td>$0.11</td>
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<tr>
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<tr>
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<td>$12.70</td>
</tr>
</tbody>
</table>

| Residential Electric Service | 31 07/19 06/16 10334 | 9716 | 1.000 618 KWH | | | $73.26 |
| Customer Charge | 31 days at $0.1644 | | | | | $5.43 |
| Distribution Service | 618 KWH at $0.0166 | | | | | $10.38 |
| Electricity Service | 618 KWH at $0.0673 | | | | | $41.59 |
| State & County Tax | 511.27 at 5.00% | | | | | $6.60 |
| **Electric Subtotal** | | | | | | $60.56 |

**Total Charges for Service this Month:** $73.26

**Account Balance:** $73.26

**DATE DUE:** 08/16/94  
**AMOUNT DUE:** PLEASE PAY BY DUE DATE TO AVOID LATE PAYMENT CHARGES  
**$73.26**

**KEEP Student Book | theme III: effects of energy resource development | Reading Utility Bills 205**
### Bill 7

<table>
<thead>
<tr>
<th>Service Address</th>
<th>Customer</th>
<th>Recent Scheduled Meter Reading</th>
<th>Account Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515 Residential Lane</td>
<td>Nancy Smith</td>
<td>03/19</td>
<td>008756</td>
</tr>
</tbody>
</table>

| Previous Account Balance | $73.26 |
| Payment Received, 08/16/94 | $73.26 CR |
| Balance Forward | $0.00 |

### READING DATES

<table>
<thead>
<tr>
<th>Number of Days</th>
<th>Present</th>
<th>Previous</th>
<th>Constant x Use</th>
<th>Therm Factor</th>
<th>Therms</th>
<th>AMOUNT</th>
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<tbody>
<tr>
<td>Residential Gas Service</td>
<td>29 08/17</td>
<td>07/19 7255</td>
<td>7241</td>
<td>1.000</td>
<td>14 CCF</td>
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<td>14 Therm at $0.2116</td>
<td>$2.96</td>
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<td></td>
</tr>
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<td>$2.96</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administrative Charge</td>
<td>14 Therm at $0.2116</td>
<td>$2.96</td>
<td></td>
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<td>State &amp; County Tax</td>
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<td>Residential Electric Service</td>
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<td>07/19 10997</td>
<td>10334</td>
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| Total Charges for Service this Month | $75.40 |
| Account Balance | $75.40 |

### Bill 8

<table>
<thead>
<tr>
<th>Service Address</th>
<th>Customer</th>
<th>Recent Scheduled Meter Reading</th>
<th>Account Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515 Residential Lane</td>
<td>Nancy Smith</td>
<td>10/18</td>
<td>008756</td>
</tr>
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</table>

| Previous Account Balance | $75.40 |
| Payment Received, 09/06/94 | $75.40 CR |
| Balance Forward | $0.00 |

### READING DATES

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<th>Number of Days</th>
<th>Present</th>
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<th>Constant x Use</th>
<th>Therm Factor</th>
<th>Therms</th>
<th>AMOUNT</th>
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<tr>
<td>Residential Gas Service</td>
<td>33 09/19</td>
<td>08/17 7266</td>
<td>7255</td>
<td>1.000</td>
<td>11 CCF</td>
<td>1.021</td>
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<td>Customer Charge</td>
<td>33 days at $0.1644</td>
<td>$5.43</td>
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<tr>
<td>Distribution Service</td>
<td>11 Therm at $0.2116</td>
<td>$2.33</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Gas Supply Service</td>
<td>11 Therm at $0.2116</td>
<td>$2.33</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Administrative Charge</td>
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<td>$2.33</td>
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<td>08/17 11546</td>
<td>10997</td>
<td>1.000</td>
<td>549 KWH</td>
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<td>$5.43</td>
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<td></td>
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| Total Charges for Service this Month | $65.29 |
| Account Balance | $65.29 |

### Reading Utility Bills

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<th>DATE DUE</th>
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<th>PLEASE PAY BY DUE DATE TO AVOID LATE PAYMENT CHARGES</th>
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<tbody>
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<td>09/14/94</td>
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### Bill 9

**Service Address:** 1515 Residential Lane  
**Customer:** Nancy Smith  
**Next Scheduled Meter Reading:** 11/15  
**Account Number:** 008756

<table>
<thead>
<tr>
<th>Reading Dates</th>
<th>Reading</th>
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<th>Amount</th>
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<tbody>
<tr>
<td>29 10/18 09/19 7287</td>
<td>7266</td>
<td>1.000 21 CCF 1.000</td>
<td>21 Therms</td>
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<td>Customer Charge</td>
<td>29 days at $0.1644</td>
<td>$4.77</td>
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<tr>
<td>Distribution Service</td>
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<td>Gas Supply Service</td>
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<tr>
<td>Administrative Charge</td>
<td>21 Therms at $0.0080</td>
<td>$0.17</td>
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<td>Natural Gas Service Charge</td>
<td>21 Therms at $0.2213</td>
<td>$4.65</td>
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<td>State &amp; County Tax</td>
<td>$14.03 at 5.50%</td>
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<tr>
<td>Residential Gas Service</td>
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**Residential Electric Service**

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<th>Reading Dates</th>
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<tr>
<td>29 10/18 09/19 1237</td>
<td>11546</td>
<td>1.000 191 KWH</td>
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<td>Customer Charge</td>
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<tr>
<td>Distribution Service</td>
<td>191 KWH at $0.0158</td>
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<td>Electricity Service</td>
<td>191 KWH at $0.0572</td>
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<td>State &amp; County Tax</td>
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<td>Residential Electric Service</td>
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</table>

**Total Charges for Service this Month:** $34.75

**Account Balance:** $34.75

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### Bill 10

**Service Address:** 1515 Residential Lane  
**Customer:** Nancy Smith  
**Next Scheduled Meter Reading:** 12/15  
**Account Number:** 008756

<table>
<thead>
<tr>
<th>Reading Dates</th>
<th>Reading</th>
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<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 11/15 10/18 7347</td>
<td>7287</td>
<td>1.000 60 CCF 0.992</td>
<td>60 Therms</td>
</tr>
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<td>Customer Charge</td>
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<td>$4.60</td>
<td></td>
</tr>
<tr>
<td>Distribution Service</td>
<td>60 Therms at $0.2116</td>
<td>$12.70</td>
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</tr>
<tr>
<td>Gas Supply Service</td>
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</tr>
<tr>
<td>Administrative Charge</td>
<td>60 Therms at $0.0080</td>
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<td>60 Therms at $0.2213</td>
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<td>State &amp; County Tax</td>
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<tr>
<td>Residential Gas Service</td>
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**Residential Electric Service**

<table>
<thead>
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<tr>
<td>28 11/15 10/18 11935</td>
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<td>198 KWH at $0.0168</td>
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<tr>
<td>Electricity Service</td>
<td>198 KWH at $0.0572</td>
<td>$11.33</td>
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<td>State &amp; County Tax</td>
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<tr>
<td>Residential Electric Service</td>
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<td>$20.32</td>
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</table>

**Total Charges for Service this Month:** $53.09

**Account Balance:** $53.09

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**KEEP Student Book** | **theme III: effects of energy resource development** | **Reading Utility Bills** | **207**
<table>
<thead>
<tr>
<th>Service Address</th>
<th>Customer</th>
<th>Most Scheduled Meter Reading</th>
<th>Account Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515 Residential Lane</td>
<td>Nancy Smith</td>
<td>01/18</td>
<td>008756</td>
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Previous Account Balance $51.09  
Payment Received, 12/02/94 $53.09 CR  
Balance Forward $0.00

<table>
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<th>READINGS</th>
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<tbody>
<tr>
<td>Number of Days Present Previous Present Constant Use eTherm Factor Therms</td>
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<td>30 12/15 11/15 7496 7347 1 000 149 CCF 0.989 147 Therms</td>
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<td>$31.11</td>
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</tr>
<tr>
<td>Gas Supply Service</td>
<td>147 Therms at $0.0090</td>
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</tr>
<tr>
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<tr>
<td>State &amp; County Tax</td>
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<td>Gas Subtotal</td>
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</table>

Residential Electric Service | 30 12/15 11/15 12155 11335 1 000 220 KWH | $4.93 |
| Customer Charge | 30 days at $0.1644 | $4.93 |
| Distribution Service | 220 KWH at $0.0168 | $5.72 |
| Electricity Service | 220 KWH at $0.0572 | $12.58 |
| State & County Tax | $21.21 at 5.50% | $1.17 |
| Electric Subtotal | $22.38 |

Total Charges for Service this Month: $95.97
Account Balance $95.97

Date Due 01/14/95  
Amount Due $95.97  
Please Pay by Due Date To Avoid Late Payment Charges

---

<table>
<thead>
<tr>
<th>Service Address</th>
<th>Customer</th>
<th>Most Scheduled Meter Reading</th>
<th>Account Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515 Residential Lane</td>
<td>Nancy Smith</td>
<td>02/17</td>
<td>008756</td>
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</table>

Previous Account Balance $95.97  
Payment Received, 01/04/94 $95.97 CR  
Balance Forward $0.00

<table>
<thead>
<tr>
<th>READING DATES</th>
<th>READINGS</th>
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<th>AMOUNT</th>
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</thead>
<tbody>
<tr>
<td>Number of Days Present Previous Present Constant Use eTherm Factor Therms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential Gas Service</td>
<td>34 01/18 12/15 7705 7496 1 000 209 CCF 0.997 208 Therms</td>
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</tr>
<tr>
<td>Customer Charge</td>
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<tr>
<td>Distribution Service</td>
<td>208 Therms at $0.2116</td>
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<td>Gas Supply Service</td>
<td>208 Therms at $0.0090</td>
<td>$1.66</td>
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</tr>
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<td>Administrative Charge</td>
<td>208 Therms at $0.2213</td>
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<td>Natural Gas Service Charge</td>
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<td>State &amp; County Tax</td>
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Residential Electric Service | 34 01/18 12/15 12155 11355 1 000 251 KWH | $5.59 |
| Customer Charge | 34 days at $0.1644 | $5.59 |
| Distribution Service | 251 KWH at $0.0168 | $4.22 |
| Electricity Service | 251 KWH at $0.0572 | $14.36 |
| State & County Tax | $24.17 at 5.50% | $1.33 |
| Electric Subtotal | $25.50 |

Total Charges for Service this Month: $128.14
Account Balance $128.14

Date Due 02/15/95  
Amount Due $128.14  
Please Pay by Due Date To Avoid Late Payment Charges

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Reading Utility Bills | theme III: effects of energy resource development | KEEP Student Book
Analyzing Energy Use Patterns

Introduction
A family's home energy use patterns can be found by reading a set of utility bills that cover a full year. Some residential energy use patterns that match changes in electricity or natural gas use are given below. Be sure to review the complete list of patterns before drawing any conclusions, since a change in electricity or natural gas use may have more than one cause. In addition, small changes may not be fully explained by the patterns below.

Patterns Related to Changes in Electricity Use
There is a large increase in use from September to January or February, then a large decrease from February to April or May. The total usage is at least three to four times greater in the winter than it is in the summer.
**Possible Causes:**
- The customer most likely heats the home with electricity.
- The customer uses a number of portable electric space heaters.

There is a small increase in use from September to January or February, then a small decrease from February to April or May.
**Possible Causes:**
- The customer increased the use of lighting because there is less daylight in winter than there is in summer.
- The customer limited the use of portable electric space heaters.

There is a large increase in use from May to July, then a large decrease from August to October.
**Possible Causes:**
- The customer most likely has air conditioning. The larger the increase, the more likely the customer has central air conditioning or a number of room air conditioners.
- The customer may use a dehumidifier.

Patterns Related to Changes in Natural Gas Use
There is a large increase in use from September to January or February, then a large decrease from February to April or May. The total usage is at least three to four times greater in the winter than it is in the summer.
**Possible Cause:**
- The customer most likely heats with natural gas.

There is nearly constant use from month to month for a number of months, especially from May through September even though the customer heats the home with natural gas.
**Possible Cause:**
- Customer may have a natural gas water heater, stove, dryer, or other gas appliance, or a combination of these appliances.
Patterns Related to Changes in Both Electricity and Natural Gas Use

There is a noticeable decrease in use during any month.

Possible Causes:

• The weather was warmer than usual during a winter, spring, or fall month.
• The weather was cooler than usual during a summer month.
• Occupants were not at home very much.
• One or more occupants may have been away for an extended period of time. Possibilities include family vacations, business trips, or hospital stays.

There is a noticeable increase in use during any month.

Possible Causes:

• The weather was colder than usual during a winter, spring, or fall month.
• The weather was warmer than usual during a summer month.
• Occupants often stayed home.
• The household had a temporary increase in number of occupants. For instance, a relative may have been visiting for a few weeks.
• The occupants had a number of guests. This situation may occur during weddings, graduations, holidays, or family functions.
• The occupants increased their electricity use for things like Christmas lights during the winter holiday season.

There is a noticeable increase or decrease in use that lasts for several months.

Possible Causes:

• A new large appliance, such as a refrigerator or dishwasher, was added (increase in use).
• A smaller appliance, such as a waterbed heater or a coffee maker, was left on for most of the day every day, or a number of smaller appliances were added (increase in use).
• A new large appliance that uses one kind of energy source replaced an appliance that used another. For instance, a new gas stove may have replaced an old electric stove (gas use increased and electricity use decreased).
• Occupants took significant measures to conserve energy (decrease in use).
Objectives
Students will be able to
• read and interpret information from electric and natural gas meters; and
• compare how energy is used during the day or week to activities and routines at home or at school.

Rationale
Observing and interpreting energy consumption patterns by reading utility meters makes students aware of how they use energy and may lead to strategies that can help them effectively manage energy use in the future.

Materials
• Copies of the following pages from the Student Book:
  - Meter Locations and Close-Ups, page 211 (optional)
  - How to Read Electric Meters, page 213
  - How to Read Natural Gas Meters, page 218
  - Observing Daily Meter Readings, page 220 (see Considerations to Conducting Activity)
• Watt meter (optional; see Getting Ready)
• Actual utility meters (optional; see Getting Ready)
• Graph paper (one or two sheets per student)

Background
While walking by a house or building, you will often encounter small pieces of equipment encased in glass and metal, mounted on or placed near building walls. If you pause and look closely, you may see four or five circular dials with pointers aimed at clock-like numerals. Perhaps a flat metal plate with ruler-like markings is also inside, spinning quickly. Or you may see a digital display that looks like the numerals on your digital clock or VCR. This equipment is not keeping time, but it seems to be measuring something all the time.

To understand why meters are important, consider the role of measurement in buying and selling goods and services. The prices of all goods and services have units of measure attached to them. Units of measure allow buyers to know how much they get for the price they pay. Familiar examples include the price per pound for potatoes, the cost per foot for lumber, or the price per hour that a plumber charges for labor. To ensure that these units are accurate and consistent, many kinds of measuring equipment and methods have been developed. For instance, a scale is used for weighing potatoes, a tape measure is used for measuring the length of lumber, and the plumber’s wristwatch is used for keeping track of time spent on the job. Energy also has to be measured in order for it to be sold. Meters measure the amounts of electricity and natural gas customers use, so the utility can charge them correctly.

Electrical meters measure electricity use in kilowatt-hours, a unit of energy that combines a unit of power (kilowatts) with a unit of time (hours). One kilowatt-hour (kWh) of energy is equal to the energy output of ten 100-watt light bulbs turned on for one hour. Natural gas meters, however, do not directly measure the amount of energy in the gas that the customer uses. Instead, they measure the volume of the gas in units of hundred cubic feet.

Grade Level: 5-8 (9-12)
Subject Areas: Family Living and Consumer Education, Mathematics, Science (Physical), Technology Education
Setting: Classroom, home, school
Time: Preparation: 2 hours to 2 days Activity: 2 days to 2 weeks
Vocabulary: Cubic foot, Kilowatt-hour, Meter, Meter Reader, Therm
Major Concept Areas:
• Consumption of energy resources
• Quality of life
Getting Ready:
See also Considerations to Conducting Activity after Extensions. Electric and natural gas meters may be available from the school’s science department or a local utility. Students can also measure the energy use of various appliances with a watt meter. By plugging a meter into an outlet and then plugging an appliance such as a refrigerator into the meter, students can measure energy use and energy cost for the refrigerator. Watt meters may be available from your local utility or local public library.

You may want to give students copies of Reading Utility Meters: Meter Locations and Close-Ups to help them find their meters.

You may want to contact your local utility regarding their rules for reading meters.
(abbreviated ccf, where the first "c" stands for the Roman numeral one hundred) or thousand cubic feet (abbreviated mcf, where the "m" stands for the Roman numeral one thousand). After the meter has measured the volume of natural gas, the amount of natural gas energy used is calculated by multiplying the volume of the gas by energy units called therms (one therm is equal to 100,000 Btu of energy). This calculation is usually shown on the natural gas bill.

The utility gathers information from meters by having a meter reader go from house to house or building to building to read them. Some utilities have added new equipment to meters where the utility vehicle simply drives by the home and collects the information without actually coming to the house. To make the job easier, most meters are located on the outside of houses and buildings. Meter reading is usually done about once a month, although other meter reading periods are possible.

Meters can also be used to determine customers' energy use patterns. Daily energy use patterns for residential customers may show that more electricity is used during meal times than at other times. Weekly energy use patterns may show that weekend energy use is higher than weekday use. Utility forecasters and planners use these patterns to make sure that enough energy is available for all their customers at different times of the day and week. Energy use pattern information can also benefit customers by helping them become more aware of how much energy they use and when they use it. This awareness can help customers develop strategies that save money and improve energy efficiency.

**Procedure**

**Orientation**
Ask students if they know how the electricity or natural gas used by their family or school is measured. If they do not know, tell students that devices called meters measure the amount of electricity and natural gas people use. Show them the photographs of electric and natural gas meters. (Show students actual meters if you have them.)
Ask students where they have seen meters. Responses may include their basement, on the outside wall of a house or building, or on a metal box next to a house or building.

Tell students that they will be reading meters to find out how much electricity or natural gas is used at their homes or school. If a watt meter is available, demonstrate how this gadget measures energy use of various appliances like toasters, lamps, and hair dryers.

Review the definition of kilowatt-hour units with students if electric meters will be read, and cubic feet units if natural gas meters will be read (see Background).

Steps
1. Hand out copies of How to Read Utility Meters. Check activity sheet responses for accuracy. As an option, students can read the meters shown in the photographs or the demonstration meters that have been brought to class.

2. Suggest that students ask their parents to help them investigate their home utility meters. For example, during the evening students can use a flashlight to watch the meter for two minutes and then turn off all the lights and other appliances in the house and compare the meter movements. During the day, students can ask their parents to unplug the refrigerator and see how this affects the meter.

3. Hand out copies of Observing Daily Meter Readings. Have students record the meter data on the activity sheet tables according to the instructions. You may also want to consider the following:
   - If students have both electric and natural gas meters, you may want to divide the class into electric and natural gas meter readers.
   - If students will be reading meters at school, have them share activity sheets and take turns recording meter data on the tables.

Closure
Have students comment on the weekly energy use patterns they graphed, and discuss their answers to the questions on the activity sheet.

Discuss how the readings might vary at different times of the year. Have students make predictions and then plan to conduct the measurements in the future to test their predictions.

Assessment
Formative
- Are students able to properly read the example meters on How to Read Utility Meters?
- How well did students complete Observing Daily Meter Readings?
- How well did students’ observations of home or school energy use correspond to the energy use patterns that they graphed?

Summative
- Ask students if they think the times of the day when electricity and natural gas use at home was highest and lowest were the same for all the students in the class. Tabulate meter reading data from individual students to see when the highest and lowest use of electricity and natural gas occurred. Ask students to explain why the highs and lows may or may not be different.
- Challenge students to design a utility bill that accurately reports energy use for a month. Evaluate the bills based on student creativity and presentation of information. Show students actual bills and have them compare their creations, noting the strengths and limitations of each.

Related KEEP Activities:

Credits:
Extensions

Invite a meter reader or a representative from your local electric or natural gas utility to share further information about meter reading with the class. Find out if they can bring demonstration meters to your class.

Have students record hourly meter readings for one day. See if they can determine which activities use the most energy or if there are certain times of the day when energy is used more.

Considerations for Conducting Activity

Ideally, students can read electric and natural gas meters at their homes and their school ("home" means any type of dwelling—a house, apartment, mobile home, etc.). However, you must consider a number of things before you send students off to read meters. The activity sheets can be adjusted to accommodate these restrictions, if necessary.

- Not every home has natural gas service, and some may not have electric service.
- Electric and natural gas use varies widely for different homes.
- It may not be possible to record changes in meter readings every hour if usage is low.
- Accessing meters in apartments or schools may be difficult or impossible, which means that students will not be able to read them.
- Meters used in apartments may measure the energy used by more than one family or dwelling unit.
- Some meters may not indicate which apartment they correspond to, or may only measure electricity or natural gas used by part of an apartment or a combination of an apartment, an outside hallway, and outdoor lighting.
- The landlord may pay the utility bill and pass along the energy costs to the tenants.
- Students may not be able to read meters outside of normal school hours or on weekends.

Reading Utility Meters Answer Sheet

Electric Meters:
1. 8, 4, 6
2. 3, 6, 0
3. 7, 1, 5, 1
4. 2, 9
5. 1, 0
6. 3, 1, 7, 4
7. January 1 5, 1, 3, 5
8. January 8, 1176 x 10 = 11,760

Gas Meters:
1. 1, 5, 1
2. 4, 8, 6
3. 3, 4, 2
4. 6, 0, 8
5. 2, 1, 5
6. 7, 0, 0
7. 0, 4, 7
8. 9, 8, 9
9. 1, 9, 2
10. 5, 1, 0
Location of an Electric Meter

Close-up of an Electric Meter
Location of a Gas Meter

Close-up of a Gas Meter
This exercise is for people whose utility meters look like this:

In this exercise, you will learn how to read your meter.

1. Each dial of the meter has a little hand. Usually the hand is between two numbers. Then the hand is indicating the number which is less, just like a clock.

Here's a dial indicating the number 2.

What is the reading on this dial? 

What is the reading on this dial? 

What is the reading on this dial? 

2. Your meter will have a row of four or perhaps five dials. Look at the meter face at the top of the page. On the dial on the far right, the numbers go around just as they do on a clock. But look at the dial next to it. The numbers go around in the opposite direction. It reads counterclockwise. Whether the numbers go clockwise or counterclockwise, always read the smaller of the two numbers the hand is between.
Here are some more dials.
What does this one read? ______

What is the reading on this dial? ______

What is the reading on this dial? ______

3. The dials are arranged left to right in the same order as the digits in the number. Write down the numbers in order from left to right.

What does this meter read?
______ ______ ______

What does this meter read?
______ ______ ______

What does this meter read?
______ ______ ______
4. Sometimes a hand seems to be pointing exactly at a number. Has it reached it yet or not? To find out, look at the dial to the right. If the hand on the dial to the right has already passed zero, then you should put down the number the other hand seems to be pointing at. If it hasn’t, put down the next lower number.

What do these two dials read? __ __

What do these two dials read? ___ __

What do these two dials read? __ __

What do these two dials read? __ __

What do these two dials read? __ __

What do these two dials read? __ __

What do these two dials read? __ __

What do these two dials read? __ __

What do these two dials read? __ __
5. In some areas, utilities may have different rules for reading the last dial. The meter-person may be instructed to put down whichever number the hand is closest to, or the highest of the two numbers the hand is between. What is the rule in your area?

6. Now we're ready to read meters. Read the following meters:
7. To find out how much energy we've used since the last time the meter was read, we have to subtract the old reading from the new reading. How much electricity did these houses use?

January 1 __ __ __ __  
February 1 __ __ __ __  

June 30 __ __ __ __  
July 30 __ __ __ __  

September 13 __ __ __ __  
October 13 __ __ __ __  

8. Some meters are marked "X-10" or "K-10." This means that, instead of reading kilowatt-hours, the meter reads tens (or twenties) of kilowatt-hours. If your meter has such a marking, you must multiply the reading by 10 (or, if the meter is marked "K-20," multiply by 20).
How to Read Natural Gas Meters

You will find it easy to learn how to read your gas meter, since you already know how to read an electric meter. The hands on the dials of the gas meter go around the same way as the hands on the electric meter, and follow the same rules:

If the hand is between two numbers, the reading is the lower of the two numbers.

The dials read from left to right, just like the numerals on a page.

If a hand seems to be exactly on a number, look at the dial to the right. If the hand on that dial is between 0 and 1, the reading is the number the hand is on. If the hand on the other dial is between 9 and 0, the reading is the next lower number.

Most gas meters look something like this:

On the top are two dials all by themselves. They are marked "one-half cubic foot" and "one cubic foot." The gas company uses these dials to check the meters, to make sure they are accurate. They are not used when you read the meter.

Notice that the dial on the far right is marked "1 Thousand." This means that each time the pointer on this dial goes around, a thousand cubic feet of natural gas has been used. The "9" on this dial therefore means 500 cubic feet. Because there are no hundred's or ten's dials, we must add two zeros to our reading to get the correct number of cubic feet.

Here are some meters. Write down their readings in the blanks provided.
Instructions
You want to find out how much electricity or natural gas is used each day over the course of a week. To do this, you will read a meter every day, at the same time each day.

Directions
1. Circle the type of meter you are reading. If your home has both an electric and a natural gas meter, make sure your teacher has told you which one you should read.
   - Electric (go to Step 2 and then Step 4)
   - Natural gas (go to Step 3 and then Step 4)

2. If a multiplier is shown on the electric meter, write it here: ______ Go to Step 4.

3. If you are reading a natural gas meter, write down the cubic-feet units it uses here: __________

4. Fill in the table on the next page with the meter reading data you are recording (see example). Write the units used by the meter in the box labeled "Meter Reading." Try to record your reading at the same time each day. Bring this sheet to class after you have completed the table.

Example:
A student reads an electric meter located on an outside wall of her house. There is no multiplier listed on the meter. Here are her daily meter readings for Monday and Tuesday.

<table>
<thead>
<tr>
<th>Day of the Week</th>
<th>Time</th>
<th>Meter Reading (List units.) kilowatt-hours</th>
<th>Difference in Readings</th>
<th>What Was Happening and How Was Energy Being Used During the Day?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>4:30 PM</td>
<td>4451</td>
<td></td>
<td>Spaghetti dinner (electric stove); family watched TV before bed; breakfast (coffee maker, microwave); then everyone left for school or work.</td>
</tr>
<tr>
<td>Tuesday</td>
<td>4:32 PM</td>
<td>4457</td>
<td>6</td>
<td>(4457 - 4451)</td>
</tr>
</tbody>
</table>

NOTE: If a multiplier was listed for an electric meter in Step 2, multiply meter readings by the multiplier number before recording them in the table.

If a multiplier such as "K-10" had been listed on the meter, then the entry for Monday would be 44510 (4451 x 10) and the entry for Tuesday would be 44570 (4457 x 10).
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Meter Reading (list units)</th>
<th>Difference in Readings</th>
<th>What Was Happening and How Was Energy Being Used from One Day to the Next?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday</td>
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<tr>
<td>Monday</td>
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<tr>
<td>Total</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
5. On the graph below or on a sheet of graph paper, plot the meter readings for the week.

<table>
<thead>
<tr>
<th></th>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wed.</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
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<tr>
<td>Difference in Reading</td>
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</tbody>
</table>

**Questions**

1. During which day was electricity or natural gas use the highest? During which 24-hour period was it the lowest?

2. Describe how the use of electricity or natural gas changed during the week. Did it change a lot or only a little?

3. Using your observations of what was happening and how energy was being used from one day to the next, explain the pattern of electricity or natural gas use that is shown on the graph you made.

4. Find out how much your family spent on energy during this time. Multiply the total energy used by the cost per kilowatt/hour (or per therm if measuring natural gas).

Example: If electricity is $0.06/kWh, then 30 kWh x $0.06/kWh = $1.50

5. Multiply this amount by 52 to get an estimate of your energy costs for a year. What do you think about your family's yearly energy costs?

6. Are there limitations with using this method to estimate your yearly energy costs? (Hint: Do you think your energy usage will be higher or lower six months from now?)
Objective
Students will be able to
• define energy;
• describe how energy is used to maintain, organize, and change systems;
• identify sources of energy;
• describe forms of energy; and
• explain how the first and second laws of thermodynamics apply to energy use.

Rationale
Writing projects provide students with unique opportunities to express their knowledge about energy—what it is, where it comes from, what forms it takes, and what properties it has.

Materials
• Copies of the following pages from the Student Book:
  - Project Proposal Form, page 88
  - Peer Review Form, page 89
  - Story Evaluation Form, page 91
• Samples of stories written by students from previous years, with the authors' names removed (optional)

Background
The primary message of the theme We Need Energy is that everything depends on energy. Thoroughly understanding this message involves answering some basic questions. These questions include “What is energy?” and “What does energy do?” To demonstrate that they have mastered the concepts in this theme, students should be able to describe accurately how they, their environment, and their community depend on energy. This description should include the definition of energy and how it behaves.

Writing-as-Learning does not consist of students sitting at their desks and writing a two-page essay that the teacher has to spend the weekend grading. Instead it is an ongoing, progressive process, where the evaluation is formative rather than summative. That is, teachers facilitate the development of students' written material, assess students' word choices and organizational skills, and note their progress. The key to success of the Writing-As-Learning approach is that students must be actively involved in the process. Students should view writing as a creative avenue to explore and express their comprehension rather than a chore. A benefit of using writing as an assessment tool is that students become better writers. The challenge of using the correct wording to relate new experiences to prior knowledge can enhance students' communication skills and vocabulary.

Writing is an engaging process where students are compelled to think on paper. Students need to analyze, interpret, and work to make words and sentences correctly express what they understand. By reading students' creative writing projects, teachers gain insight into students' thought processes about essential energy concepts. Students should keep these stories and use them to refresh their memories about energy.

Procedure
Orientation
Invite students to author a potential best-selling story about energy. This story might be presented in written form or as a play, video, or comic strip.

Review the role energy plays in our lives and how it is often overlooked and unappreciated. Explain that energy is a challenging topic because it is so abstract. Tell students that their mission, as good authors, is to take this complex, important topic and write a story that is meaningful to the
average reader. Warn students that this is a challenging project, but their reward will be a unique understanding of energy that should be shared with the general public.

Steps
1. Introduce students to the Project Proposal Form. Share the evaluation criteria listed on the Story Evaluation Form:
   - Discuss the evaluation criteria and tell students that the main objective is accurate representation of important energy concepts. If possible, have samples that do and do not meet the criteria available for student reference.
2. As a class, identify important energy concepts that should be included:
   - Begin with a prewriting activity where students identify major concepts in energy that they know or would like to know (use the project criteria as a reference). It may help to relate activities and lessons in which they have participated that addressed energy concepts. Students can use a graphic organizer such as a concept map to arrange the concepts.
3. Divide the class into cooperative working groups of two or three students:
   - Discuss responsibilities associated with developing stories, such as designing, researching, drafting, reviewing, revising, and presenting. Students may want to assign certain responsibilities to different group members.

NOTE: This can also be a project where the whole class works together to create one story (for example, each cooperative learning group can develop a chapter). Another approach is to have students work individually.

4. Ask groups to decide on a story line and distribute the Project Proposal Form. Invite the groups to brainstorm fun ways to tell the story. They should decide on their audience, the setting, a plot, and how their main message (the importance of energy) will be delivered. Following are several creative approaches to presenting the story:
   - Adventures of energy as it flows through human and/or natural ecosystems (could be presented as a cartoon strip)
   - A “whodunit” mystery where the reader must “track” or locate evidence of energy
   - A script for a play or a video
   - An interview where people share their experiences with and insights into energy
   - A story of energy in one day of your life (perhaps a birthday or a community event)
   - An illustrated storybook for younger children

Tell students to identify the pros and cons of each format. Help students to select the approach that is most feasible, yet provides a creative challenge. After students have a general idea of how they want to write the story and what energy information to include, have them complete their Project Proposal Form. Meet with the groups to discuss the form and to help them clarify their questions concerning the information they need to write the story.

Getting Ready:
Students can be encouraged to keep an “Energy Learning Log” to prepare for this writing activity (see Appendix).

This activity can be presented at the beginning, middle, or end of an energy unit. Or this activity can be the energy unit, because researching and writing the story will help the students learn and understand basic energy concepts. Students can be given class time to conduct research or be expected to do this on their own. In addition, students can gain knowledge and skills about effects of energy use and development through participating in other class activities such as those found in the KEEP Activity Guide.
Resources:
For Teachers


For Students


5. Researching and writing the first draft: Help students identify strategies to answer the questions related to their story. Encourage students to develop a system, such as an "Energy Learning Log," for recording and organizing their research. As much as possible, allow students class time to complete the project. This time can be used to monitor student progress, answer questions, and provide editorial suggestions. This also gives you the opportunity to observe group dynamics, and make sure each student is doing his or her fair share.

6. Reviewing the first draft: The purpose of the review is to identify where text can be added, deleted, or streamlined to strengthen the accuracy and presentation of energy concepts in the story. Help students to understand that if stories are carefully reviewed, revised, and edited, the results of the final evaluation should not be surprising.

Stories can be reviewed by students as well as by you. A Peer Review Form has been provided to guide students' reviews of each others' stories. Encourage the reviewers to point out the strengths of the story first, and then provide suggestions to improve the story. Visit each group to monitor their discussions.

7. Revising the story based on the review: When the groups receive their reviews, they should brainstorm how they'll address the comments. Things to consider include "What additional research is needed?" "Which ideas should we accept or reject and why?" and "How should we incorporate suggestions?"

During the revision process students should pay attention to their writing skills, taking care to use proper spelling, grammar, and punctuation. When they have completed the final draft, another student (a fresh pair of eyes) needs to read and edit it, because authors often miss or overlook their own errors.

8. Editing the final draft: Editing can also be conducted by peers. Remind students that they are to focus only on spelling and grammatical errors, and not rearrange or critique the content, as this should have been addressed in the review. Rather than expecting every mistake to be identified, encourage the editors to concentrate on two or three types/kinds of recurring errors. Be available to answer questions and check students' work to make sure their editorial comments are correct and to make sure nothing important has been overlooked.

Closure
Have the groups read or present their completed stories to each other. Students may be motivated to take extra care in developing their stories if they know they will be read or seen by an audience outside the classroom. Discuss creative ways to display or present the stories. The local library or businesses may be interested in exhibiting copies of students' work. If the stories are entertaining and educational, they can be published and sold as a fund-raiser or donated to another class or school.

Assessment
Formative
• Did students work together cooperatively in groups?
• Did they ask pertinent and insightful questions?
• Did they conduct reviews seriously, providing useful comments?
• How did they respond to and address the reviews of their project?

Summative
The Story Evaluation Form provides an agree/disagree scale to evaluate papers. Passing grades should receive "Strongly Agree" and "Agree." Modify or adapt this form as needed.
## Project Proposal Form

<table>
<thead>
<tr>
<th>Name(s)</th>
<th>Responsibilities*</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
</tr>
</tbody>
</table>

*If this is a group project, write down each person's primary responsibility.

### Purpose of Project

To develop a story that emphasizes the importance of energy in our lives.

#### Date Story is Due

#### Suggested Length

#### Summary of Proposed Story Line (include audience, setting, and general plot description)

### Criteria

The purpose of the project must be emphasized within the story.

The story must address the following questions:

- What is energy?
- What evidence is there that energy is being or has been used?
- Where does the energy come from? (Identify sources.)
- In what forms does energy exist?
- What happens to energy as it is being used? (Relate to energy transfer and conversion; also tie in the first law of thermodynamics.)
- What are the limitations of energy use? (Relate to the second law of thermodynamics.)

The story must be edited and checked to make sure grammar, punctuation, spelling, etc. are correct.

Include other criteria or considerations.

Generate a list of additional questions about energy you'll need to know to write this story.
Title of the Story _______________________________________________________

Author(s) ____________________________________________________________

Reviewer(s) __________________________________________________________

---

Answer each of the following questions carefully, highlighting strengths and providing suggestions whenever possible.

Does this story address the purpose of this project? Why or why not?

What do you like best about this story?

What did you find confusing or difficult to understand in the story?

How effectively does the story meet each of the criteria for this project?

What suggestions do you have for improving the story? (Focus on suggestions for addressing the purpose of the project and meeting criteria.)

On the back or on another piece of paper, write any other comments you have. (You may refer to Supplemental Review Questions.)

---

KEEP Student Book | theme I: we need energy | Energy Story
Supplemental Review Questions

Instructions
Add these questions to the Peer Review Form as needed.

How would you summarize the story line? (Include audience, setting, and general plot description.)

What made it easy or difficult to summarize the story?

Is the story original?

What made the story interesting? What made it dull?

Was the story easy to understand? (Consider organization, sense of purpose, and plot development.)

To what extent did mechanical errors (spelling, grammar, punctuation, etc.) make reading difficult?

How thoroughly and accurately are each of the following incorporated into the story?
  • Energy defined
  • Evidence that energy was or is being used
  • Sources of energy identified
  • Different forms of energy described
  • Descriptions of what happens to energy as it is being used
  • Limitations of energy use

Who is the intended audience for this story?

Do you think the audience will clearly understand and appreciate how the author(s) think and feel about energy? Will they gain insight into important energy concepts?

Include other considerations.
The story emphasizes the importance of energy.  

<table>
<thead>
<tr>
<th>STRONGLY AGREE</th>
<th>AGREE</th>
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<th>STRONGLY DISAGREE</th>
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Comments:

The story properly addresses the criteria.  

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</table>

Comments:

The story is original, interesting, and creative.  

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<th>STRONGLY DISAGREE</th>
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Comments:

The story is well organized.  

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Comments:

The story is readable (including grammar, spelling, and punctuation).  

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Comments:

The story has been turned in on time.  

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<th>YES</th>
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Comments:

The story is the correct length.  

<table>
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<th>YES</th>
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</table>

Comments:

The story deserves a passing grade.  

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</table>

What I liked best about the story:

Suggestions I have for improving the story (see above for comments):

- The above comments and suggestions could be made; consider them for your next project.
- The above comments and suggestions should be made to improve the grade of this project.
- The above comments and suggestions must be made to receive a passing grade.
Appendix F

Follow-up survey
Please take a few minutes to fill out this survey, it will help me immensely with my graduate project and help to understand the EE needs of the staff. Return the surveys to my mailbox (Monet-Bakken) or drop them off at my room.

Check all that apply

1. Do you infuse Environmental Education standards in your classroom?
   _ Yes _ No _ What are Environmental Education Standards?

2. Do you have Environmental Education resources?
   _ Yes _ No _ What are Environmental Education resources?

3. Would you like Environmental Education resources appropriate for your classroom?
   _ Yes _ No _ I still don’t understand what an Environmental resource is.

4. Did you participate in including Global Warming theme into at least one of your lessons for Earth Day?
   _ Yes _ No
   Please explain how you participated.

5. Have you infused more EE into your curriculum this year compared to other years?
   _ Yes _ No

6. What helped you most in infusing more EE in your curriculum?
   _ Earth Day reminder
   _ Lessons hand delivered
   _ EE Resources
   _ Other (please explain) ______________________________________________________________

7. What barriers still exist that prevent you from including more EE in your curriculum?
Appendix G

Comparison of Initial and Follow-up Surveys
### Data from Initial Survey

#### Actual Numbers from Initial Survey

<table>
<thead>
<tr>
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<td>Do you have EE resources?</td>
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<td>Would you like EE resources?</td>
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#### Actual Survey Numbers on infusing (X) or could infuse (?) EE Standards

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Data From Initial Survey

Pre-survey of teaching EE standards

EE standards in classrooms pre-survey results
### Data from Follow up Survey

#### Actual Numbers from Follow up Survey

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<tr>
<th>Question</th>
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<td>Do you have EE resources?</td>
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<tr>
<td>Would you like EE resources?</td>
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<tr>
<td>Did you participate in the Earth Day Theme</td>
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<td>Have you infused more EE in your curriculum this year compared to other years?</td>
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<table>
<thead>
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<th>What barriers still exist that prevent you from infusing EE in your curriculum?</th>
<th>Time</th>
<th>Information</th>
<th>Technology</th>
<th>Lack of administrative support</th>
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<table>
<thead>
<tr>
<th>What helped you most in infusing EE in your curriculum?</th>
<th>Earth Day reminder</th>
<th>Lessons hand delivered</th>
<th>EE resources</th>
<th>Other</th>
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Follow up survey results

What barriers still exist that prevent you from infusing EE in your curriculum?
Comparison of Initial and Follow up Survey

Change in "yes" responses to survey questions

Change in "no" response to survey questions
Appendix H

Rubicon Atlas Curriculum Mapping
<table>
<thead>
<tr>
<th>UNIT</th>
<th>DISTRICT OBJECTIVES/BENCHMARKS (WI STANDARDS-SUBJECT, NUMBER)</th>
<th>TERMS/CONCEPTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>01-Biochemistry</td>
<td>Students will: 1. List &amp; explain the three subatomic particles (Science, D.12.1) 2. Use the periodic table (Science, D.12.1) 3. Distinguish types of chemical bonds (Science, D.12.4) 4. Use chemical equations (Science, D.12.4) 5. Distinguish molecules with attraction, repulsion to water (Science, D.12.4) 6. Distinguish between polymer, monomer for the 4 major biological molecules (Science, D.12.1) 7. Explain the three major types of polysaccharides and where they are found (Science, F.12.1) 8. Explain how the phospholipid bilayer works (Science, F.12.1) 9. Identify types of steroids (Science, D.12.1) 10. Identify condensation synthesis and hydrolysis reactions (Science, D.12.4) 11. List the subunits of a nucleotide (Science, F.12.1) 12. Explain essential &amp; nonessential amino acids (Science, F.12.1) 13. Explain how coupling reactions occur (Science, D.12.3) 14. Explain enzyme kinematics (Science, D.12.4) 15. Identify acids and bases (Science, D.12.6) 16. Evaluate whether carbohydrates or fats are suited for Energy storage (Science, D.12.3) 17. Distinguish between the four levels of protein structure (Science, D.12.1) 18. Explain the 1st and 2nd laws of energy (Science, D.12.10)</td>
<td>- Proton, neutron, electron, nucleus, electron cloud, valence electrons, isomers  - Atomic Number, Atomic Weight, ionic Charge, ion  - Ionic, covalent, hydrogen bonds  - Reactants, Products  - Hydrophobic, hydrophilic  - Mono-, di-, polysaccharides: Carbohydrates; fatty acids, glycerol, triglycerides: Lipids; Amino Acids: Proteins;  - Nucleotides: Nucleic Acids  - Glycogen, starch, cellulose  - Testosterone, estrogen, cholesterol  - Peptide Bonds  - Sugar, Base, Phosphate group  - Endergonic, exergonic reactions  - Reaction rate, substrate, enzyme-substrate complex  - pH scale  - primary, secondary, tertiary, quaternary  - conservation of energy, energy transfer</td>
</tr>
<tr>
<td>02-Cells</td>
<td>Students will: 1. List and explain the two tenets of the Cell Theory (Science, F.12.3) 2. Explain theories/reasons why cells have evolved to be small (Science, F.12.3) 3. Compare/contrast the differences between Eukaryotic and Prokaryotic Cells (Science, F.12.1) 4. Compare/contrast the differences between Plant and Animal cells (Science, F.12.1) 5. List and explain the five pieces of evidence to the Endosymbiotic hypothesis (Science, F.12.3) 6. List and explain the two parts of the Fluid Mosaic Model (Science, F.12.1) 7. Distinguish molecules which can travel through a selectively permeable membrane (Science, F.12.1) 8. Compare/contrast Active and Passive Transport (Science, F.12.10) 9. Compare/contrast Diffusion and Osmosis (Science, F.12.1) 10. Compare/contrast Simple and Facilitated diffusion (Science, F.12.1) 11. Analyze which way water will flow in Hypertonic, Hypotonic, or Isotonic solutions (Science, F.12.1) 12. Estimate relative molecule sizes based on</td>
<td>- Surface area, volume, ratio  - Cell membrane, wall, nucleus  - Concentration, gradient  - Solute, pressure  - Mitochondria, chloroplast, lysosome, vacuole, ribosome, nucleus, cytoskeleton, endoplasmic reticulum, golgi apparatus  - Phagocytosis, pinocytosis  - Prophase, metaphase, anaphase, telophase  - G1, S, G2, interphase, cytokinesis, karyokinesis</td>
</tr>
<tr>
<td><strong>03a- Photosynthesis</strong></td>
<td><strong>03b- Respiration</strong></td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td>Students will:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Compare E transfer efficiencies of photo / respiration (Science, F.12.10)</td>
<td>Students will:</td>
<td></td>
</tr>
<tr>
<td>2. Identify the characteristics of a RedOx reaction (Science, D.12.6)</td>
<td>1. Specify why terms respiration and breathing are misused (Science, A.12.4)</td>
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<tr>
<td>3. Memorize the overall reactions for photosynthesis and respiration (Science, F.12.1)</td>
<td>2. Compare / contrast photosynthesis &amp; respiration (Science, F.12.1)</td>
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<td>4. Interpret a diagram depicting the % E harnessed from the Sun (Science, F.12.10)</td>
<td>3. Compare/ contrast aerobic &amp; anaerobic (Science, F.12.1)</td>
<td></td>
</tr>
<tr>
<td>5. Relate an ETS to a turbine dam and explain ATP production (Science, F.12.9)</td>
<td>4. Explain why most advanced animals undergo aerobic (Science, F.12.10)</td>
<td></td>
</tr>
<tr>
<td>6. Analyze early experiments testing plant growth vs. soil loss (Science, F.12.11)</td>
<td>5. Relate the type of cell and number of mitochondria (Science, F.12.11)</td>
<td></td>
</tr>
<tr>
<td>7. Distinguish which wavelengths of light are absorbed by plant pigments &amp; explain the color of plants (Science, F.12.9)</td>
<td>6. Explain why the E of glucose is released in stages and steps (Science, F.12.11)</td>
<td></td>
</tr>
<tr>
<td>8. Discuss factors affecting pigment separation in chromatography (Science, F.12.1)</td>
<td>7. Contrast ender &amp; exergonic as they relate to glucose and ATP (Science, F.12.10)</td>
<td></td>
</tr>
<tr>
<td>9. Calculate an Rf value &amp; compare pigment movements (Science, F.12.1)</td>
<td>8. List the four (five) stages of respiration (Science, F.12.1)</td>
<td></td>
</tr>
<tr>
<td>10. Identify where the light &amp; dark rxns occur in the chloroplast (Science, F.12.9)</td>
<td>9. Explain the processes of Glycolysis, Transition Reaction, Krebs cycle, ETS, Fermentation. (Science, F.12.1)</td>
<td></td>
</tr>
<tr>
<td>11. Explain how Photosystems I &amp; II work (Science, X.12.0)</td>
<td>10. For each of the above, explain Where, When, Aerobic (?), Final Product, ATP formed (Science, F.12.9)</td>
<td></td>
</tr>
<tr>
<td>12. List the steps of the cyclic / non-cyclic pathways (Science, F.12.9)</td>
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<td></td>
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<tr>
<td>11. Define Metabolism (Science, D.12.3)</td>
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<td>04-Heredity Students will:</td>
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<tr>
<td>1. Explain the process of meiosis (Science, F.12.4)</td>
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<tr>
<td>2. Compare and contrast meiosis/mitosis (Science, F.12.4)</td>
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<td>3. Interpret class trait data to determine dominance for traits (Science, F.12.3)</td>
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<tr>
<td>4. Analyze simulated blood sample results to determine blood types (Science, F.12.3)</td>
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<td>5. Solve genetics problems involving different forms of inheritance (Science, F.12.3)</td>
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<tr>
<td>6. Relate the laws of probability to genetic inheritance (Science, F.12.3)</td>
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<tr>
<td>7. Analyze pedigree charts (Science, F.12.3)</td>
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<tr>
<td>8. Examine and solve karyotype example problems (Science, F.12.3)</td>
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<tr>
<td>05-Molecular Genetics Students will:</td>
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<tr>
<td>9. Compare and contrast the different forms of nucleic acids: Interpret the findings that led to the base pairing rules and Chargaff’s rules (Science, B.12.2)</td>
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<tr>
<td>10. Explain the Watson&amp;Crick model of DNA: Double stranded, backbone P-S-P, bases h-bonded, double helix, 5’→3’ direction (Science, F.12.2)</td>
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<td>11. Describe the DNA replication process (Science, F.12.2)</td>
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<td>12. Describe how errors in the replication process are recognized and repaired (Science, F.12.2)</td>
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<tr>
<td>13. Compare/contrast the three types of RNA (Science, F.12.4)</td>
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<td>14. Translate the strands of DNA using the genetic code (Science, D.12.3)</td>
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<td>15. Explain the process of transcription (Science, F.12.2)</td>
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<td>16. Explain the three steps of translation (Science, F.12.2)</td>
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<td>17. Describe the Prokaryotic regulation Operon model (Science, F.12.2)</td>
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<tr>
<td>18. Compare/contrast the lac and trp operon (Science, F.12.2)</td>
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<tr>
<td>19. Explain mutations and relate them to Cancer (Science, F.12.2)</td>
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<td>20. Illustrate the process of gene splicing using restriction enzymes (Science, B.12.4)</td>
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<td>06-Evolution Students will:</td>
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<td>1. Discuss a brief history of Charles Darwin and his voyage (Science, B.12.1)</td>
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<tr>
<td>2. Differentiate between view held before Darwin and after (Science, B.12.1)</td>
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<td>3. Relate the evidence Darwin found to his thoughts on evolution (Science, B.12.4)</td>
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<td>4. Express these four areas of evidence used to support evolution (Science, B.12.4)</td>
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<tr>
<td>5. Employ the Hardy-Weinberg law/equation (Science, F.12.6)</td>
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<tr>
<td>6. Interpret the Hardy-Weinberg law (Science, F.12.6)</td>
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<tr>
<td>7. Compare/contrast Darwin and Lamarck (Science, A.12.2)</td>
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<tr>
<td>8. Relate the game ‘survival of the fittest’ to natural selection (Science, F.12.5)</td>
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<tr>
<td>9. Explain the three types of natural selection (Science, F.12.5)</td>
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<tr>
<td>10. Relate continental drift and mass extinction to</td>
<td></td>
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<td>11. Interpret the mitochondrial DNA research with respect to human origins (Science, F.12.6)</td>
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<td>12. Analyze where humans fit in the classification of primates (Science, F.12.6)</td>
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<tr>
<td>13. Explain what australopithecines are (Science, F.12.6)</td>
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<tr>
<td>14. Formulate a timeline of all the previous hominid species (Science, F.12.6)</td>
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<tr>
<td>15. Compare the 'Out of Africa' and 'Multiregional' hypotheses (Science, F.12.6)</td>
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<tr>
<td>16. Relate Neandertals and Cro-Magnons to modern humans (Science, F.12.6)</td>
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<table>
<thead>
<tr>
<th>07-Human Systems</th>
<th>Students will:</th>
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<tbody>
<tr>
<td>1. Explain the skeletal system (Science, F.12.11)</td>
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<tr>
<td>2. Explain the muscular system (Science, F.12.11)</td>
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<td>3. Explain the respiratory system (Science, F.12.11)</td>
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<td>4. Explain the circulatory system (Science, F.12.11)</td>
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<td>5. Explain the digestive system (Science, F.12.11)</td>
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<tr>
<td>6. Explain the urinary system (Science, F.12.11)</td>
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</tbody>
</table>
Appendix I

Curriculum Committees
Campbellsport School District Curriculum Teams
(A teacher co-chair will be selected for each committee)

Reading/Language Arts—Administrative Co-Chair, Connie Strand

Patty Baker  |  Amie Giese  |  Keith Rooker
Wanda Bellmer |  Jason Gilhaus|  Jeanine Schraufnagel
Melissa Cochran |  Dianne Graf |  Jan Soyk
Torie Daane |  Kathy Koyen |  Jenny Voightlander
Michelle Dahlinger |  Beth Lambie |  Kay Wehner
Marci Danza |  Vi Lamers |  Jasmine Weller
Carol DeRemer |  Tiffany Meidl |  Brendon Young
Michelle Fredricks |  Diane Mencheski |  
Kimberly Hatch |  Patty Pelischek |  

Mathematics—Administrative Co-Chair, Tom Koyen

Thea Ash  |  Pam Fleischman |  Wendy Krcmar
Julie Baseley |  Jesse France |  Marshall Olson
Jeff Baughman |  Dan Heisdorf |  Heidi Retzer
Diane Blackmore |  Bonnie Herman |  Candy Roth
Jeanne Cisewski |  David Kelln |  Mike Ruhl
Cindy Delgado |  Jeff Krcmar |  Nick Weisse

Social Studies—Administrative Co-Chair, Tom Hercules

Sandra Alvarado |  Steve Hamm |  Rick Simpson
Joan Bradford |  Shelly Hoenecke |  Tina Sokol
Craig Ellenbecker |  Mike Kulibert |  Donna Standke
Shelly Gassner |  Betty Lindemer |  Tina Werderman
Dion Grisar |  Kurt Parker |  
Jane Gurno |  Lynne Rodman |  

Science—Administrative Co-Chair, Michael Maxson

Stephanie Ballard |  Steve Heminger |  Becky Palmer
Jim Dichraff |  Bob Hepp |  Kay Spielbauer
Sarah Desiderio |  Kevin Hugo |  Billi Timm
Kris Engstrom |  Jay Killinger |  Mary Waters
Melissa Gellings |  Tanya Monet-Bakken |  

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Fine Arts—Administrative Co-Chair, Michael Maxson

Sharyl Aubuchon
Linda Boelhke
Shanda Cerney
Dan Gazzola
Royal Gingery

Mandy Liebenow
Erin Nelson-George
Dan Seidl
Sue West

Guidance—Administrative Co-Chair, Laura Stautz

Sherry Collins
Kathy Gravelle
Linda Gross
Gene Mathews

Judy McCabe-Krudwig
Raebecca Olson
Diana Pasten

Information/Technology Literacy—Administrative Co-Chair, Michael Maxson

Julia Crouch
Chris Fredricks

Dave Skaaland
Sue Wolf

Physical Education/Health—Administrative Co-Chair, Tom Koyen

Mark Immel
Pat Kent
Mary Lindberg

Mark Peterson
Darcy Salm
Sara Wettstein

Vocational Education (Agriculture, Business Ed., FACE, Technology)—Administrative Co-Chair, Connie Strand

Gerry Burr
Ree Koth
Kirk Kramp
Joan Mayer
Oran Nehls

Teri Panzer
Shawn Prell
Carl Semrow
Tina Trumbower
Doug Walkner

World Languages—Administrative Co-Chair, Tom Hercules

Mar Ellenbecker
Lisa Rashid