We’re Having a WALE of a Time
Wells, Aquifers, Landfills and the Environment

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Science 9
9th Grade General Science
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We’re having a WALE of a Time
Wells, Aquifers, Landfills and the Environment
Unit Plan

In fulfillment of requirements for Michigan Technological University’s SS 5150 Natural Hazards and Human Impacts Class.

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This second unit plan of the summer of 2008 is dedicated to my daughter Sydney. She has given up so much of her time with her mom this summer so that I may take classes to ensure both of our lives are enriched through learning new knowledge. I love you very much Sydney.

Mom
I. Unit Overview

This unit was specifically designed for 8th or 9th grade Earth Science students. This unit explores human use of wells, aquifers, landfills and their interaction directly and indirectly within the environment. Students experience a one day field trip to Camp McGregor and Liberty Environmental Landfill to explore natural hazards that can be associated with water usage. At Liberty Environmental Landfill, students will be greeted by Fox and Boley Drilling Inc. to discuss with them how wells are drilled. Upon completion of this unit, students will have a greater understanding how water moves over time throughout the atmosphere, hydrosphere, lithosphere and biosphere in a systems approach. Students will also gain a greater understanding of how human impacts on the natural environment effect future generations. Students also acquire a greater understanding in their role in the community in protecting such a valuable resource such as water for sustainability of the environment and the Earth.

II. Sources Consulted

Sources for this unit plan were derived from the various presentations, lectures, field studies, shared ideas and readings from the Natural Hazards and Human Impacts Course (June 23rd through July 3rd 2008) at Michigan Technological University. Individual lesson plan references that were consulted are listed at the end of lesson in the unit. A list of additional resources is listed at the end of this unit plan for extensions on activities and reference materials.

III. Learning Objectives

Students in the 9th grade Science 9 class will be engaged in the day’s activities and speakers to achieve the following outcomes and/or learning objectives.

- Students will describe how aquifers hold groundwater and how wells are drilled.
- Students will be able to discuss the environmental impacts landfills could potentially have on the water shed.
- Students will be able to define terms such as water table, porosity, leaching and permeability groundwater transport.
• Students will learn their role in the community in protecting a valuable resource such as water for sustainability of the environment and the Earth.
• Students will have a greater understanding how water moves over time throughout the atmosphere, hydrosphere, lithosphere and biosphere in a systems approach.

IV. State or National Standards

State and/or national content expectations for this unit are listed below:

Earth Science High School Content Expectations

• E1.1 Scientific Inquiry
  Science is a way of understanding nature. Scientific research may begin by generating new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical reasoning. Some questions in science are addressed through indirect rather than direct observation, evaluating the consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.
  • E1.1A Generate new questions that can be investigated in the laboratory or field.
  • E1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.
  • E1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).
  • E1.1D Identify patterns in data and relate them to theoretical models.
  • E1.1E Describe a reason for a given conclusion using evidence from an investigation

• E1.2 Scientific Reflection and Social Implications
  The integrity of the scientific process depends on scientists and citizens understanding and respecting the “Nature of Science.” Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning
during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.

- **E1.2A** Critique whether or not specific questions can be answered through scientific investigations.
- **E1.2B** Identify and critique arguments about personal or societal issues based on scientific evidence.
- **E1.2C** Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.
- **E1.2D** Evaluate scientific explanations in a peer review process or discussion format.

**E2.1 Earth Systems Overview**
The Earth is a system consisting of four major interacting components: geosphere (crust, mantle, and core), atmosphere (air), hydrosphere (water), and biosphere (the living part of Earth). Physical, chemical, and biological processes act within and among the four components on a wide range of time scales to continuously change Earth’s crust, oceans, atmosphere, and living organisms. Earth elements move within and between the lithosphere, atmosphere, hydrosphere, and biosphere as part of geochemical cycles.

- **E2.1A** Explain why the Earth is essentially a closed system in terms of matter.
- **E2.1B** Analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth.
- **E2.1C** Explain, using specific examples, how a change in one system affects other Earth systems.

**E4.1 Hydrogeology**
Fresh water moves over time between the atmosphere, hydrosphere (surface water, wetlands, rivers, and glaciers), and geosphere (groundwater). Water resources are both critical to and greatly impacted by humans. Changes in water systems will impact quality,
quantity, and movement of water. Natural surface water processes shape the landscape everywhere and are affected by human land use decisions.

- **E4.1A** Compare and contrast surface water systems (lakes, rivers, streams, wetlands) and groundwater in regard to their relative sizes as Earth’s freshwater reservoirs and the dynamics of water movement (inputs and outputs, residence times, sustainability).

- **E4.1B** Explain the features and processes of groundwater systems and how the sustainability of North American aquifers has changed in recent history (e.g., the past 100 years) qualitatively using the concepts of recharge, residence time, inputs, and outputs.

- **E4.1C** Explain how water quality in both groundwater and surface systems is impacted by land use decisions.

**English and Language Arts High School Content Expectations**

**STANDARD 2.1 Develop critical reading, listening, and viewing strategies.**

- **CE 2.1.1** Use a variety of pre-reading and previewing strategies (e.g., acknowledge own prior knowledge, make connections, generate questions, make predictions, scan a text for a particular purpose or audience, analyze text structure and features) to make conscious choices about how to approach the reading based on purpose, genre, level of difficulty, text demands and features.

- **CE 2.1.2** Make supported inferences and draw conclusions based on informational print and multimedia features (e.g., prefaces, appendices, marginal notes, illustrations, bibliographies, author’s pages, footnotes, diagrams, tables, charts, maps, timelines, graphs, and other visual and special effects) and explain how authors and speakers use them to infer the organization of text and enhance understanding, convey meaning, and inspire or mislead audiences.

- **CE 2.1.3** Determine the meaning of unfamiliar words, specialized vocabulary, figurative language, idiomatic expressions, and technical meanings of terms through context clues, word roots and affixes, and the use of appropriate resource materials such as print and electronic dictionaries.

- **CE 2.3.5** Engage in self-assessment as a reader, listener, and viewer, while monitoring comprehension and using a variety of strategies to overcome difficulties when constructing and conveying meaning.
• **CE 2.3.6** Reflect on personal understanding of reading, listening, and viewing; set personal learning goals; and take responsibility for personal growth.

V. **One Day Field Trip Agenda to Camp McGregor**

One Day Field Trip Agenda to Camp McGregor  
We’re having a WALE of a Time—Wells, Aquifers, Landfills and the Environment

7:30 to 8:00 Bus ride to Camp McGregor

8:00 to 8:30 Introduction to the schedule for the day and warm-up

8:30 to 9:25 Pennsylvania’s Cool Water Resource Team Teaching Pairs Quest (Computer Lab)

9:30 to 10:00 Speaker from Fox and Boley Inc. Well Drilling

10:00 to 12:15 Bus Ride to Liberty Landfill

12:00 to 12:30 Lunch

12:30 to 1:30 Cool Water Resource Group Presentations

1:35 to 2:10 Water Sample Quality Collection at Lake

2:15 to 3:25 Water Sample Testing in Lab

3:30 to 4:00 Discussion of Pollution and the Students Role in the Environment

4:05 to 4:30 Load Buses and drive back to the High School

VI. **Speaker Contact Information for Fox and Boley Drilling Inc. and Liberty Landfill**

Contact Information:

**Fox and Boley Drilling Inc.**  
6655 Brooklyn Road  
Jackson MI 49201  
517-536-8869  
517-536-4759
VII. One Day Field Trip to Camp McGregor with Activities, Lectures and Labs

I. Title of Lesson: We’re Having a WALE of a Time-Wells, Aquifers, Landfills and the Environment

   Length of Lesson: 1 Day Field Trip to Camp McGregor

   Grade Level: 9th Grade-Science 9

II. Introduction:

   Statement of problem:
   - How do landfills contribute to the contamination of aquifers and wells and how can humans prevent this contamination?

   Intended outcomes:
   - Students will describe how aquifers hold groundwater and how wells are drilled/dug.
   - Students will be able to discuss the environmental impacts of landfills could potentially have on the water shed.
   - Students will be able to define terms such as water table, porosity, leaching and permeability groundwater transport.
   - Students will learn their role in the community in protecting a valuable resource such as water for sustainability of the environment and of Earth.
• Students will have a greater understanding how water moves over time throughout the atmosphere, hydrosphere, lithosphere and biosphere in a systems approach.

IV. High School Content Expectations:
Earth Science High School Content Expectations are listed under the state and/or national standards section at the beginning of the unit.

V. Lesson Objectives:

Content Objectives-students will:
• Students will describe the layers of the water table including the saturated and unsaturated zones.
• Students will describe how aquifers hold groundwater and how wells are drilled or hand dug.
• Students will be able to discuss the environmental impacts of landfills could potentially have on the water shed.
• Students will be able to define terms such as water table, porosity, leaching and permeability groundwater transport.
• Students will have a greater understanding how water moves over time throughout the atmosphere, hydrosphere, lithosphere and biosphere in a systems approach.

Literacy Objectives-students will:
• Read for information.
• Read to perform a task.
• Read to develop fluency.
• Acquire new vocabulary.
• Synthesize information from the text.
• Make inferences from the text.

VI. Materials Needed at Camp McGregor and Liberty Landfill:
• Print
http://www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/groundwaterprotection/gw
Contact Information for Camp McGregor:

Where nature & learning meet
(And other cool things happen!)

Camp McGregor is 85-acres of nature at its best with lush woods, open meadows, and animals in their natural habitat on the shores of pristine Crispell Lake. The Jackson County ISD has owned and operated Camp McGregor ever since it received the camp from its former owners -- the 4-H Club. The camp is an integral part of the ISD, serving each division to ensure that Jackson County students, parents, educators and community get the most out of public education.

The camp is home to the JCISD's Math & Science Center and observatory -- one of the most modern computer-driven telescopes you'll find in the state. The high-tech science facilities at Camp McGregor demonstrate our commitment to the success of all students by offering educational programs to our local school districts.

The camp also hosts a special education camp each summer for Lyle Torrant students, illustrating our commitment to providing diverse opportunities and experiences for each student. Camp McYack is another JCISD special education program held at the camp each June.

The camp is available for private rental based on availability. It is also home for all of the 4-H Horse Shows during the spring and summer each year. Camp McGregor offers:
• Nature Trails
• Sandy Beach Lakefront (boat launch located nearby)
• Lodge Banquet Facility with commercial kitchen and seating for 100 people.
• 6 Cabins with Electricity
• Shower House
• Picnic Pavilion

For more information, explore the resource links on this page, or contact:

Camp office: (517) 529-0002

E-mail: susan.jamieson@jcisd.org

For Information or Reservations, contact:
Mark & Sue Jamieson,
Camp Directors
(517) 529-0002

Or e-mail: susan.jamieson@jcisd.org

Camp McGregor
Located on Crispell Lake
10380 Adams Road
Clarklake, MI  49234

VI. Safety Concerns:

At the landfill field trip students will stay together as a group during the exploration of the landfill and follow the directions of the presenter to insure safety at the facility. There are no safety concerns associated with this field that the instructor needs to be aware of at this time.

VIII. Instructional Input:

Block 1-Introduction to the Day and Warm-Up Discussion (8:00am to 8:30am)

Teacher ask the students to make generalizations about the water cycle drawing on previous knowledge (Implicit Teaching Strategy, Walker, pp. 258-259) Students will also discuss the Earth Systems Science Venn Diagram handout and how these systems interact with each other in positive and negative ways.

Block 2-Pennsylvania’s Cool Water Resource Activity (8:30am to 9:25am)
Students will be reading selected sections of Pennsylvania’s Cool Water Resource provided by the instructor. Students will be paired up with another student and given a small section of this booklet to read and create a mini lesson to teach the other students in the afternoon presentation section of the day. Students may use overhead transparency sheets with the overhead projector or create a poster to assist them in accomplishing the teaching of their particular section of the Pennsylvania’s Cool Water Resource activity. Student will also produce of the many previous learned graphic organizer flow charts during their presentation. *(Graphic Organizer Strategies, Walker 2004)*

**Block 3-Speaker from Fox and Boley Drilling Inc. (9:30am to 10:00am)**

Students will have a speaker come in from Fox and Boley Drilling Inc. and speak to them regarding how a well is dug or drilled into an aquifer for water. They will also be given an opportunity observe the parts of a drilling rig. A representative from Fox and Boley Drilling Inc. will bring one of their drilling trucks and explain how they are used to drill into various layers of the ground in search of water. A representative will also bring the various materials that wells are constructed of (such as casing, pumps, caps etc.) for students to see as a visual reference to underground construction of a well casing.

**Block 4 Liberty Landfill (10:00am to 12:15pm)**

Students will ride to Liberty Landfill and take a tour of the facility of waste management. Staff will discuss with them the difference between an environmental landfill and the importance of not accepting liquids in this type of landfill. They will also discuss precautions in such a facility to ensure safe groundwater.

**Block 5-Cool Water Resource Group Presentations (12:30pm to 1:30pm)**

Students will present their Pennsylvania Cool Water Resource group presentations to the class. They will use graphic organizers, overhead transparencies and/or other teaching methods to convey the information that they were given in Block 2 to present to others in the class. Students in the audience will have an opportunity to ask questions to the group. Groups will present in the order that the information was presented in the Pennsylvania Cool Water Resource Manual.
Block 6-Water Sample Collection at the Lake Crispell (1:35pm to 2:10pm)

Students will walk down to the beachfront at Lake Crispell. As a large group we will discuss the concept of the water table, porosity, permeability, saturated and unsaturated zone that was presents by Fox and Boley Drilling Inc. Students will get into small groups of 3 to 4 students. They will dig a hole in the sand about six to eight feet from the beach. They will pour a bucket of water into the hole. They will discuss their observations amongst their small groups. The instructor will walk around and question their findings. At the last five minutes of at the beach, students will wade out into the water collecting a small water sample in the containers provided. Students then will walk as a group to the lab to test their water sample.

Block 7- Water Sample Testing in the Lab at Camp McGregor (2:15pm to 3:25pm)

Below is a description of the kit that the students will use in the lab to test the pollution levels in Lake Crispell. This kit is available through Flinn Scientific.


**Flesh Water Pollution Testing Kit:**

How safe are our streams, lakes, rivers, and ponds? What are the pollution levels in these local surface waters? This kit allows your students to check water quality using safe, simple and effective tablet-type tests. Students will perform ammonia, chlorine, dissolved oxygen, nitrate, phosphate, and pH tests.

Kit also includes a detailed background section on types of water pollution, sources and effects of each factor tested, color comparison charts, reproducible student handouts, and a complete teacher's guide with sample data, answers, and further extensions.

Block 8- Discussion of Pollution and the Students Role in Environmental Protection of this Valuable Resource (3:30 to 4:00pm)

Students will meet back at the main lodge to discuss the pollution results of the lab testing of Lake Crispell. They will also discuss as a group their role in the protection of water as a valuable resource. At the conclusion of the day, students will board the bus to head back to the high school.
IX. Strategies for Promoting Student Inquiry:

- Strategies for promoting student inquiry are using Graphic organizers for a visual picture increasing the use of technology in the classroom.
- Students are excited about the topic at hand naturally because of the news exposure and the global concern of our planet Earth and its natural resources.
- Students are excited with field trips off school campus.
- Student inquiry is promoted by guest speakers with topics they have a connection too.

X. Assessment of Learning:

- Visual assessment of group discussion and interaction amongst students.
- Observation of student participation on the activities and lab.
- Participation in a written summary of individual thoughts on the topic for assessment upon the next day they return to the regular classroom.

XI. Closure:

- Ask students to share any of the questions they have generated about our responsibility in the sustainability of water and landfills.
- Ask the students to participate in a discussion of the day and the structure its activities.

XII. Teaching/Learning Styles Employed

A. Multiple Intelligences

   a. Verbal/Linguistic Intelligence
      i. Learning new vocabulary
      ii. Completing Graphic Organizers and Charts

   b. Naturalist Intelligence
      i. Communion with nature

   c. Visual/Spatial Intelligence
      i. Forming mental images
      ii. Graphic representation
      iii. Interpreting Visual Images
d. Interpersonal Intelligence
   i. Verbal and Nonverbal communication
   ii. Working cooperatively in a group

e. Logical/Mathematical Intelligence
   i. Discerning relationships and connections
   ii. Scientific reasoning
   iii. Understanding the order and meaning of words
   iv. Memory and recall

B. Learning Styles (visual, auditory, kinesthetic/tactile)
   a. Visual
   b. Auditory
   c. Kinesthetic/tactile

XIII. References:
Sources for this unit plan were derived from the various presentations, lectures, field studies, shared ideas and readings from the Natural Hazards and Human Impacts Course (June 23rd through July 3rd 2008) at Michigan Technological University. Other sources for this unit plan were derived from textbooks and websites listed below.


Pennsylvania’s Cool Water Resource Website:

Permission slip adopted and modified for field trip from www.glenn-co.k12.ca.us/capay/trip.htm accessed on August 8th 2008.


IX. Unit Assessment

Assessment of Learning:

• Students will turn in the written summary of individual thoughts on the topic for assessment upon the next day they return to the regular classroom.

• Visual assessment of group discussion and interaction amongst students during the activities, labs, discussions and lectures.

• Students upon return to the classroom will collaborate and present with a partner a part of the field trip sharing their reflections and connections to their role in environment. The teacher will facilitate the presentation order and topic selection.

X. Appendix

Listed below are the various links and/or copies of activity worksheets, workbooks or permission slips needed to complete We’re having a WALE of a Time Wells, Aquifers, Landfills and the Environment Unit Plan

A. Pennsylvania’s Cool Water Resource Website-
   http://www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/groundwaterprotection/gwpub/default.htm

B. Permission Slip for the Field Trip

C. Earth Systems Science Venn Diagram
Parent Permission for School Sponsored Activity
And Consent to Medical Treatment

Please complete both top and bottom of form

(Name of Student) _______________ has the opportunity to participate in a school activity away from school premises. If you approve the following arrangement, please sign at the bottom of this section and return to the faculty sponsor.

NATURE OF ACTIVITY ________________________________________________________________

DESTINATION _______________________________________________________________

DATE ___________ TIME OF DEPARTURE _______________ DATE/TIME OF RETURN _______________

TRIP SUPERVISOR ___________________________________________________________________

MEANS OF TRANSPORTATION: (Sponsor please check)

A. District-owned bus ____________
B. Commercial (Name of company) ________________________________
C. Other (Specify) __________________________________________________________________

I understand the nature of the school activity in which my son/daughter will be participating and that he/she is expected to abide by all school regulations during the course of the activity.

I understand that the district is liable or responsible for the conduct or safety of my son/daughter only while he/she is or should be under the immediate and direct supervision of an employee of the district.

I hereby give my permission for him/her to participate in the above-described activity.

I further agree that, in the event of an accident, illness or any other circumstance requiring medical treatment, such treatment may be procured for my son/daughter without financial obligation to the district.

Date: __________________ Signature of Parent/Guardian _________________________________

IMPORTANT MEDICAL INFORMATION THE SUPERVISOR SHOULD KNOW: _____________

EMERGENCY TELEPHONE NUMBERS: _______________________________________________

THIS FORM SHOULD BE KEPT BY THE CHAPERONE DURING THE ACTIVITY
(Please complete the form below)

AUTHORIZED TO TREAT A MINOR

I (We), the undersigned parent, parents or legal guardian of ____________________________, a minor, do hereby authorize and consent to any x-ray examination, anesthetic, medical or surgical diagnosis and treatment and emergency hospital care which is deemed advisable by an is to be rendered under the general or special supervision of any member of the medical staff and emergency room staff licensed under the provisions of the Medicine Practice Act and on the staff of any acute general hospital holding a current license to operate a hospital from the State of Michigan Department of Public Health. It is understood that effort shall be
made to contact the undersigned prior to rendering treatment to the patient, but that any of the above treatment will not be withheld if the undersigned cannot be reached.

Date: ___________ Signature of ____________________________
Father and/or Mother, or Guardian

Allergies to Drugs or Foods ________________________________

Date of last Tetanus Booster ________________________________

PLEASE COMPLETE BOTH TOP AND BOTTOM OF FORM

Earth Systems Science
XI. Additional Teaching Resources


• [http://www.vims.edu/bridge/lesson.html#high](http://www.vims.edu/bridge/lesson.html#high) on July 12th 2008.

• Hydrologic Cycle:  

• Lake Information:  

• Sun and Earth—Heating of the earth  

• Water Quality  