A Saratoga Lake Watershed Education Guide

By

Lauren Fletcher and Sieglinde Mueller

A SENIOR CAPSTONE PROJECT IN ENVIRONMENTAL STUDIES

Environmental Studies Program
Skidmore College

May 2, 2008

Senior Capstone Project Advisors
Robert Turner
Cathy Gibson

Table of Contents:

Abstract:

The Saratoga Lake Watershed Education guide was created through an analysis of existing environmental education curricula and tailoring the activities to 3rd, 4th, and 5th grade students within the local watershed (Figure 1). The curricula analysis identified several key concepts imperative to teaching environmental and watershed education (Table 1). Activities in the Education Guide focus on ten of the thirteen key concepts: the hydrologic cycle, what a watershed is, headwaters to tap, streams/water quality, land use, wetlands, connectedness, cultural perspective, historical perspective, and community (Table 3). The analysis resulted in a 32-lesson Watershed Education Guide incorporating indoor and outdoor activities that focus on hands-on learning. Three activities, a watershed model, a wetlands model, and a create-your-own filter project were field tested at two local elementary schools: Saratoga Independent School in Saratoga Springs, NY, and Saint Mary's School in Ballston Spa, NY.

Introduction:

As human impacts on ecosystems become widely recognized, an increase in trends toward finding sustainable solutions for the future is apparent. Environmental education, a growing trend, provides students with a background in environmental issues that helps guide their decisions as they become more involved in community legislation. First defined in 1969 by William Stapp at the University of Michigan, environmental education is “aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, and motivated to work towards their solution” (Stapp et al, 1969). Through teaching the interconnected relationships within all ecosystems at an early age, a sense of responsibility and ownership regarding our natural surroundings is instilled in students. These ideals were recognized and supported through federal legislation with the Environmental Education Act of 1970, promoting “the educational process dealing with man’s relationship with his natural and manmade surroundings, and includ[ing] the relation of population, conservation, transportation, technology and urban and regional planning to the total human environment” (McComas, 2002). The establishment of the Environmental Education Office of the Environmental Protection Agency in 1990 strengthened support for environmental education. Combining several methods and approaches to teaching these concepts, environmental education offers multiple ways to offer an exposure to the natural world.

There are two main components to environmental education. Firstly, outdoor education provides contextual experiences to compliment and expand upon the print and electronic media source dominated lessons learned within the classroom (Woodhouse and Knapp, 2000). Multiple studies suggest that outdoor education helps to provide the individual with a greater sense of awareness, knowledge and environmental sensibility, while enhancing their social and critical thinking skills (Kenney et al, 2003; Woodhouse and Knapp, 2000; Palmberg and Kuru, 2000). Furthermore, experiences in nature develop feelings of safety and self-confidence, therefore increasing the individuals' willingness to participate in future outdoor activities (Palmberg and Kuru, 2000).

The second component to environmental education is a place-based approach. Working to prepare the individual to live and work while sustaining the cultural and ecological integrity of the places they inhabit, place-based curricula closely connects the students with their immediate surroundings and simultaneously teaches traditional classroom lessons. Demonstrating a strong interdisciplinary approach, localized environmental education touches upon geography, ecology, sociology and politics. Based upon experiential methods, place-based environmental education can include service learning to connect the place to the individual and their community (Woodhouse and Knapp, 2000).

Engaging individuals in their communities and ecosystems is vital toward creating a sustainable future for our societies. Introducing students to the outdoors, specifically in their neighborhoods, towns and cities, environmental education teaches "people about the natural world and particularly about ways in which ecosystems work…often aiming to change people's perceptions about the value of the natural world and to teach how to change environmental behaviors… [I]t is important to teach and understand the impact of natural systems on human beings and human society" (Neill, 2006). These teachings work towards instilling a sense of pride and ownership in the environment and manifest themselves when the students become decision-making citizens.

The need to educate citizens in an environmentally responsible manner stems from the large disconnect to the natural world. Currently, our younger generations have grown up alongside booming technological advancements and often find themselves "plugged in" to computers, video games or iPods, creating a sharp separation between children and the outdoors. Richard Louv in his 2006 book, *Last Child in the Woods: Saving our Children from Nature-Deficit-Disorder*, uses the term nature-deficit-disorder to describe the lack of outdoor values in children today. Using environmental education to engage students in real-life problem-solving scenarios helps to bridge the gap and further a movement towards environmental responsibility and sustainability. Promoting programs within schools at all grade levels is necessary to build momentum for environmental education, and requires engaging children in the natural areas in their homes, schools, and neighborhoods.

The basis of the Saratoga Lake Watershed Education Guide is to compile lessons and activities to spark environmental interests among 3rd, 4th, and 5th graders approximately 10 years old. Focusing primarily on hands-on activities, the guide is based around the Saratoga Lake Watershed and incorporates outdoor and place-based components. Centering the activities on a specific watershed helps to demonstrate the interconnected relationships between the community, the children and their environment. The interdisciplinary study of a watershed provides a perfect forum for comprehensive and active learning where students can easily explore the biological, chemical and physical interactions in their watershed while investigating their surrounding community, historical and cultural relationships (Bodzin and Shive, 2004). Adopting a curriculum around a localized watershed provides an appropriate context for integrating sustainability approaches within geographic education and presents environmental concepts to students in a manner that is directly attached to the real world where their local place matters (Eflin and Sheaffer, 2006). As watersheds are defined by local hydrology, their study leads to a more comprehensive understanding of local environmental problems directly affecting their communities (EPA, 1996). Students gain a better understanding of their individual responsibility within the watershed, as well as the role of their community.

Demonstrated through reviewed literature, the focus on a watershed enhances environmental interest and awareness and often leads to more involved decision-making and hands-on protection (Kenney et al, 2003; Woodhouse and Knapp, 2000; Palmberg and Kuru, 2000). The watershed approach to environmental education and the Saratoga Lake Watershed Education Guide helps build a sense of community, assist to reduce political and local conflicts, increase the commitment to environmentally responsible actions, and improve the success rate of vital environmental programs (EPA, 1996).

Methods:

I. Identify Selection of Environmental and Watershed Curriculum

Multiple environmental and watershed education curricula and studies were analyzed to determine thematic key concepts (Table 1). The analysis provided a quantification of the concepts that are integral to environmental and watershed education and must be included in the Saratoga Lake Watershed Education Guide. Utilizing concepts already outlined in existing curricula ensures the use of valuable ideas and guarantees that the lessons have been implemented and are feasible and appropriate.

For the purpose of this research, a curriculum is defined as a document, or series of documents from one source, that provides outlines of specific lessons. A study is defined as a document that focuses on the social, political and educational benefits of environmental or watershed education and merely touches upon the lesson themes. The publications in the analysis were found by conducting broad Internet searches for watershed and environmentally oriented lesson plans and curricula. Any curriculum containing lesson plans, activities and themes related to community issues and natural features of the Saratoga Lake Watershed is included.

In total, nineteen curricula and lesson plans were reviewed; seven written by non-profit organizations, eleven by public organizations, and two by private groups or individuals (Table 2). The non-profits that have published curricula in the analysis include: Adopt-a-Watershed, Earthforce, Give Water a Hand, The Groundwater Foundation, The Izaak Walton League of America, Project WET, and The Water Education Foundation. The public organizations that have curricula included in the analysis are the Environmental Protection Agency (contributing five lesson plans), Farm*A*Syst/Home*A*Syst, The Globe Program, the U.S. Department of Health, Education and Welfare, and the Center for Global Environmental Education. *Watershed: A Successful Voyage into Interpretative Learning* by Mark Springer, is also included in the public category, although it is written by an individual, because it outlines the implementation of a watershed education program in a public school. Two private curricula, written by Vera Wood and Clive Dobson, were also incorporated into the analysis. Of the nineteen curricula, one is written on a statewide scale and one on a local scale. The remaining seventeen are generally focused environmental curricula. Determining the publishing organization and scale of the lessons mentioned in the studies is impossible; therefore, they were not included in this portion of the analysis.

The age ranges of the included curricula and studies in the analysis are varied. A total of nine publications focus on grades K-12, seven publications focus on more specific ranges between K and 8th grade, two are for high school students, two for college students, and eight have no specific grade range. It is necessary to look at higher education curricula, in additions to elementary school lessons, because the Saratoga Lake Watershed Education Guide should provide the background for concepts taught in middle and high school.

The curricula analysis is not meant to be exhaustive but only to provide insight into the concepts taught by existing programs. The analysis provides a varied sample of publishing organizations, age ranges, and focus levels to ensure the Watershed Education Guide is based on sound principles.

II. Identification of Curricula Key Concepts

Identified by the nineteen curricula and nine studies, common key concepts were categorized. The concepts were identified using the publication's subtitles, and/or listed objectives. The identification of key concepts in larger curricula, such as Project WET, The Center for Global Environmental Education, and Farm*A*Syst/Home*A*Syst, were found through the organization's mission statement. A quantification of the prevalence of individual concepts was possible through focusing on the natural and social sciences. The key concepts from a natural science perspective are the hydrologic cycle, watersheds, water moving from the headwaters to the tap, streams/water quality, basic Earth sciences, the affects of land use practices, and the study of wetlands. The key social science concepts are cultural and historical perspectives, community influence and action, service learning, and pollution mitigation. The concept of connectedness between humans and natural systems is a common theme and is included under both the social and natural science headings. Each concept is discussed in greater detail below:

The hydrologic cycle is the natural pathway through which water moves from one physical state to another. Existing in lakes, streams, oceans, soil, and the atmosphere, water travels through the hydrologic cycle as precipitation, evaporation, evapotranspiration, and surface flow. An understanding of the hydrologic cycle is imperative to understanding natural systems and watersheds.

A watershed education guide is not successful if students do not know what a watershed is. Watersheds are comprised of the land area that drains into a specific body of water. This means that any drop of water falling within the watershed will eventually convene at one point. The movement of water from the headwaters to the tap is imperative to understanding watersheds and the affects of human activity. Any negative impacts to water quality in the headwaters are directly reflected in the lakes and streams at the bottom of the watershed. It is vital that students understand the movement of water through the watershed so they can be aware of the impacts of their actions.

Streams are major contributors to the motion of water and are vital in understanding many environmental issues. To understand contributions and effects of streams, students should learn about water quality, healthy vs. unhealthy streams, and human activities that impact them.

Earth science is an all encompassing term regarding the study of Earth's systems, including the attributes of rocks, fossils, sediments and weather and climate systems. Watershed curricula that include Earth science generally teach soil properties and types and their effects on groundwater infiltration or related concepts.

The varying types of land usage within a watershed have direct effects on water quality and other environmental features. Teaching the results of land use changes often includes comparing the effects of deforestation and development on water quality and quantity, biodiversity, and pollution.

Wetlands are defined as areas where water saturation dominates the nature of soil development and the types of animal and plant communities in the area. Studying wetlands includes examining the variations between types of wetlands, their filtering capabilities, the processes that create and sustain wetlands, and the plants and animals that strive there.

Cultural perspectives are difficult to include in large scale environmental curricula because they vary between watersheds. Incorporating culture requires teaching students about the ways in which their culture affects community-made decisions regarding environmental resources and protection. Historical perspectives are similar but focus on the history of the watershed and how it has affected how the watershed looks today.

Community can be easily included in environmental and watershed education through field trips and collaboration with local adults and students at nearby schools. Field trips to water treatment plants, farms, or visits with local anglers or officials are wonderful ways to incorporate the community into the lessons.

Learning through participation in community service initiatives is known as service learning. It provides students with hands-on experience, interaction with community members and an opportunity to help the environment or those less fortunate.

Teaching student about the problems facing our environment is imperative, although preparing them with the knowledge to fix it is vital. Discussing mitigation in the classroom includes teaching children steps they, as individuals, can take to combat environmental problems and what the community as a whole can accomplish.

The concept of connectedness does not include its own lessons, but is engrained in each lesson. The other key concepts cannot be understood without knowledge of related systems and processes, both natural and human. Students who understand connectedness will be more able to understand environmental problems and the best steps for mitigation.

III. Comparison of Concepts

The most commonly taught key concepts included in watershed and environmental education curricula and studies were identified (Table 1). The most often taught natural science concepts are watersheds, streams/water quality, and the interconnectedness of the entire watershed. Wetlands are the least taught natural science concept; this may be because they are often taught in their own curricula. Community is the most common concept discussed from the social sciences and the least common is historical and cultural perspectives. Most of the curricula included in the analysis had no focus and therefore did not include any sort of cultural or historical references.

The Watershed Education Guide include**s** key concepts that were deemed necessary through the curriculum analysis. The natural science objectives are the hydrologic cycle, watersheds, the travel of water from the headwaters to the tap, streams/water quality, wetlands, and the implication of land use practices. Although wetlands are determined the least important by the curricula analysis, it is being included because the Saratoga Independent School is adjacent to Bog Meadow Brook, a marshland preserve providing a perfect teaching forum. Cultural perspectives, historical perspectives and community will be included in the social science portion. The interconnectedness of the entire watershed will be a recurring theme in every lesson**.** The natural science objectives are imperative to include in the Watershed Education Guide because they will instill children with the knowledge to make informed decisions about the care and protection of their watersheds, while the social science objectives will allow children to understand the influence that individuals and communities have on the environment and natural resources.

The Watershed Education Guide is written for students in grades 3rd through 5th. Many of the included activities are derived from lessons written for that age range although some have been simplified or made more in-depth to accommodate the proper ages. The guide is written for the Saratoga Independent School in Saratoga Springs, NY and St. Mary's School in Ballston Spa, NY but will be appropriate for any school within the Saratoga Lake Watershed.

Results:

The completed Saratoga Lake Watershed Education Guide (Appendix 1) is comprised of thirty-two activities to be taught inside or outside the classroom. The activites teach a variety of natural science and social science concepts (Table 3). The Education Guide does not provide a complete day-to-day schedule but is meant to be a supplement to existing school curriculum. Incorporating these lessons ensure**s** students are gaining a localized, hands-on, environmental education.

Three of the activities were taught at local elementary schools to ensure their age-appropriateness, feasibility, and ability to convey the key concepts. At the Saratoga

Independent School, the *Wetland Model, Option 1* activity was taught to the 2^{nd} and 3rd graders and the *Make a Watershed Model* activity was taught to the 4^{th} and 5^{th} graders. Both activities proved to be age appropriate and actively engaged the students in the model creation and discussion process. The wetland model was created using modeling clay to simulate topography and a strip of carpeting to simulate a wetland and allowed students to visualize the function of wetlands as flood reducers, sedimentation prevention, and pollution remediation. Students were actively involved in the building of the model and had trouble keeping their hands out of it during discussion. The model was particularly appropriate for SIS because students could peer over the playground fence and see Bog Meadow Brook, a functioning wetland, directly behind the school. For the watershed model, the students were actively involved in the model-building and decision-making process by arranging rocks, buckets and over-turned bowls to create topography. A plastic tablecloth was laid over the arrangement and students took turns simulating rainstorms with spray bottles. They were surprised to watch the spreading of pollution throughout their watershed, and offered constructive suggestions on where to build hypothetical communities. Class-wide discussion progressed smoothly and the students seemed to make the right assumptions and connections. During the concluding discussion, students provided personal anecdotes about their community and directly related environmental problems within the model to those of Saratoga Lake Watershed. Students quickly connected the spread of food coloring from the cotton ball in the model to the flow of road salt into waterways. Slightly sun burnt and covered in food coloring, the students lined up at the door of the school to return to their regular classes.

At St. Mary's School, the 5th grade science class was taught two activities: *Make Your Own Filter* and the *Make a Watershed Model*. For the filter activity, students were divided into four groups and the students used their own choice of a limited selection of materials to see who could filter out the most contaminants. This activity provided a perfect forum for exploring the difficulties of remediation of contaminated water while simultaneously building upon teamwork skills. The contaminated water was put together in front of the class, and each component was compared to real-life pollutants. The students were enthusiastic and engaged in the filter building process, and offered constructive ideas and insights into team and class-wide discussions. Students were able to defend the choices they made, understand the choices made by other teams, and relate the activity to the village water treatment process. The watershed model built upon ideas presented in the filter activity, demonstrating the interconnectedness of land-use, as well as the difficulty in remediation and maintaining a healthy watershed.

Using the same activity in two locations helped provide insight on the importance of locality when teaching about a watershed. The introduction and discussion questions at SIS revolved primarily around wetlands and Loughberry Lake as a drinking water source. Helping students visualize the areas they are already familiar with helped to apply our watershed model to real-life. At St. Mary's, the introduction and discussion questions revolved around familiar potential pollution sites in and around Ballston Spa, and utilized Saratoga Springs as a neighbor to apply possible political issues. The watershed model inspired participation in both school groups and has successfully introduced concepts that align with their current curricula in a localized manner.

Conclusion:

The thirty-two activities of the Saratoga Lake Watershed Education Guide are focused on ten concepts from the natural and social sciences; the hydrologic cycle, what a watershed is, headwaters to tap, streams/water quality, land-use, wetlands, connectedness, cultural perspectives, historical perspectives, and community. Each activity teaches one or more of these important concepts. The most often taught concept is that of connectedness, covered in all but one lesson. Streams/ water quality is taught in twenty-four activities, whereas the concepts of what a watershed is, headwaters to tap, land-use, and community are taught in approximately seventeen lessons each. The remaining concepts, cultural and historical perspectives, and the hydrologic cycle, are taught in nine, six, and ten lessons respectively. These concepts align well to teach students about the value and importance of their natural surroundings, especially within their communities and fit within their existing curriculum.

The analysis, compilation and implementation of localized watershed lessons and activities raise awareness and build an environmentally responsible citizenry. Many of the published curricula lack a focus on a specific watershed and the communities surrounding it because they are written by large-scale organizations looking to reach wide audiences. The Saratoga Lake Watershed Education Guide is entirely focused on Saratoga Lake, its watershed, and its communities. This approach provides a sense of place for the students and adopts real-life issues and concerns to instill a sense of environmental responsibility and awareness in their communities and natural surroundings.

Acknowledgements:

We would like to thank the following people and organizations for their generous help and time in completing this project: Bob Turner and Cathy Gibson for throwing the syllabus out the window on day one; Pam Quinn, Mary Sacks, and the children of Saratoga Independent School; Sue Reiter and the children of St. Mary's School in Ballston Spa; Saratoga SPA State Park; Saratoga PLAN; Kelly Grindstaff and Dawn Riley of the Skidmore College Education Department; Dr. GIS; Ballston Spa Carpet and Tile; Scout the Cat; the entire Environmental Studies and Geosciences Departments; and most of all our loving parents and siblings.

Works Cited:

Adopt-a-Watershed. 2008. <www.adopt-a-watershed.org> Accessed February 23, 2008.

Bodzin, A. and L. Schive. April 2004. Watershed investigations. Science Scope **27(7):** 21-23.

Brody, M. Spring 1997. Descending the watershed: rethinking the “place” of curriculum. Canadian Journal of Environmental Education **2**:114-131.

Charlotte Harbor Environmental Center, Inc. 2007. <www.checflorida.org> Accessed April 6, 2008.

Center for Global Environmental Education. 2001. Rivers of Life. < http://cgee.hamline.edu/rivers>

Dobson, C. 1999. Watersheds: a practical handbook for healthy water. Firefly Books Limited; Buffalo, New York, USA.

Earth Force. 2007. <www.earthforce.org> Accessed February 4, 2008.

Eflin, J. and A. L. Sheaffer. 2006. Service learning in watershed based initiatives: keys to education for sustainability in geography? Journal of Geography **105:** 33-44.

Environmental Protection Agency. 2006. Deep subjects- wells and groundwater. . <http://www.epa.gov/ogwdw/kids/teachers_4-8.html> Accessed January 27, 2008

Environmental Protection Agency. 2006. Excuse me- is this the way to the drainpipe? <http://www.epa.gov/ogwdw/kids/teachers_4-8.html> Accessed January 27, 2008.

Environmental Protection Agency. 2006. Sourcebook. <http://www.epa.gov/safewater/kids/wsb/index.html#about> Accessed February 24, 2008.

Environmental Protection Agency. 2006. The case of the disappearing water. <http://www.epa.gov/ogwdw/kids/teachers_4-8.html> Accessed January 27, 2008.

Environmental Protection Agency. 1996. Why watersheds? <http://www.epa.gov/owow/watershed/why.html> Accessed February 24, 2008.

Farm*A*Syst/Home*A*Syst. 2000. <http://www.uwex.edu/homeasyst/> Accessed February 24, 2008.

Give Water a Hand. 2005. <http://www.uwex.edu/erc/gwah/index.html> Accessed February 24, 2008.

Haury, D. L. 2000 Studying watersheds: a confluence of important ideas. Educational Resources Information Center. <http://www.eric.ed.gov> Accessed January 27, 2008.

Illinois Environmental Protection Agency. 2007. Water cycle wheel. <http://www.epa.state.il.us/kids/fun-stuff/water-cycle/wheel-part-1.html> Accessed February 4, 2008.

Kenney, J. L., et al. 2003. Helping teachers to use their schools backyard as an outdoor classroom: a report on the watershed learning center. Journal of Environmental Education **35(1):** 18-26.

Louv, R. 2006. Last child in the woods: saving our children from nature-deficit disorder. Algonquin Books; Chapel Hill, North Carolina, USA.

McComas, W. F. 2002. The ideal environmental science curriculum: history, rationales, misconceptions and standards. The American Biology Teacher, **64 (9):** 665 – 672.

McCrea, E. J. 2006. The roots of environmental education: how the past supports the future. Environmental Education and Training Partnership. University of Wisconsin-Stevens Point, College of Natural Resources, Stevens Point, WI. <http://www.eetap.org.>

Neill, J. 2006. What is environmental education? Wilderdom. <http://wilderdom.com/environment/EnvironmentalEducation.html> Accessed April 25, 2008.

Palmberg, I. E. and J. Kuru. 2000. Outdoor activities as a basis for environmental responsibility. The Journal of Environmental Education **31(4):** 32-36.

Project Learning Tree. 2004. <http://www.plt.org/cms/pages/21_21_9.html> Accessed April 23, 2008.

Project WET (Water Education for Teachers). 2006. <www.projectwet.org> Accessed January 24, 2008.

Project WILD. The Council for Environmental Education. <www.projectwild.org> Accessed April 6, 2008.

Ranger Rick's Nature Scope. 1997. Wading into Wetlands; Expanded Edition. National Wildlife Federation. McGraw-Hill Contemporary; Columbus, Ohio, USA.

Save the Bay. 2005. San Francisco Bay Watershed Curriculum. <www.savesfbay.org> Accessed April 6, 2008.

SC Life: Natural History of South Carolina Education and Outreach. <http://www.clemson.edu/SCLife/> Accessed April 16, 2008.

Shepardson, D. P., et al. 2002. The impact of professional development program on teachers' understandings about watersheds, water quality and stream monitoring. The Journal of Environmental Education **33(3):** 34-40.

Smith, J. M. et al. 2006. Using technology and inquiry to improve student understanding of watershed concepts. Journal of Geography **105:** 249-258.

Springer, M. 1994. Watershed: a successful voyage into integrative learning. National Middle School Association; Columbus, Ohio, USA.

Stapp, W. B. et al. 1969. The concept of environmental education. Journal of Environmental Education. **1 (1):** 30 – 31.

Stroud Water Research Center. 2008. <www.stroudcenter.org> Accessed April 6, 2008.

The Globe Program. 2007. <http://www.globe.gov/fsl/html/templ.cgi?curriculum&lang=en> Accessed February 24, 2008.

The Groundwater Foundation. 2008. <http://www.groundwater.org/kc/kc.html> Accessed February 24, 2008.

The Izaak Walton League of America. <http://www.iwla.org/index.php?id=25> Accessed February 24, 2008.

The Saratoga Springs Open Space Project. Bog Meadow Brook Nature Trail Educator's Guide. Saratoga PLAN; 112 Spring Street, Saratoga Springs, NY 12866.

United State Department of Health, Education, and Welfare. 1970. Outdoor education in Oregon schools. Oregon State Department of Education: Salem, OR, USA.

Vannote, R.L., et. al. 1980. River continuum concept. Canadian Journal of Fisheries and Aquatic Sciences. **37:** 130-137

Verona, M. E. and D. Curtis. 2002. Customization in the design and implementation of the riverweb water quality simulator (WQS)." United States Department of Education.

White, N. and L. Danielson. WECO: watershed education for communities and officials. North Carolina State University; Raleigh, NC. <http://www.ces.ncsu.edu/depts/agecon/WECO /index.html> Accessed January 27, 2008.

Wood, V. 2007. My watershed: an early elementary curriculum exploring local hydrology. Diss.Texas State University, San Marcos, TX, USA.

Woodhouse, J. L. and C. E. Knapp. 2000. Place-based curriculum and instruction: outdoor and environmental education approaches. Education Resource Information Center <http://www.ael.org/eric/digest/edorc006.htm> Accessed January 28, 2008.

References:

Conservation Technology Information Center at Purdue University. Getting to know your local watershed: a guide for watershed partnerships. <http://ww.2.ctic.purdue.edu/kyw/brochures/gettoknow.html> Accessed January 27, 2008.

Conservation Technology Information Center at Purdue Unversity. Putting together a watershed management plan: a guide for watershed partnerships. <http://ww.2.ctic.purdue.edu/kyw/brochures/puttogether.html> Accessed January 27, 2008.

Environmental Protection Agency. 2008. Educational resource for teachers/students: top rated water curricula by others. <http://www.epa.gov/adopt/resources/ toprelated.html> Accessed February 24, 2008.

Environmental Protection Agency. 2008. Hudson-Hoosic watershed profile. <http://cfpub.epa.gov/surf/huc.cfm?huc_code=02020003> Accessed January 27, 2008.

O'Brien, L.M. 2007. Raising children who care for our world. Childhood Education **83(5):** 322- 323.

Saving Water Partnership. 2002. Why conserve? <www.savingwater.org> Accessed January 27, 2008.

Shepardson, D. P., et al. 2007. What is a watershed? Implications of student conceptions for environmental education and the national science education standards". Science Education **91(4):** 554-578.

The LA Group, P.C. 2002. Land to lake perspectives; a watershed management plan for Saratoga Lake. Saratoga Lake Protection and Improvement District.

UNESCO. 1978. The Tbilisi Declaration. *Final Report Intergovernmental Conference on Environmental Educaiton,* organized by UNESCO in cooperation with UNEP, Tbilisi, USSR, 14-16 October 1977. *Connect: UNESCO-UNEP Environmental Education Newsletter* **3(1):** 1-8,

Water Education Foundation. 2008. <http://www.water-ed.org/default.asp> Accessed February 24, 2008.

Figures & Tables-

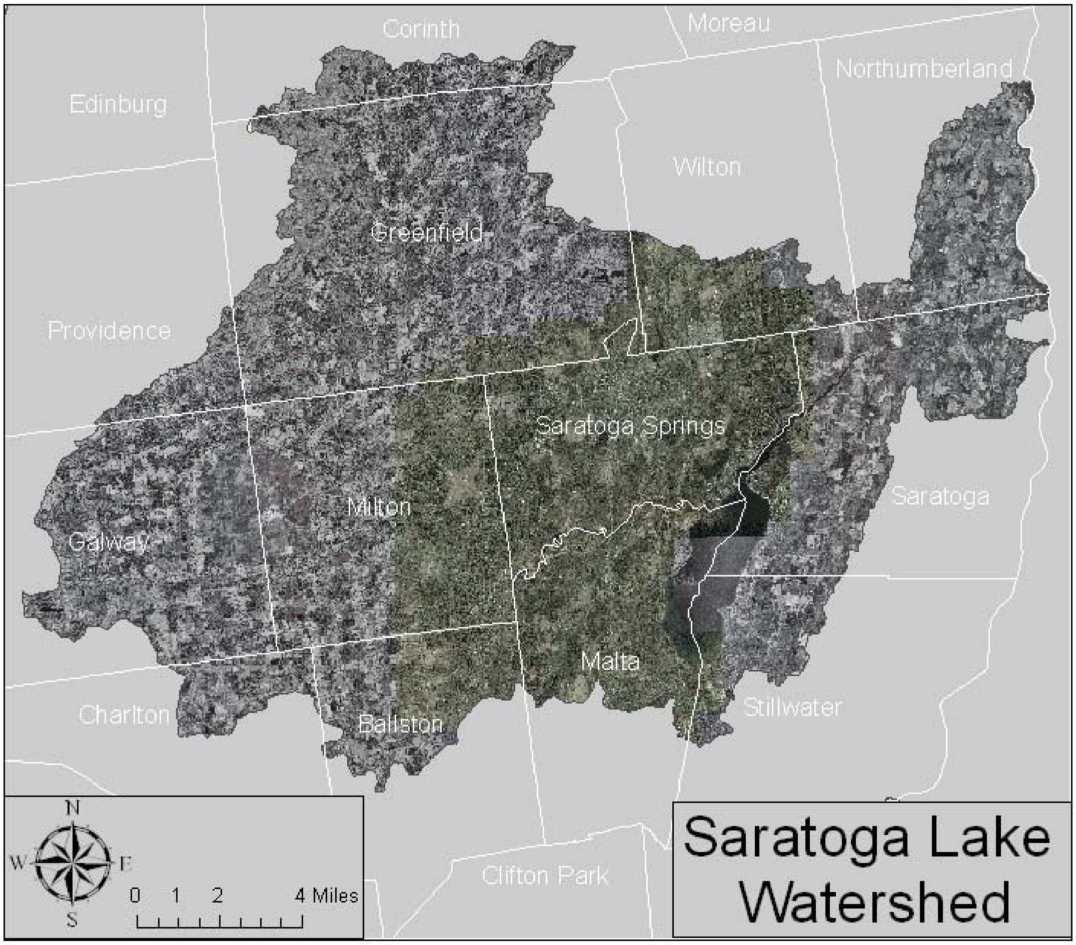


Figure 1- <u>Saratoga Lake Watershed</u> map showing the location of the watershed, the focus of the Education Guide, within Saratoga County, New York. The area within the watershed is comprised of aerial imager

Table 1- <u>Key Concepts from Environmental Education Curricula and Studies</u> showing the breakdown of key concepts taught by existing environmental and watershed education curricula and studies.

Author	Year	Grade Range	Hydrologic Cycle	Watershed?	Headwaters to Tap	Streams/Water Quality	Earth Science	Land Use	Wetlands	Connectedness	Cultural Perspective	Historical Perspective	Community	Service Learning	Mitigation
			Natural Sciences												
										Social Sciences					
Curricula															
Adopt-a-Watershed	2008	K-12	X	X	X	X	X	X		X	X		X	X	X
Center for Global Environmental Education	2001	K-12	X	X	X	X				X	X	X	X		
Deep Subjects, EPA	2006	3-6	X		X	X	X			X					X
Disappearing Water, EPA	2006	4-6	X												
Dobson	1999	K-12	X	X	X		X	X		X					X
Drainpipe, EPA	2006	K-6			X										
Earth Force	2004	K-12	X	X	X	X		X		X	X		X	X	X
EPA Source Books	2006	3-5	X	X	X	X	X	X	X	X			X		
Farm*A*Syst/Home*A*Syst	2000	12+		X	X			X		X			X		X
Give Water a Hand	2005	4-8	X	X	X	X		X		X			X	X	X
The Globe Program	2007	K-12	X	X	X	X	X	X		X	X		X	X	X
The Groundwater Foundation	2008	-	X			X	X							X	
Illinois EPA	2007	K-6	X							X					
Izaak Walton League of America	-	K-12	X	X		X			X				X	X	X
Project WET	2006	K-12	X	X	X	X	X	X		X	X	X	X	X	X
Springer	1994	6-8	X	X	X	X	X	X	X	X	X	X	X	X	X
US Dept of Health, Ed. & Welfare	1968	K-12	X			X	X		X	X					
Water Education Foundation	2008	K-12	X	X	X	X	X	X	X	X					
Wood	2007	-	X	X	X					X					X
Studies															
Bodzin & Shive	2004	-	X	X	X	X	X	X		X		X			
Brody	1997	-		X				X		X	X	X	X		X
Eflin & Sheaffer	2006	12+	X	X	X		X						X	X	
Haury	2000	-		X		X	X	X							X
Kenney, et al.	2003	-		X		X				X			X		X
Shepardson, et. al.	2002	-		X		X				X					
Smith, et. al.	2006	9-12		X	X	X		X		X	X	X	X		
Verona & Curtis	2002	9-12		X		X		X							
White & Danielson	-	-		X	X	X		X					X		X
Totals			19/28	22/28	18/28	20/28	13/28	16/28	5/28	20/28	8/28	6/28	15/28	9/28	15/28

Table 2- <u>Publishing Organization & Focus Level of Curricula in the Analysis</u> showing the publishing year, suggested age range, publishing organization and focus level of the watershed and environmental education curricula and studies in the curricula analysis (Table 1).

Curricula/ Lesson Plans	Year	Age Range	Publishing Organization	Focus Level
Adopt-a-Watershed	2008	K-12	Non-profit	General
Center for Global Environmental Education	2001	K-12	Public	General
Deep Subjects, EPA	2006	3-6	Public	General
Disappearing Water, EPA	2006	4-6	Public	General
Dobson	1999	K-12	Private	General
Drainpipe, EPA	2006	K-6	Public	General
Earth Force	2004	K-12	Non-profit	General
EPA Source Books	2006	3-5	Public	General
Farm*A*Syst/Home*A*Syst	2000	12+	Public	General
Give Water a Hand	2005	4-8	Non-profit	General
The Globe Program	2007	K-12	Public	General
The Groundwater Foundation	2008	-	Non-profit	General
Illinois EPA	2007	K-6	Public	General
Izaak Walton League of America	-	K-12	Non-profit	General
Project WET	2006	K-12	Non-profit	General
Springer	1994	6-8	Public	Local
US Dept of Health, Ed. & Welfare	1968	K-12	Public	State
Water Education Foundation	2008	K-12	Non-profit	General
Wood	2007	-	Private	General

Table 3- Key Concepts Taught by Saratoga Lake Watershed Education Guide activities (Appendix 1) additional concepts from the curricula analysis (Table 1).

Lesson	Inside or Outside the Classroom?	Hydrologic Cycle	Watershed?	Headwaters to Tap	Streams/Water Quality	Land Use	Wetlands	Connectedness	Cultural Perspective	Historical Perspective	Community	Earth Science	Service Learning	Mitigation
		Focus Concepts of The Saratoga Lake Watershed Education Guide										Additional Concepts		
		Natural Sciences										Natural Sci.		
								Social Sciences					Social Science	
A Day in the Life of a Raindrop	Inside	X		X				X						
Backyard Watershed Swap	Inside	X	X	X	X	X	X	X	X	X	X	X	X	X
Creature Classifieds	Inside				X			X						
Drought Cups	Inside			X	X			X						
Earthy Sundaes	Inside			X	X			X			X	X		
Follow the Raindrop!	Inside		X	X	X			X	X		X			X
Guess the pH	Inside				X	X		X						X
Hydrologic Cycle Wheel Illustrations	Inside	X						X						
Karner Blue Pond	Inside		X	X	X	X	X	X	X		X			X
Let's Clean Water	Inside				X	X	X	X				X		X
Life in Saratoga Lake	Inside		X					X						
Make your Own Filter	Inside				X			X				X		X
Saratoga Lake Watershed and You; Watershed Journals	Inside	X	X	X	X	X	X	X	X	X	X	X	X	X
Saratoga Lake Watershed Newspaper	Inside	X	X	X	X	X	X	X	X	X	X	X	X	X
Saratoga Lake Watershed Vocabulary Project	Inside	X	X					X			X			
Tick Safety	Inside										X			
Water Cycle in Your Window	Inside	X						X						
Water Detectives	Inside	X	X	X	X			X				X		X
Wetland Model, Option 1	Inside				X		X	X			X			X
Wetland Model, Option 2	Inside				X	X	X							X
Wetland Plants & Pollution	Inside				X	X	X	X						X
What Does Your Aquifer Look Like?	Inside			X	X			X			X	X		
What is a Watershed?	Inside		X	X				X			X	X		X
What Rocks about Soil	Inside					X		X				X		
Make a Watershed Model	Inside & Outside	X	X	X	X	X	X	X			X			X
Rain, Rain, Soil Away	Inside & Outside		X		X	X		X			X	X		X
Watershed Explorers	Outside		X	X	X	X	X	X	X	X	X			
Aquatic Insect Water Quality Assessment	Outside		X		X			X						
Erosion: Causes & Effects	Outside		X	X	X	X		X			X	X		X
Investigating Saratoga Lake Watershed	Outside		X	X	X	X	X	X	X		X			X
Our Wild Watershed	Outside		X	X	X	X	X	X	X	X	X			X
Saratoga Lake Watershed Survey	Outside	X	X	X	X	X	X	X	X	X	X	X		X

Appendix 1-

The Saratoga Lake Watershed Education Guide Activities

Activities Table of Contents:

Let's Clean Water	This activity allows children to analyze different methods of cleaning water, and show the dangers of drinking contaminated water.	Inside	Pg. 58
Life in Saratoga Lake	This project will teach students about plants and animals that live in Saratoga Lake through individual research and presentations to the class.	Inside	Pg. 59
Make Your Own Filter	This activity works on team collaboration and analysis of different methods of water filtration and treatment.	Inside	Pg. 61
Saratoga Lake Watershed and You; Watershed Journals	This journal activity will incorporate language arts skills into the students understanding of the human and natural forces acting on the Saratoga Lake Watershed.	Inside	Pg. 63
Saratoga Lake Watershed Newspaper	This activity will create an opportunity for students to explore an area of the watershed that they are personally interested in. The class will publish a newspaper about the issues, communities, ecosystems, or other aspects of the Saratoga Lake Watershed.	Inside	Pg. 66
Saratoga Lake Watershed Vocabulary Project	This exercise will help students familiarize themselves with locations within the watershed and the connections between them.	Inside	Pg. 68
Tick Safety!	This lesson will help educate students, and their parents, about preventative tick protection and safely removing ticks.	Inside	Pg. 70
Water Cycle in Your Window	This activity is a quick and easy way to demonstrate the processes of the water cycle inside the classroom by constructing a simple, miniature model.	Inside	Pg. 76
Water Detectives	This activity will allow students to investigate substances from their watershed in a safe environment. Some tools will be introduced to assist them with the identification.	Inside	Pg. 78
Wetland Model, Option 1	Through creating a wetland model, students will become familiar with the processes of wetlands and their ecological function.	Inside	Pg. 82

Wetland Model, Option 2	This activity will teach students how water travels from places they are familiar with to Saratoga Lake and provide a venue to explore the pollution the water may pick up on the way by drawing a comic strip.	Inside	Pg. 84
Wetland Plants and Pollution	This activity demonstrates the absorption of pollution in plants and allows students to observe the physical changes.	Inside	Pg. 87
What Does Your Aquifer Look Like?	This activity is a quick and easy way to visually demonstrate the stratigraphic layers of aquifers and learn basic vocabulary.	Inside	Pg. 89
What is a Watershed?	This activity will allow students to easily observe the movement of water through a watershed and help define what a watershed is.	Inside	Pg. 91
What Rocks About Soil?	This activity will introduce students to soil, the five soil-forming factors and help them understand how little soil we actually have on Earth.	Inside	Pg. 94
Make a Watershed Model	This exercise will introduce students to a watershed and allow them to explore the topographic changes that alter the water pathways.	Inside & Outside	Pg. 99
Rain, Rain, Soil Away	This activity allows students to better understand erosion by testing different soil types to measure the resilience against erosion.	Inside & Outside	Pg. 102
Watershed Explorers!	This activity will teach students how to observe and analyze watershed conditions to make conclusions regarding its health.	Outside	Pg. 109
Aquatic Insect Water Quality Assessment	This activity will give students an opportunity to spend hands-on time in a stream and introduce them to aquatic insects. Students will also learn to estimate the health of the stream, and the relative width of the channel, using the insects.	Outside	Pg. 112

Erosion: Causes and Effects	This activity will introduce students to the causes and effects of erosion through investigating erosion in the outdoors!	Outside	Pg. 120
Our Wild Watershed	This bus tour will introduce students to Saratoga Lake Watershed and the communities, historical industries, and various creeks within it. The optional collect of water quality data can easily be included.	Outside	Pg. 122
Investigating Saratoga Lake Watershed!	This activity will familiarize students with local hydrology through visual surveys and raise questions about land use and water chemistry issues.	Outside	Pg. 127
Saratoga Lake Watershed Survey	This exercise will allow students to conduct visual surveys and scientific measurements to help determine the health of the Saratoga Lake Watershed.	Outside	Pg. 130
Safe Stream Access in the Saratoga Lake Watershed	<u>Teacher Notes</u>: Outlines selected sites where students can safely get to the stream to collect data.	--	Pg. 137

A Day in the Life of a Raindrop

Where will the water you drink this morning be tomorrow?

Adapted from Project WET

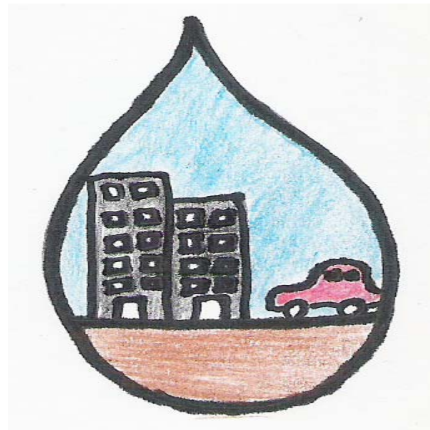
Using an interactive game, students learn the movement of water through the water cycle and the changes in state that water undergoes.

Objectives-

- ✓ Describe the movement of water
- ✓ Identify the states of water as it moves through the water cycle

Estimated Time-

- ✓ 50 minutes (preparation time)
- ✓ Two-50 minute periods (activity time)



Materials-

- ✓ 9 large pieces of paper
- ✓ Copies of Water Cycle Table
- ✓ Marking pens
- ✓ A bell, whistle, buzzer or some sound maker
- ✓ 9 boxes, about 6 inches on a side: 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. The labels for the sides of the die are located in the attached 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.

Background-

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

Procedure-

1) Tell students they are going to become water molecule moving through the water cycle

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

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 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 attached 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).

7) Students should keep track of their movements. Having them keep a journal or notepad to record each move they make, including stays, can do this.

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

Concluding Activities-

1) Have students use their travel records to write stories about places water has been. Include a description of what conditions were necessary for water to move to each location and the state water was in as it moved.

2) Discuss any cycling that took place, that is, if any students returned to the same station.

3) 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.

Water Cycle Table:

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

Water Cycle Table continued…

STATION	DIE SIDE LABELS	EXPLANATION
Ocean	two sides *clouds*	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	four sides *stay*	Water remains in the ocean.
Lake	one side *ground water*	Water is pulled by gravity; it filters into the soil.
	one side *animal*	An animal drinks water.
	one side *river*	Water flows into a river.
	one side *clouds*	Heat energy is added to the water, so the water evaporates and goes to the clouds.
	two sides *stay*	Water remains within the lake or estuary.
Animal	two sides *soil*	Water is excreted through feces and urine.
	three sides *clouds*	Water is respired or evaporated from the body.
	one side *stay*	Water is incorporated into the body.
Ground Water	one side *river*	Water filters into a river.
	two sides *lake*	Water filters into a lake.
	three sides *stay*	Water stays underground.
Glacier	one side *ground water*	Ice melts and water filters into the ground.
	one side *clouds*	Ice evaporates and water goes to the clouds (sublimation).
	one side *river*	Ice melts and water flows into a river.
	three sides *stay*	Ice stays frozen in the glacier.

Backyard Watershed Swap!

Adapted from Project Learning Tree, 2004

This activity will give students an oppurtunity to compile objects and notes that symbolise or teach about their area within the watershed, and also receive a similar box from students elsewhere in the watershed.

Objectives-

- ✓ Learn the characteristics of their own environment and compare these characteristics to another region

Estimated Time-

- ✓ 1 hour to prepare
- ✓ 1 hour and 45 minutes for the activity

Materials (*for each team of 4-5 students*)-

- ✓ Books about the natural history of your region
- ✓ Markers
- ✓ Crayons
- ✓ Drawing paper
- ✓ Any other art supplies

Procedure-

1) Tell the students they are going to exchange "environments" with students at St. Mary's School in Ballston Spa, NY or Saratoga Independent School in Saratoga Springs, NY. It is their responsibility to teach them about their place in the watershed, as they are located at opposite ends.

2) Brainstorm with the students a list of items to include in the box. Then have the students divide up the responsibilities of researching, collecting and preparing the materials for the box. They might want to consider some of the following items for their box:

    a. Brief descriptions of your immediate area written by the students.

    b. A collage of pictures of their place in the watershed (bodies of water, human impacts: road crossings, construction sites, etc) taken by the students or from newspapers, books, magazines.

    c. A book with drawings of some interesting plants and animals they see in their backyards.

d. Picture of the students and the school/meeting area.

e. Stories written by the students about their favorite things to do or favorite places to go.

f. A field guide prepared by the students to all the trees in their neighborhood.

3) While you are waiting for the box from the other school to arrive, ask students what they know about the other town, any places they have been to in that town, names of the bodies of water, etc.

4) When the box arrives, examine the contents with your students. Have them compare the items with those they sent out, and look for signs of the box coming from the same watershed, but a different part of it.

5) Have them draw pictures or write stories about the other town, and what they learned from examining the similarities/differences between them.

6) Have all the students write a short thank-you note describing what they liked best about the box they received and their favorite things they included the one they sent. Allow them to ask questions about things they received and maybe why the other group chose some of the things they did.

Creature Classifieds

Adapted from San Francisco Bay Watershed Curriculum, 2005

This activity will help students learn about a plant or animal through internet and library research and write a classified ad seeking for an animal to fill a niche.

Objectives-

- ✓ Understand niches and how each animal plays an important role in the ecosystem.

Estimated Time-

- ✓ 1- 2 hours

Materials-

- ✓ Print and internet resources regarding plants and animals of the Northeast

Background-

The term niche can be difficult for students to understand. This exercise will help solidify the idea of a niche through the exploration of a certain plant or animal. A niche is the specific role or 'job' an organism has within the habitat. Everything an organism does is because of its niche—how it protects itself, how it gathers food, where it lives, when it is active. A well-adapted organism fills its niche extremely well. The students will write a niche want ad and gain a better understanding the concept of an ecological niche, but they will also learn about a particular organism and how it interacts will its environment.

Niche Want Ad Examples-

Elegant individual need to probe into mudflats and feed on small mud creatures. Must enjoy the outdoors and be able to withstand long hours standing in salt water. Webbed feet, long legs, and long bill a plus. Formal dress (tuxedo, white shirt) required. 1-800-555-BIRD

Excellent swimmer needed to live and work on the bottom of San Francisco Bay. Main responsibility will be eating plankton and detritus. Experience with camouflage required, prefer tan and olive colors. Must be able to avoid egrets, herons, and terns.

Drought Cups

Adapted from Project WET

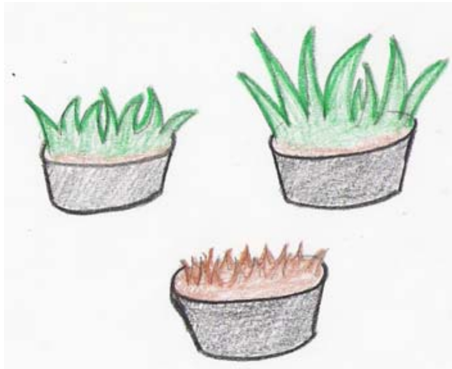
This activity will help students define drought by examining vegetation under different watering conditions.

Objectives-

- ✓ Define drought by observing the growth of plants under drought and non-drought conditions

Estimated Time-

- ✓ 1 – 2 weeks



Materials-

- ✓ Cups
- ✓ Grass seeds
- ✓ Eyedroppers

Background Discussion-

Discuss with the children what they think a plant needs to grow. Ask them what will happen if there is no water?

Record their answers for future discussion.

Procedure-

1) Give each child three cups where they will plant seeds, one labeled "water", one labeled "little water" and the other labeled "no water".

2) Each day have the children water the plants with eyedroppers. One cup labeled "water" is given ten drops of water, the second cup is given one drop of water and the third cup is given no water.

3) Do this over a one-to two-week period of time. Observe the results with the children, drawing upon their initial responses during the introduction.

Earthy Sundaes

Adapted from The Groundwater Foundation
and the US EPA

This activity is an interactive way to study the layers that form aquifers and show the impact that contaminated groundwater can have on wells.

Objectives-

- ✓ To teach about the geologic formations in an aquifer
- ✓ Understand how pollution can get into groundwater and how pumping can cause a decline in the water table
- ✓ Learn about: confining layers, contamination, recharge and water tables.

Estimated Time-

- ✓ 30 Minutes

Materials-

- ✓ Blue/red food coloring (or substitute with red, grape or orange soda)
- ✓ Vanilla ice cream (one 5-quart bucket yields 60 aquifers at one generous scoop per student)
- ✓ Clear soda (7-up, Sprite, etc)
- ✓ Small gummy bears, chocolate chips, crushed cookies, cereal, crushed ice or other material to represent sand and gravel
- ✓ Variety of colored cake decoration sprinkles and sugars
- ✓ Drinking straws
- ✓ Clear plastic cups
- ✓ Ice cream scoop
- ✓ Spoons

Background-

Introduce groundwater, using the vocabulary introduced in the *What does your Aquifer Look Like?* lesson.

Procedure-

1) Begin to construct your edible aquifer by filling a clear plastic cup 1/3rds full with gummy bears, chocolate chips or crushed ice (gravels and soils).

2) Add enough soda to just cover the candy/ice.

3) Add a layer of ice cream to serve as a “confining layer” over the water-filled aquifer. Discuss what a confining layer is/does.

4) Add more “sand/gravel” on top of the “confining layer”.

5) Colored sugars and sprinkles represent soils and should be sprinkled over the top to create the porous top layer (top soil).

6) Now add the food coloring to the soda. The food coloring represents contamination. Watch what happens when it is poured on top of the “aquifer”.

7) Point out that the same thing happens when contaminants are spilled on the earth’s surface.

8) Using a drinking straw, drill a well into the center of your aquifer.

9) Slowly begin to pump the well by sucking on the straw. Watch the decline in the water table.

10) Notice how the contaminants can get sucked into the well area and end up in the groundwater by leaking through the confining layer.

11) Now recharge your aquifer by adding more soda that represents a rain shower.

12) Review what you have learned as you enjoy eating your edible aquifer!

<u>WARNING:</u> Be sure to check with parents about food allergies or dietary restrictions!

Follow the Raindrop

Adapted from San Francisco Bay Watershed Curriculum, 2005

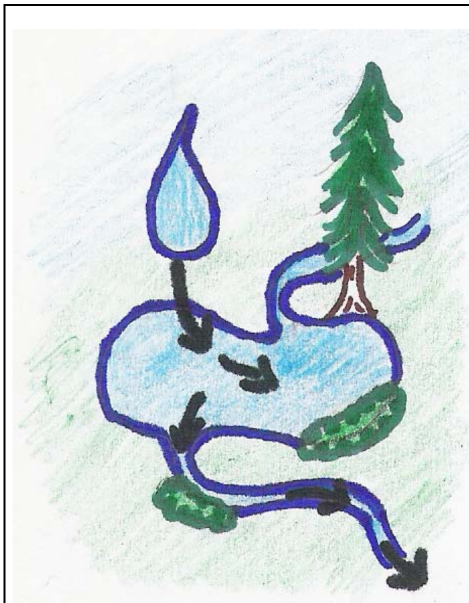
This activity will teach students how water travels from places they are familiar with to Saratoga Lake and provide a venue to explore the pollution the water may pick up on the way by drawing a comic strip.

Objectives-

- ✓ Explore the connections between familiar places (home, school, parks) and Saratoga Lake
- ✓ Understand how waters travels through the watershed, the pollutants that it may pick up, and trace the path from their local waterway to the lake

Estimated Time-

- ✓ 45 minutes to 1 hour



Materials-

- ✓ Saratoga Springs regional maps
- ✓ Pens, colored pencils, or markers

Background-

Many people never realize the direct result their neighborhoods can have on their watershed. This exercise will show students how water travels from their homes or school to Saratoga Lake. The health of the lake is, in many ways, dependent on the quality of the water flowing into. Examining maps will make this idea from tangible to students.

Procedure-

1) Students, in groups or individually, will need to select a location in the watershed to examine. Students can trace the streams from their homes, school, family member’s house, favorite restaurant or park, to Saratoga Lake. The only requirement is that the selected location must be within the watershed.

2) Students should determine the location of their chosen place, the nearest creek, and where that creek begins. Ask students to notice the scale of the map. How many miles as the crow flies is their location from the lake? How many miles on roads?

3) Once students determined the path that water must travel from their location to Saratoga Lake, ask them to make a list of potential pollutants that the water may pick up.

4) Have them imagine that they are a drop of rain falling on the roof of their house, or the school parking lot, or an impervious surface associated with their location. In each box of the attached comic strip, students should draw the surfaces that the water might travel over, the places it may pass, and the pollutants it might pick up. Every box of the comic strip doesn’t have to have a picture in it, and more can be easily added.

5) Ask students to come together as a class to discuss their comic strips at the conclusion of the lesson. Which raindrop has the shortest journey? The longest? Which raindrop picked up the most pollutants? The least?

Comic Strip Title:

Guess the pH

Adapted from The GLOBE Program, 2005

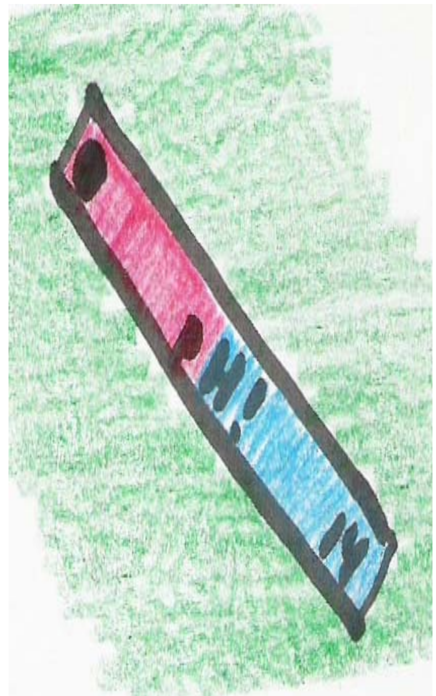
Using an interactive game, students explore the acidity of liquids and other substances around them and what pH levels can tell us about the environment.

Objectives-

- ✓ Learn how different substances have varying pH levels
- ✓ Practice scientific inquiry abilities: develop explanations using observations; recognize and analyze alternative explanations; communicate procedures explanations; communicate procedures and explanations; use instruments to gather data accurately

Estimated Time-

- ✓ One 45-minuted period for preparation
- ✓ One 45-minute period for the game



Materials-

For each team: (about 4 students)

- ✓ 20 pH strips
- ✓ 3 – 5 small cups
- ✓ Paper and pencil
- ✓ Labels to attach results to results board

For the class:

- ✓ Results board (one line of pH levels from 2 – 9 for each team)
- ✓ Flip chart with rules
- ✓ Additional pH strips
- ✓ Cups of solutions prepared for analysis

Advanced Preparation-

Prepare various acidic and basic mixtures/solutions of natural and processed materials. These should be labeled with the ingredients and a letter, but not their acidic or basic characteristic.

Examples of acidic solutions include: fermented grass, diluted and concentrated lemon juice, black coffee, vinegar, orange juice, and soft drinks. Basic solutions include: salt water, shampoo, baking soda, chlorine bleach, household ammonia, and oven cleaner.

Local water and soil solutions should be used as well. Soil water solutions are produced by mixing equal amounts of distilled water with soil, and then allow the soil particles to settle out.

You can also produce solutions from materials found around the local school area, such as oil drippings from vehicles, liquid in a discarded bottle, etc.

Background-

Remind students of the difference between hypothesis and results.

Encourage them to develop their hypothesis and find a way to test it with results.

Divide your class into separate teams.

The Rules of the Game-

1) Explain that the objective of the game is for each team to identify solutions that have a pH range of 2 – 9. The students should draw a horizontal pH scale line from 0 – 14, marking pH 7 as the neutral point. Each unit should be spaced at least 1 cm apart. They then draw a box underneath each pH unit from 2 – 9. Each team finds substances that have a pH corresponding to a box in the pH scale.

2) Draws the score board (shown below) on the blackboard.

3) One point is awarded for each box filled, even if the team finds two samples with the same pH.

4) Students should record all the information about the solution from the labels and the pH they measured.

5) When students are ready to submit a sample for the game results board, they show the teacher their notes and sample. Together they measure the pH with a new pH strip. If the pH agrees with the students' previous measurement, the sample is approved and the points are added to the team's score.

6) The teacher gives a new pH strip for each sample added to the results board.

Score Board-

	pH								
Teams	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
Team 1									
Team 2									
Team 3									
Team 4									

Extensions-

Beginners-

1) For a basic understanding, use salt and sugar and explain to students that salty does not necessarily mean basic. Cola soft drinks are good examples of a sweet and very acid liquid

Intermediate-

1) Make the game more competitive. For instance, the team that finds the first sample of a particular pH value receives 5 points; subsequently, samples for that pH level receive only 1 point.

2) Make the game more difficult by limiting the sample sources to only natural materials

3) Limit the number of pH strips given to each group and set up a rule for buying a new one with game points.

Discussion-

After the game, sit with students around the results board and identify what samples they have found, where the samples were/are found, and the pH of the samples.

Encourage students to present their own ideas about why different samples have different pH values.

Discussion Continued-

Emphasize differences among water samples from soils, rocks, artificial surfaces, lakes, rivers, etc. Mention the acid neutralization capacities (alkalinity) of some rocks and the acidic influences of different materials.

Ask them why it was difficult to find some samples for some pH levels, and easy to find others.

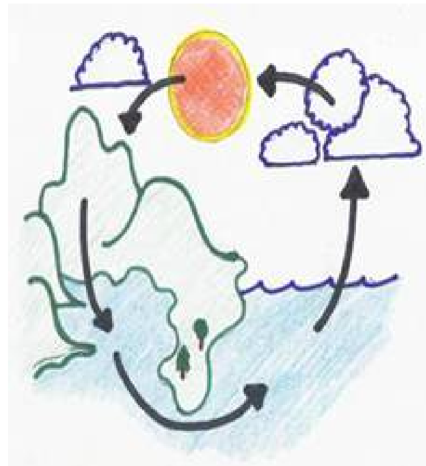
Hydrologic Cycle Wheel Illustrations

Adapted from Wood, 2007 & Illinois EPA, 2007

This exercise will teach students about the movement of water through the hydrologic cycle by creating an interactive water cycle wheel.

Objectives-
- ✓ Understand and explore the hydrologic cycle.
- ✓ Learn the concepts of evaporation, condensation, precipitation, transpiration and infiltration.

Estimated Time-
- ✓ 25 minutes



Materials-
- ✓ Photo copies of the water wheel
- ✓ Markers, crayons, or colored pencils
- ✓ Paper fasteners (brads)
- ✓ Scissors

Procedure-

1) Begin the activity with a thorough lesson about the different steps of the hydrologic cycle, focusing on the following terms.

   i. Evaporation- Ask students if they have ever seen the water level decrease in a puddle or glass of water left in the sun. Explain that the sun warms water in oceans, lakes, rivers, etc. and transforms the water into vapor. The vapor then leaves the water body and rises into the atmosphere.

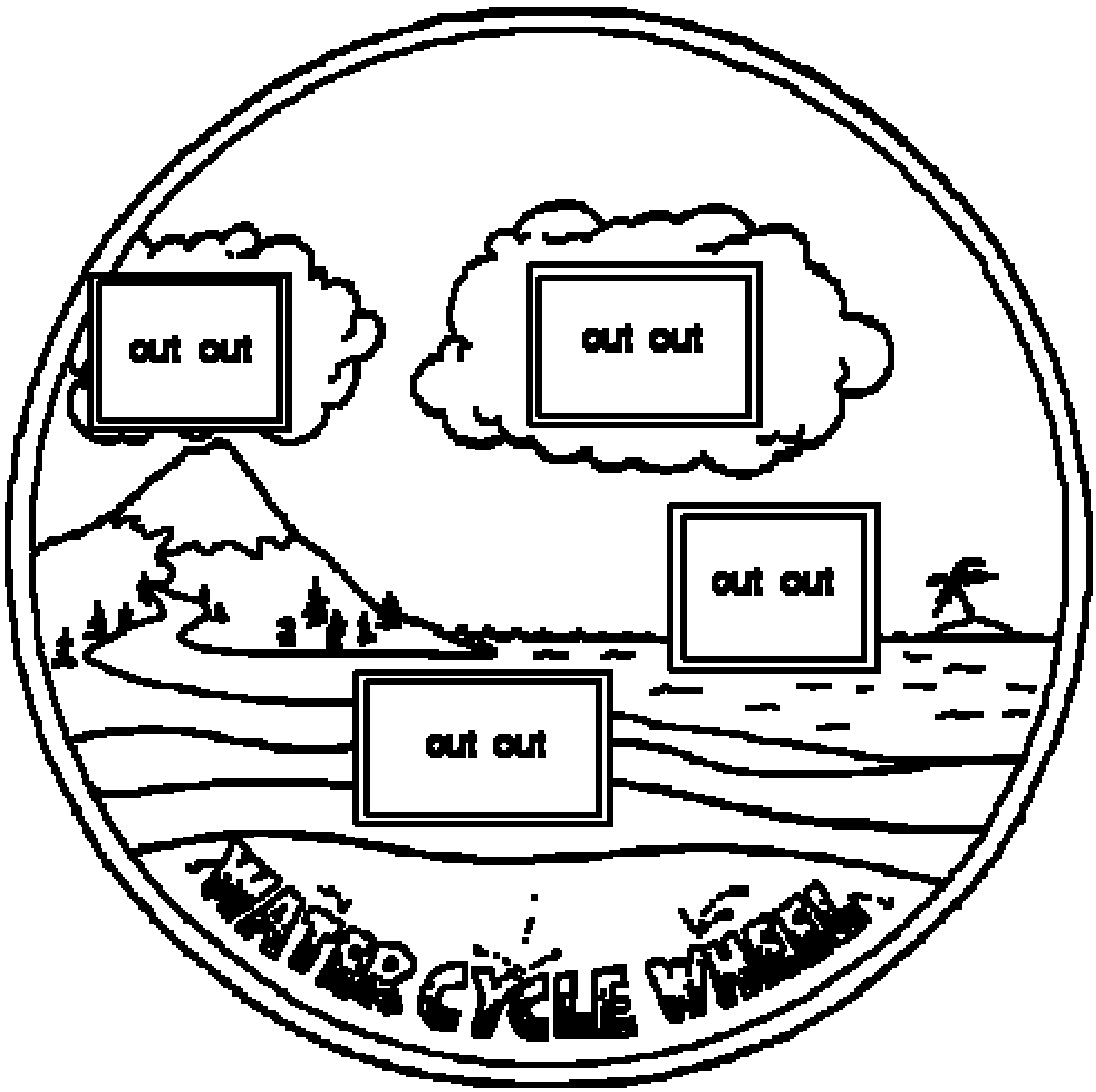
   ii. Transpiration- Ask students if they have ever seen a plant sweat. Continue to explain that transpiration is the process that plants use to lose water from their leaves. In short, transpiration is like evaporation but water is escaping from the leaves rather than the surface of a lake.

   iii. Condensation- As water vapor in the air (from evaporation) rises in the atmosphere, it cools and transforms back into a liquid. The condensation, the liquid state, forms clouds.

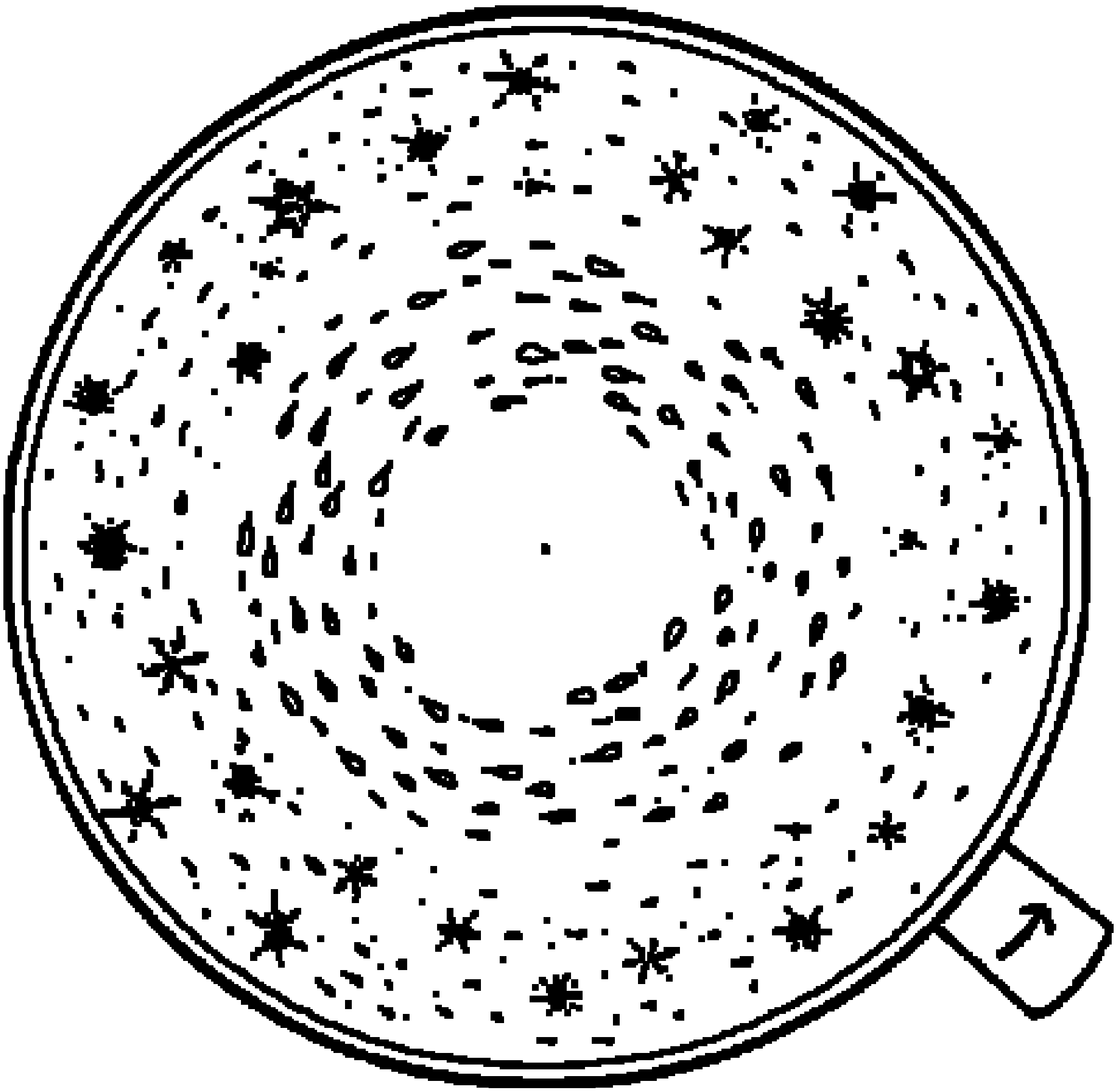
   iv. Precipitation- When the condensation droplets become large and heavy, they begin to fall. Clouds are made of water droplets to light to fall, whereas rain is water droplets to heavy to remain in the clouds. Depending on the temperature, droplets can freeze as they fall and form hail, sleet, or snow.

v. Infiltration- Ask students where the water from a sprinkler watering a garden goes. Explain that water that does not evaporate is absorbed by the soil and becomes groundwater. The process of the water entering the soil is called infiltration.

2) Once students understand the principles of the hydrologic cycle, have them color in the water wheel. When completed, cut out each wheel and use a brad to fasten them together in the center. Use the tab on the bottom wheel to rotate it and see the water cycle in action!



out out
out out
out out
out out
WATER CYCLE WHEEL



Karner Blue Pond

Adapted from Project WILD
& Saratoga Springs Open Space Project

Karner Blue Pond is an activity investigating land use and its effects on a wetland and a pond. Students will design a community, keeping the health of the pond and wetland at heart.

Objectives-
- ✓ Evaluate the effects of different land uses on wetlands
- ✓ Discuss lifestyle and land use changes that will minimize damaging effects on wetlands
- ✓ Introduce students to the struggles to arrange overlapping interests and uses regarding responsible land management decisions

Estimated Time-
- ✓ 2- 3 hours

Materials-
- ✓ Scissors
- ✓ Masking tape
- ✓ Paste or glue
- ✓ Sets of land use cutouts
- ✓ Karner Blue Pond cutouts
- ✓ Large pieces of paper to attach the cutouts to

Background Discussion-

Human land use affects wildlife habitat in both positive and negative ways. The choices humans make toward land use are a reflection of their priorities and lifestyles. Some people believe that untouched natural areas should be preserved regardless of human needs, while some believe that undeveloped areas merely consist of raw materials for human consumption. Others believe that a balance between economic growth, and a healthy, vigorous natural environment should be found.

Growth is at the core of land use issues. In natural areas, growth is limited by the need for balance of energy between all parts of the natural system. Energy in a natural system is defined by food, water, shelter and space for survival; meaning that natural systems have the ability to be self-regulating. This capacity to self-regulate means that all members of an ecosystem are able to live in harmony and must be equally considered.

Human usage often disturbs the harmony and self-regulation. Water is used for irrigation and removed from its natural path. Wetlands are seen as useless swamps when they are actually nurseries for hundreds of plant and animal species.

The challenge presented to humans is to be responsible in our development. How can we develop the skills, knowledge, awareness, and commitment that are needed to make responsible decisions regarding the remaining areas of natural wildlife habitat?

Procedure-

1) Prepare copies of the two cutout sheets in advance. Explain to students that they will be responsible for arranging the pattern of land use around Karner Blue Pond in a manner that will best preserve the area.

2) Divide the class into group of three to five students. Assign each group an interest group to represent. Possible interest groups are:

   a. Residents- who want to live in the area.

   b. Farmers- who want to use the land to raise food and livestock.

   c. Business interests- want to use the land for commerce and economic growth.

   d. Gas station owners- want to make a living servicing and repairing cars.

   e. Parks department- want people to have places for recreation.

   f. Highway department- want to maintain access to the area.

   g. Racetrack representative- want to preserve jobs and commerce.

3) Distribute the land use materials. Have students cut apart the land use options and Karner Blue Pond. Explain that ALL pieces must be used. The park and farmland tiles may be cut into smaller pieces. Parts may touch, but not overlap. The students can also create more land use options of their choosing. Suggest that students use loops of tape to attach their land use pieces, so that they can change their minds if necessary.

4) Before making land use decisions, have students create a list of the pros and cons of each land use on the blackboard. Here is an example of the pros and cons of farmland:

   a. Pros

i. Produce food
ii. Economic value
iii. Provide jobs through seasonal employment
iv. Preserve rural views

b. Cons
i. Use pesticides
ii. Source of natural soil erosion
iii. Sometimes drain wetlands for farm land
iv. Use chemical fertilizers that can damage water supply

5) Allow students to develop Karner Blue Pond keeping the desires of their assigned interest group in mind.

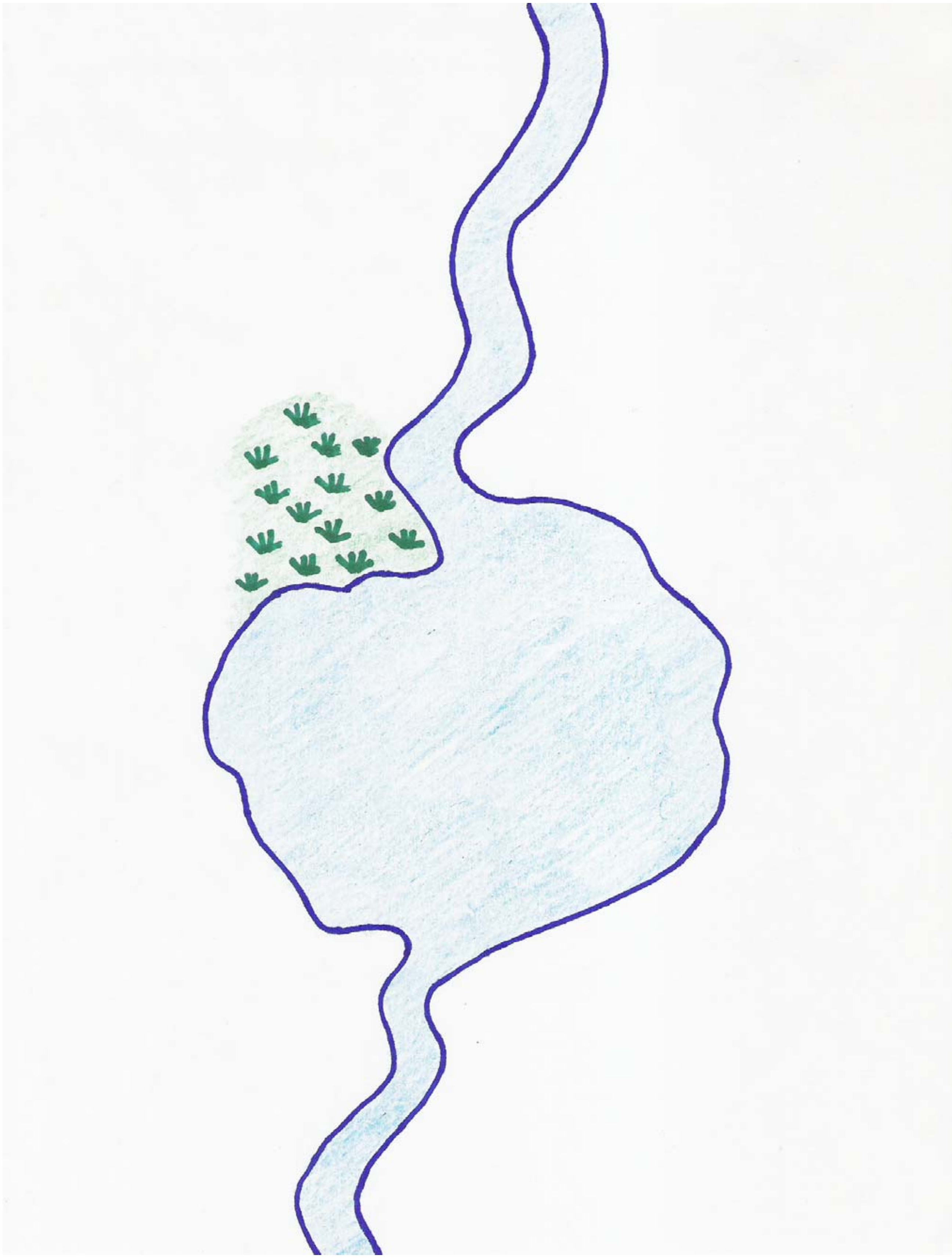
6) When students have had ample time to grapple with the assignment, invite each group to display their development plan and describe their choices. Hold classroom discussion that emphasizes that:

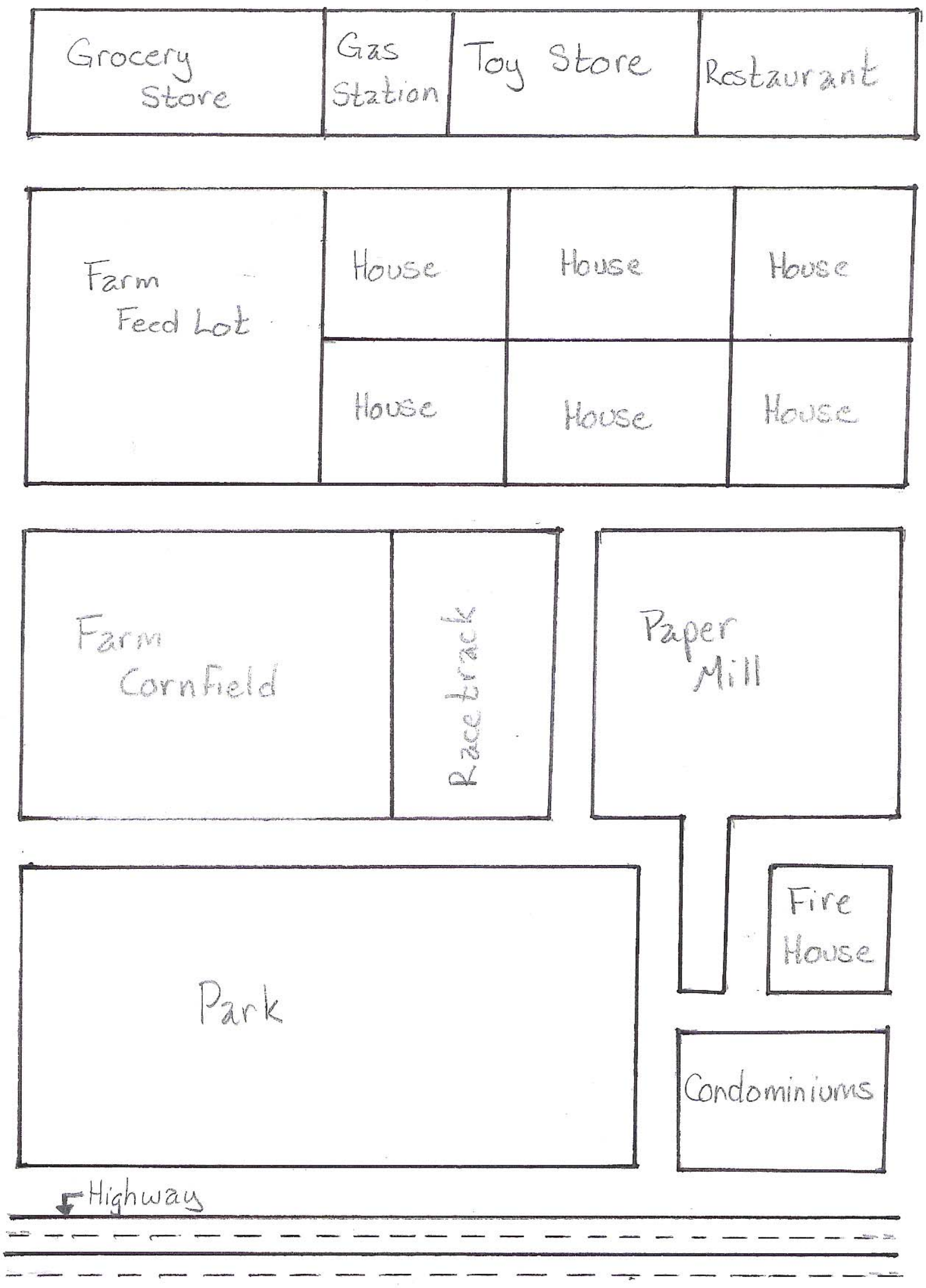
a. No land use can be excluded
b. Wildlife habitat must be preserved
c. Everyone in the group must agree

Be sure to explain that there are often no-win situations when it comes to wildlife preservation, tell students to merely try to minimize threats, not eliminate them.

7) Allow students additional time to work on their development plans. Display the final plans in the front of the room for everyone to see. Analyze and discuss the advantages and disadvantages of each plan while being sensitive to the students' frustration. Explain that although the plan may not be perfect, they can reduce negative impacts to Karner Blue Pond.

8) Ask students what the people in charge of the various land uses can do to reduce effect on Karner Blue Pond. Have students create a list of things they personally can do to reduce the damaging effect of their lifestyle on the environment.




Grocery Store
Gas Station
Toy Store
Restaurant
Farm Feed Lot
House
House
House
House
House
House
Farm Cornfield
Racetrack
Paper Mill
Fire House
Park
Condominiums
Highway

Let's Clean Water!

Adapted from Project WET

This activity allows children to analyze different methods of cleaning water, and show the dangers of drinking contaminated water.

Objectives-

- ✓ Children will learn how to filter water

Estimated Time-

- ✓ 45 minutes – 1 hour

Materials-

- ✓ Two 2-liter soda bottles for each group
- ✓ Different sized rocks
- ✓ Cheese cloths
- ✓ Coffee filters

Background Discussion-

Begin the activity with a discussion on the importance of clean water, and the dangers of drinking polluted water.

Procedure-

1) Set up two filters made from two soda bottles for each group. Cut the bottles in half, and invert the nose end of the bottle and set it in the base. The nose end of the bottle will form a funnel and the base will collect water.

2) Put the cheesecloth in one filter and the coffee filter in the other.

3) Put several white rocks in each funnel to provide a base for the filter.

4) Provide a large container of dirty water.

5) Put the children into small groups. Tell them to use the filters to clean the dirty water, so a little cat can drink it.

Concluding Discussion-

Compare each group's water and see which one is cleaner. Have children draw pictures or take turns talking about how they cleaned the water.

Life in Saratoga Lake

Adapted from San Francisco Bay Watershed Curriculum, 2005

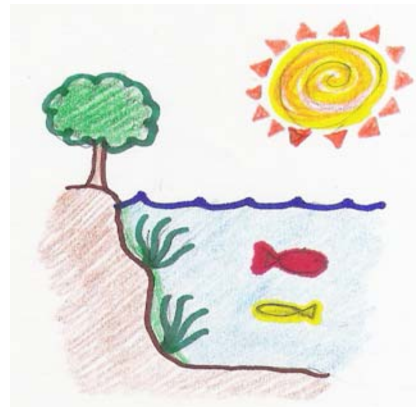
This project will teach students about plants and animals that live in Saratoga Lake through individual research and presentations to the class.

Objectives-

Learn about a plant or animal through internet and library research.

Estimated Time-

- ✓ 2- 3 weeks



Materials-

- ✓ Reference books featuring plants and animals of the Northeast
- ✓ Internet access and a printer
- ✓ Poster board
- ✓ Colored construction paper
- ✓ Markers, colored pencils, paint, letter stencils, and other art supplies

Procedure-

1) Have student choose a plant or animal to research, or assign them one.

2) Explain that they will become 'experts' on their plant or animal. Brainstorm with the class the type of questions they should ask to answer the question. Each student should answer between three and five research questions.

3) Suggested Animal Questions

   i. What is its habitat? What adaptations help it survive there?

   ii. What does it eat? Where does it find its food? What adaptations help it get food?

   iii. Who are its predators?

   iv. What do your animals look like?

   v. What sounds (if any) does your animal make?

vi. What does the animal tracks look like?

vii. How does it reproduce?

viii. What are some interesting facts about your animal?

3) Suggested Plant Questions

   i. What is its habitat? What adaptations help it survive there?

   ii. What animals eat it? What animals use it for shelter or protection?

   iii. How have humans used it (medicine, food, building materials, etc)?

   iv. Is it a native or introduced species? If introduced, how did it get here?

   v. What does your plant look like?

   vi. How does it reproduce?

   vii. What are some interesting facts about your plant?

4) After completing the research, students should write up the answers to their research questions in the form of a paper. Students should also make a poster about their plant or animal and present their findings to the class.

Make Your Own Filter!

Adapted from The Groundwater Foundation

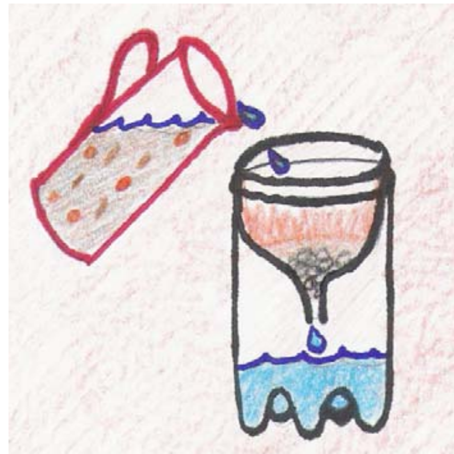
This activity works on team collaboration and analysis of different methods of water filtration and treatment.

Objectives-

- ✓ Work as a team and build the most efficient water filtration device using the items given
- ✓ Discuss how municipal water treatment plants are designed

Estimated Time-

- ✓ 45 Minutes



Materials-

Filter materials: *1 set for each team*

- ✓ 2 cups of gravel
- ✓ 2 cups of sand
- ✓ ½ cup of activated charcoal, rinsed (available at aquarium supply stores)
- ✓ Sponge
- ✓ Coffee filter
- ✓ Paper clip
- ✓ Drinking straw
- ✓ Cotton ball
- ✓ 2-liter soda bottle, cut in half
- ✓ Rubber band
- ✓ Tape (electrical or duct)
- ✓ Panty-hose
- ✓ Modeling clay or plumbers putty
- ✓ Scissors
- ✓ Yarn, 12" long

Contamination Materials

- ✓ Large bucket filled with water and the following items:
- ✓ Food coloring, about 6-8 drops
- ✓ Raisins or dried beans, about ½ cup
- ✓ Soil, about ½ cup
- ✓ Baking soda about 3 tablespoons
- ✓ Soy sauce, about 6 – 8 drops
- ✓ A paper plate, torn into small pieces
- ✓ A handful of natural items like sticks, twigs, leaves, grass, pinecones etc.

Background-

Decide how many teams you want and how many students will be on each team. We recommend smaller teams of 2-3 students as to allow all students the opportunity to get involved

Each team will need one 2-liter soda bottle, cut in half. Take the top portion of the bottle and turn it upside down and place it in the bottom portion. The filter will be built inside the inverted, top portion of the bottle. The base portion will act as a reservoir and collect the water that runs out of the filter.

Now make the contamination liquid that will be poured through the students filter. Take the bucket of water and mix in the “contamination materials”. The food coloring represents chemicals, the raisins represent animal/human waste, the potting soil represents earth, the baking soda represents road salt, the soy sauce represents motor oil, and the torn paper plate represents litter.

Procedure-

1) Discuss filtration systems and wetlands with students.

2) Provide each team with the filter materials and explain to them that they have been hired by a water treatment plant to design the most efficient water filtration system possible with the materials supplied. The teams may only use eight items, not counting the soda bottle, to construct their filtration device. Grant them fifteen minutes to discuss and construct their filter.

3) At the end of fifteen minutes, have each team share with the group which materials they built their filter from and why they decided to use each item. Then pour the “contaminated” water onto the top of each of the filtration systems. This part can be messy, so it’s best to move outside. The team that has the clearest, most debris free water in its collection base is the declared winner.

4) Compare and contrast the outcomes of each team’s filtration system. Ask each team what they would change if they could re-build their filtration system.

Saratoga Lake Watershed and You; Watershed Journals

Adapted from San Francisco Bay Watershed Curriculum, 2005

This journal activity will incorporate language arts skills into the students understanding of the human and natural forces acting on the Saratoga Lake Watershed.

Objectives-

- ✓ Practice language arts skill and personal exploration of the watershed.

Estimated Time-

- ✓ To be incorporated throughout all the watershed lessons

Materials-

- ✓ 30-50 pieces of reused 8.5”x11” paper (one side must be blank)
- ✓ Approximately 9”x12” mat board, foam board, or cardboard (not corrugated, cereal boxes can be used) for the back cover
- ✓ Approximately 9”x12” front covers cut from heavy duty paper or reused poster paper
- ✓ Hole punches
- ✓ Thick, big rubber bands
- ✓ Sticks or pencils (about 8” long)
- ✓ Large Ziploc bags for journal storage

Suggested Journal Entries-

1) What do we know?

   i. What experiences do you have in or around water? Describe the experience.

   ii. What do you already know about the Saratoga Lake Watershed? What do you want to learn?

   iii. Write down a definition of ‘watershed’.

2) What have you learned?

   i. Was your previous definition of a watershed correct? Write a new definition adding something you have learned.

Suggested Journal Entries, continued-

ii. Write a letter to a friend about what you have learned? Describe the Saratoga Lake Watershed to them. How would they get to your house if they could only travel along waterways?

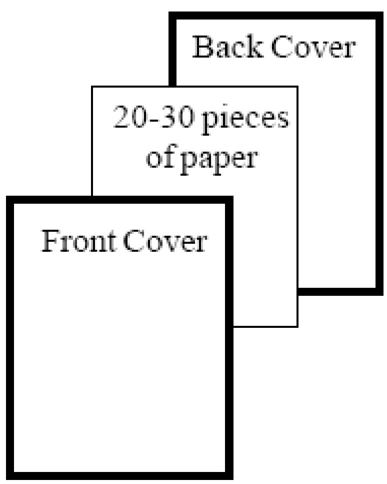
iii. Many objects make good metaphors for a watershed like a tree, bathtub or nervous system. Ask students to come up with a good metaphor and explain it in a descriptive paragraph or poem.

iv. Using what you know about the Lake, draw a picture or write a paragraph about what you think the watershed may look like in the future.

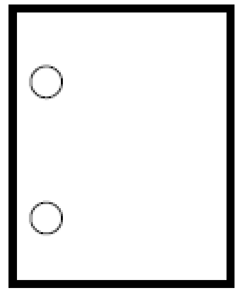
v. Describe, write a script or make a storyboard, for a commercial informing people about what they can do to protect the Saratoga Lake Watershed.

Creating the Journal-

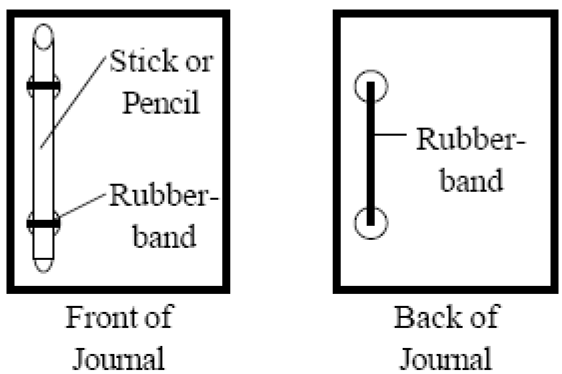
1) Stack the back cover, 20-30 pieces of paper, and the front cover in a neat pile.



2) Using a hole punch, punch two holes through the front cover, pieces of paper, and back cover along the spine of the journal. Make sure these holes line up!



3) Pole a rubber band through hole from the back (using a pencil to poke may help) and place a stick or pencil on the front. Loop the rubber band over the stick.



4) Write your name inside the journal and start writing!

Saratoga Lake Watershed Newspaper

Adapted from Project WILD
& Saratoga Springs Open Space Project

This activity will create an opportunity for students to explore an area of the watershed that they are personally interested in. The class will publish a newspaper about the issues, communities, ecosystems, or other aspects of the Saratoga Lake Watershed.

Objectives-
- ✓ Identify and discuss a diverse range of issues related to the watershed
- ✓ Development of individual ideas about the watershed
- ✓ Provide an opportunity to incorporate art, graphic sense, creative writing, composition, research and decision making skills in the production of the newspaper

Estimated Time-
- ✓ 2- 3 weeks

Materials-
- ✓ Library and internet resources
- ✓ Current nature magazines (optional)
- ✓ Cameras (optional)
- ✓ Tape recorders (optional)

Background Discussion-

Using an actual newspaper as a model, discuss the various sections with the class. Explain that special interest sections exist in most newspapers, ranging from comics, sport reports, editorials, commentary, home making articles, want ads, advertisements and political cartoons. Where would watershed news fit?

Getting the Watershed Reporters Started-

1) Ask students to pair up and select a section of the newspaper to work on. Regardless of their section, the topic must relate to the Saratoga Lake Watershed.

2) Begin the research phase by asking students to begin collecting information for their topic. If possible, a visit to local sites or interviews with local officials or community members can be incorporated. During other field trips within the watershed, ask students to bring along cameras to take photographs of anything that may relate to their topic. Be sure students know how to properly cite their sources.

3) If possible, be sure to include both serious and playful articles in the newspaper. Topics can include: a personal account of a field trip, interview with a community member about watershed issues, the creation of related cartoons, and advice columns about place to visit within the watershed and what to look for. Students will have plenty suggestions of their own.

Newspaper Production-

1) Once enough work has been completed, being the production phase of the newspaper by compiling art work and photos. If possible, the articles should be neatly written or typed in a specified column width (3.5- 4 inches wide works well). A small group can be assigned layout and design.

2) Once the articles are properly laid out and the newspaper has been given a title, distribute the paper! Copies should be made for each student to share with their parents, as well as copies to be circulated around the school.

3) Culminate the activity with a discussion about each article or feature. Be sure to emphasize what can be learned about Saratoga Lake Watershed from its content.

Saratoga Lake Watershed Vocabulary Project

Adapted from Wood, 2007

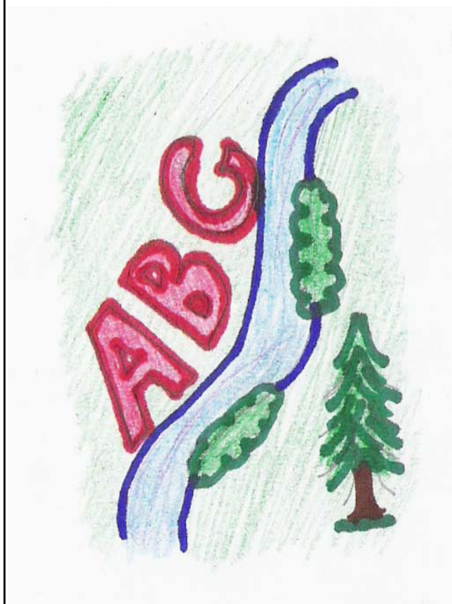
This exercise will help students familiarize themselves with locations within the watershed and the connections between them.

Objectives-

- ✓ Understand the placement of headwaters, drinking water sources, drinking water and waste water treatment plants and other significant water sources and communities
- ✓ Practice public speaking skills with presenting to the class.

Estimated Time-

- ✓ 30- 45 minutes
- ✓ Time can be easily adjusted by altering the number of groups and vocabulary words.



Materials-

- ✓ Poster board
- ✓ Markers, crayons, colored pencils, and other art supplies

Suggested Vocabulary Words-

- ✓ Drinking water source- Loughberry Lake
- ✓ Wetland- Bog Meadow Brook
- ✓ Paper Mill- Rock City Falls
- ✓ Hydrologic Cycle
- ✓ Headwaters
- ✓ Drinking Water Treatment Plant

Procedure-

1) Begin by drawing a simple schematic of the Saratoga Lake Watershed on the blackboard. Ask students where they think the headwaters, the lake, and the drinking water source are.

2) Divide the students into groups and assign each group a concept or location. Depending on the number of students and the available time, groups can be assigned more than one vocabulary word.

3) Allow time for the students to use the art supplies and poster board to illustrate, define and explain their term. Be sure students incorporate the influence of the vocabulary word on the watershed as a whole.

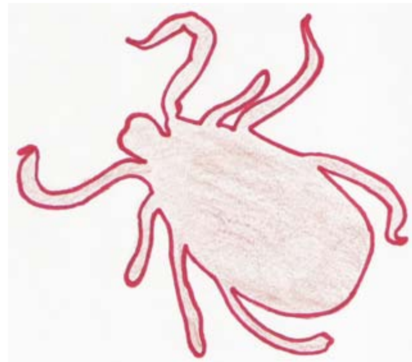
4) Once everyone has finished, invite each group to the front of the classroom to present their illustrations and explain their vocabulary word to the rest of the class. If the vocabulary word has an associated location, they should place the term in the proper area on the watershed schematic. Begin presentations with groups that have vocabulary words in the headwaters. As each group finishes, have them invite the group with the next logical term/location downstream to present their topic.

Tick Safety!

This lesson will help educate students, and their parents, about preventative tick protection and safely removing ticks.

Objectives-
- ✓ Learn how to protect oneself against ticks
- ✓ Learn how to safely remove a tick

Estimated Time-
- ✓ 45 minutes



Materials-
- ✓ Reference books
- ✓ Computer/Internet access

Procedure-

1) Have the children research ticks, tick bites and Lyme disease. A great website to start is National Geographic for kids: have them fill out the attached worksheet. (Answers provided below).

2) Ask them to take their completed worksheet home to share with their parents.

Frequently Asked Tick Questions-

1) What is a tick?

   A tick is a relative of the spider, not an insect like most people think. Ticks have eight legs like spiders; they hold onto leaves and branches with the back six legs and use the front two to grab hold of passing animals and humans. Ticks bite animals and feed of their blood. Most people can't tell they have been bitten because ticks, especially deer ticks can be very small. Most deer ticks are about the size of a sesame seeds, and young ticks can be even smaller.

2) What is Lyme disease?

   Some ticks carry Lyme disease, but not all of them. If you are bitten by a ticks, don't worry, just keep an eye of the area. If a rash in the shape of a bulls-eye appears any time up to two weeks after the bite, a doctor can easily treat the infection with antibiotics.

Not every person with Lyme disease gets the bulls-eye rash; other symptoms are tiredness, fever, headache, and upset stomach.

3) What to do if you find a tick on your person?

   If you find a tick on you, or a friend, tell an adult immediately. The adult should remove the tick with a pair of tweezers. The goal of tick removal is to extract the mouth parts and the rest of the body. Often times, the mouth parts are left in the skin.

   See *How to Safely Remove a Tick* below.

4) Where do I look for ticks on my person?

   Ticks like warm, dark places. They tend to attach around the back of the knee, thighs, belly button, armpit, behind the ears, and in your hair or the back of your neck.

   Be sure to have a parent or guardian do a "tick check" and look on your body for ticks.

5) What can I do to stay away from ticks?

   Ticks like to live in shady, wooded areas. They can also be found in tall grasses, bushes, low hanging tree branches, and sometimes lawns and gardens.

   They are usually found between April and September, but can be around whenever the weather is warm. Remember to dress properly and do a tick check when playing outside.

Preventative Tick Protection-

1) Dress Properly

   i. Wear light colored clothing (it is easier to see the dark colored ticks)

   ii. Always wear closed toed shoes like sneakers or boots

   iii. Tuck your pants into your socks and tuck in your shirt

   Ticks will always climb upward, so tucking in your pants and shirt makes it hard to get to your skin

   iv. Spray your clothes with bug spray, especially around your ankles.

v. Wear a hat and tie long hair back into a ponytail.

vi. Remain on the trails! Try to avoid heavily wooded areas.

2) Once Back Inside

i. Wash your clothes to kill any ticks that might be on them.

ii. Take a shower and check for ticks.

iii. Have a parent or guardian check places that you cannot easily see for ticks, like behind your ears.

How to Safely Remove a Tick-

1) Use fine tipped tweezers to remove the tick. Do not handle the tick with bare hands.

2) Grab the tick as close to the mouthparts as possible. The mouth part is the area that is stuck to your body.

3) Don't grab the tick around its bloated belly. You could inadvertently push the infected fluid into your body.

4) Pull the tick straight out of your skin. Do not twist or "unscrew" the tick for fear of separating the mouthparts.

5) After the tick has been successfully removed, wash the area with warm water and soap. Be sure to wash your hands, as well.

6) DO NOT:

   i. Smother a tick that is still stuck to you in petroleum jelly, nail polish, gasoline or rubbing alcohol.
   ii. Burn the tick while it is stuck to you.
   iii. "Twist" the tick out of you.
   iv. Use your fingernails to remove the tick.

Keeping Watch over the Bite Site-

1) Some ticks are so small that it can be hard to tell if you have removed the entire thing. If you do not see any remaining parts, assume you have removed the whole tick but keep watch for signs of infection.

2) Common symptoms of Lyme disease and skin infections include:

   i. Pain, swelling, redness, or warmth around the area
   ii. Red streaks leading away from the area
   iii. Pus draining fro the area
   iv. Swollen lymph nodes in the neck, armpit or groin
   v. Bulls-eye rash around the area (indicative of Lyme disease)
   vi. Fever or chills
   vii. Upset stomach

The Search for Ticks!

1) What is a tick?

2) What is Lyme disease?

3) What do you do if you find a tick on yourself?

4) Where do I look for ticks on myself?

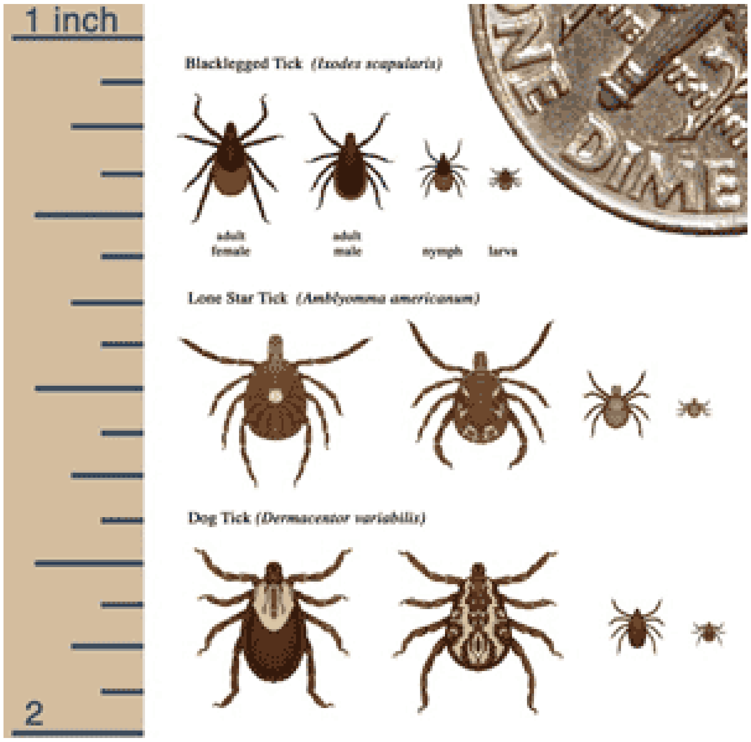
5) What can I do to stay away from ticks?

6) How do you dress properly to prevent ticks from getting on you?

7) How do you safely remove a tick?

Pictures of Ticks

http://www.morristown.com/LymesDiseaseNJ/TickDISEASE.html



http://www.hoptechno.com/images/ticklyme.gif

Water Cycle in Your Window!

Adapted from The Groundwater Foundation, 2008

This activity is a quick and easy way to demonstrate the processes of the water cycle inside the classroom by constructing a simple, miniature model.

Objectives-
- ✓ Identify the components of the water cycle and observe the water cycle

Estimated Time-
- ✓ 45 minutes – 1 hour

Materials-
- ✓ Clear plastic bag (zipper style, sandwich size works best)
- ✓ Measuring spoon
- ✓ Rubber band or twist-tie
- ✓ Masking tape

Vocabulary-

1) Water Cycle – the never-ending movement of water through the atmosphere, ground and back again; also called the hydrologic cycle.

2) Hydrologic cycle – see *water cycle*

3) Evaporation – the stage of the water cycle when water transforms from a liquid into a gas

4) Condensation – the stage of the water cycle when water transforms from a gas into a vapor and becomes suspended in the atmosphere, visually represented by clouds

5) Precipitation – the stage of the water cycle when water vapor molecules become too large and heavy to remain in the atmosphere and fall to the ground in the form of rain, snow, sleet, hail, etc.

6) Surface water – any body of water above ground: lake, pond, stream, river etc.

7) Groundwater – water contained under the ground's surface, between particles of and in the cracks of sand, soil and gravel; a common source of water for drinking and irrigation

Vocabulary, continued-

8) Infiltration – to increase the amount of groundwater through precipitation or surface water that absorbs into the aquifer, also called recharge.

9) Recharge – see *Infiltration*

Procedure-

1) Pour 2 teaspoons of water into the clear plastic bag

2) Blow air inside the bag with your mouth and quickly seal the bag closed with a rubber band, twist-tie or zipper closure.

3) Place the bag on a sunny window ledge or tape directly to the windowpane.

4) Periodically look at the bag throughout the day. What changes do you see?

Variation-

For instant results, make two bags. Put cold water in the first bag and hot water in the second bag. Compare the two.

Conclusion-

Water molecules are constantly on the move in what is called the water cycle (or hydrologic cycle). Heat from the sun causes the water to evaporate and become a vapor. As the water vapor cools, it condenses, forming tiny droplets that gather to form clouds. As the droplets get larger, they become heavier causing them to fall to the ground as precipitation (rain, sleet or snow). Some of this precipitation joins lakes and streams (surface water), and some of it soaks into the ground where it becomes groundwater. The process of water soaking into the ground is called infiltration, or recharge.

Water Detectives

Adapted from The GLOBE Program, 2005

This activity will allow students to investigate substances from their watershed in a safe environment. Some tools will be introduced to assist them with the identification.

Objectives-

- ✓ Help students understand that some substances can be identified safely with your senses. For some we may need tools to help us identify them.

Estimated Time-

- ✓ 45 minutes

Materials (*for each team of 4-5 students*)-

- ✓ 4 plastics cups
- ✓ 4 spoons or straws
- ✓ Marker to number cups
- ✓ Distilled or tap water
- ✓ Water Detectives Worksheet
- ✓ "Pollutants" which represent all of the senses (non-toxic)
  - ✓ Sight- drop of food coloring
  - ✓ Touch- backing soda, clear syrup
  - ✓ Smell- vinegar, lemon/orange juice
  - ✓ Hearing- carbonated water

Classroom Preparation-

1) Number the cups for each station from 1 – 5

2) Copy the Water Detective Worksheet for each group

3) Provide a work station with 4 cups of distilled or tap water with small amounts of a "pollutant" mixed into 4 of the cups

4) Lay out spoons or straws for dipping water from the cups.

Procedure-

1) Discuss with the students how they use their senses to detect things in their environment. Discuss the advantages and limitations of each of the senses. Questions students may want to think about:

    a. How do we use our eyes to detect danger? When does our sense of sight not work very well?

    b. How do we use our ears to detect danger? When do our ears not work very well?

    c. How do we use our sense of smell to detect danger? When does it not work very well?

2) Hold up a cup of water from one of the stations. Explain what the cup contains (water plus what known substances).

3) Ask the students which senses would be most useful for finding out with the water was unaltered tap water (intended for drinking?).

4) Consider the advantages and disadvantages of using each of your senses.

5) Explain to students that 4 of the 5 cups contain a mystery food that will be considered a pollutant in the water. (You may want to show students the boxes of 'mystery food' that have been put in the water).

6) Students are to detect which cups contain mystery pollutants and which cup has just water by using their senses. Use the Water Detectives sheet to have students record their data.

7) Ask students what other ways might be used to find out what was in the water. Introduce the idea of how we use tools and ask for examples of how we use tools to help our senses. For example, they may think of smoke detectors, microscopes, hearing aids, etc.

8) Introduce students to pH paper as a tool for sensing water. Have students use pH paper to test their cups of water. What can the pH paper detect?

Concluding Discussion Questions-

1) Ask students to:

    a. List several substances they might find in the water at their hydrology site

Concluding Discussion Questions, Continued-

b. Explain why instruments are sometimes needed to detect substances

c. Guess (hypothesize) how various substances might affect things living in the water

d. Explain how each sense is good for examining different kinds of materials

Detectives Worksheet

Name:____

	Senses				
Cup	**Sight**	**Hearing**	**Smell**	**Feel**	**pH Test**
1					
2					
3					
4					

1) **Look** at the cups. Put an X next to the cups that do not look like water.
2) **Listen** to the cups. Put an X next to the cups that do not sound like water.
3) **Smell** the cups. Put an X next to the cups that do not smell like water.
4) **Feel** water dipped from the cups. Put an X next to the cups that do not feel like water.

Which cup has ONLY water in it?____________________________________

Wetland Model, Option 1

Adapted from Ranger Rick's Nature Scope, 1997
& Saratoga Springs Open Space Project

Through creating a wetland model, students will become familiar with the processes of wetlands and their ecological function.

Objectives-

- ✓ Understand and explore wetlands and their ecological function.
- ✓ Understand that wetlands help reduce pollution, sedimentation, and can reduce flooding

Estimated Time-

- ✓ 1 to 1 ½ hours

Materials-

- ✓ Chalkboard or easel paper
- ✓ Modeling clay
- ✓ Roasting pan
- ✓ Small piece of indoor/outdoor carpeting
- ✓ 1-2 medium sponges (to remove water from model)
- ✓ Jar of muddy water
- ✓ Jar of clear water

Background Discussion-

Begin the activity by asking students to create a list of the characteristics about different types of wetlands (freshwater and salt marshes, freshwater swamps, mangrove swamps, and bogs). Discuss which characteristics you would expect to find within each of the three communities in Bog Meadow Brook; the forested wetland, open marsh, and wet meadow.

Building the Model-

1) Spread modeling clay over ½ of the roasting pan to represent land. The empty portion of the pan represents a lake or body of water.

2) Shape the clay so that is gradually slopes toward the water body.

3) Use the carpeting to create a wetland buffer between the land and the water. The carpeting should cover the entire width of the pan along the edge of the clay.

4) As you build the model, be sure to explain how each added piece represents a portion of the wetland. Discuss that scientists know that wetlands are complex natural systems that are important for filtering pollutants, reducing flood damage, and preventing soil erosion.

Demonstrating Flood Control-

1) Pour water slowly over the land surface. Discuss what happens with the students. Some of the water is slowed by the presence of the wetland. The excess, that the wetland cannot absorb, flows into the main water body. Slowing the speed of runoff is important ecologically because it prevents extensive erosion and decreases sedimentation.

2) Remove the carpeting and water from the model. Pour the same amount of water as before on the same spot in the model. Discuss the difference that the presence of the wetland makes on runoff with students. The runoff will have filled up the body of water much quicker because it is no longer buffered by the wetland. Explain that most wetlands are shallow basins that collect water.

Demonstrating Water Purification-

1) Remove the water from the model and replace the piece of carpeting with a dry piece. Pour the muddy water over the land surface and discuss what happens. Compare the water that reaches the body of water to the water left in the jar. The water should be cleaner after it passes through the wetland. The mud can represent pollution, sedimentation, or nutrients. Wetland help protect water bodies, like Saratoga Lake, from pollution, sediments or nutrients carried by the water.

2) Remove the carpeting and the water. Repeat the experiment with muddy water. What happens to the water body without a wetland in place?

Wetland Model, Option 2

Adapted from San Francisco Bay Watershed Curriculum, 2005

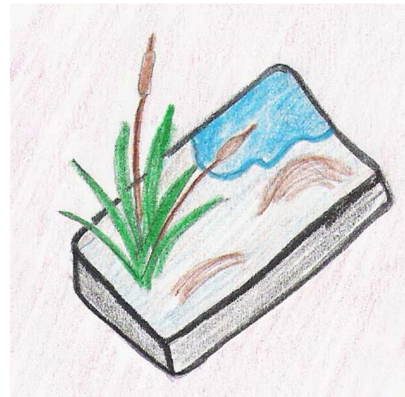
This activity will teach students about the ecological functions and importance of wetlands through a hands-on, model building experience.

Objectives-

- ✓ Investigate and understand the ecological functions of a wetland.

Estimated Time-

- ✓ 2 hours



Materials-

- ✓ Modeling clay
- ✓ Long, shallow pan: a sturdy metal or glass pan with a smooth, flat bottom works well, or a plastic or metal paint rolling pan
- ✓ Sponges (enough to span the width of each pan)
- ✓ Cup of soil
- ✓ Spray bottle full of water
- ✓ Q-tips
- ✓ Colored drink mix
- ✓ Items to represent wetland plants or animals like pine needles, clay for animals, toothpicks and marshmallow for cattails (optional)

Background-

Wetlands are transitional environments between land and water systems where the water is usually at or near the land surface. Wetlands, by definition, must include evidence of surface water or water in the root zone, hydric or undrained soils, or vegetation that has adapted to thrive in wet conditions.

In the past, wetlands were traditionally seen as mosquito-infested, damp wastelands. Because of this traditional and cultural view, many wetlands have been destroyed. The plants and animals that need wetlands to survive are suffering because of the roads, buildings, and landfills that are built on top of them.

Wetlands serve vital ecological functions as well as provided biodiversity. They serve as filters to trap pollution and sediment from urban runoff. Wetland plants slow the water enough for the heavier particles to settle out. Smaller particles are trapped in the mesh of the leaves, stems, and roots of dense vegetation. Therefore, runoff exiting the wetland is cleaner than it was upon entering.

Background, continued-

Wetlands also provide valuable flood control. When a heavy rainstorm increases runoff, the added water may flood waterways and adjacent fields, towns, or woodlands. Wetlands offer a stop for flood water to 'rest' and soak into the soil, therefore reducing the potential flood risk.

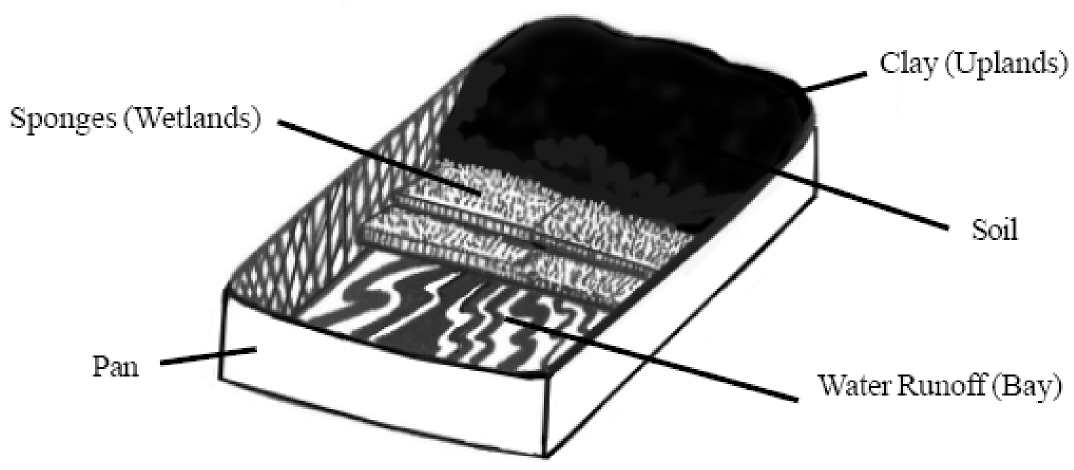
Procedure-

1) Before beginning this experiment, review with students what they have already learned about watersheds and wetlands. Ask the students:

    i. What is a watershed?
    ii. Where are the wetlands in our watershed?
    iii. How do you think wetlands act like sponges?
    iv. Wetlands also as a filter, what does this mean?

2) Divide the students into groups; groups of two work well. Have students make predictions about what they think will happen. Also, be sure to check each groups model before they run the experiment.

3) Building the model-



    i. Spread the modeling clay over half of the pan. The empty half will represent Saratoga Lake.

    ii. Shape the clay so that is slopes downward toward the lake. Be sure to seal the clay along the edge of the pan!

iii. You can create meandering streams or rivers in the clay. Be creative!

iv. Create wetlands along the edge of the land surface (modeling clay). Cut the sponges into pieces to completely cover the boundary between land and water. The model will not work properly if there are spaces in the middle or at the edge of the wetland.

v. Spray the sponges lightly so that they are damp, but not soaking wet.

4) Each group should create rain (with the spray bottle) on the upland and observe what happens to the water when it encounters the wetland.

5) Then remove the wetland and observe what happens during a rainstorm.

6) Sprinkle the upland areas with colored drink mix to represent pollution. What happens to the pollution during a rainstorm with the wetland in place? What happens if the wetland is not there?

Suggested Concluding Discussion Questions-

i. When sediment runs directly into the lake, what negative things can happen?

ii. How does a wetland protect the lake from pollution?

iii. What would happen to Saratoga Lake if there where no wetlands in the watershed?

iv. Knowing that wetlands are effective filters, do you think they can become polluted easily?

v. What can you do to preserve wetlands?

Wetland Plants and Pollution

Adapted from Charlotte Harbor Env. Center, 2007
& Saratoga Springs Open Space Project

This activity demonstrates the absorption of pollution in plants and allows students to observe the physical changes.

Objectives-
- ✓ Learn how wetland plants absorb pollution
- ✓ Draw conclusions about the importance of wetlands through classroom discussion

Estimated Time-
- ✓ 20 minutes over 2 days

Materials-
- ✓ Celery stalks
- ✓ Glasses or jars
- ✓ Food coloring

Background Discussion-

Discuss with the class the notion that water carries many substances. Some materials are dissolved by the water, others are carried by suspension (small particles floating around). Some substances carried by water are helpful for plants while others are harmful. For example, dissolved calcium helps marine organisms build shells. Pesticides, heavy metals, oil, and waste materials are harmful to the surrounding plants and animals.

Discuss the role of wetland plants as filters. Wetland plants are excellent filters because they are located on land and in the water. This means that they can capture and assimilate pollutants before they enter the nearby water bodies.

However, wetlands alone cannot solve our pollution problems because they have a limited capacity to absorb nutrients, metals, and sediments, etc. Overloading a wetland with pollutants reduces its ability to serve this function. Discuss the concept of indicator plants and how some are more sensitive to environmental disruption than others, giving insight into the health of a wetland.

Procedure-

1) Add several drops of food coloring to water in a jar. The food coloring represents toxic pollutants.

2) Cut off the bottom of the celery sticks and place them in the jars overnight. The celery represents wetland plants like cattails, sedges, or grasses.

3) Observe the celery the following day to see that the colored water has visibly soaked into the stalks. This process is called osmosis. If the dye is not visible on the outside of the stalk, break it open to observe the coloring on the inside among the plant tissue.

Suggested Discussion Questions-

1) How do wetland plants help purify water?
2) Why is the water remaining in the jar still 'polluted'? (Do plants get full?)
3) Where does the water go after uptake from the plant? (Do plants 'sweat'? What is evaporation?)
4) What happens to the pollutants? (Do plants live forever?)
5) Why can't we dump all of our waste water into wetlands?

What Does Your Aquifer Look Like?

Adapted from The Groundwater Foundation

This activity is a quick and easy way to visually demonstrate the stratigraphic layers of aquifers and learn basic vocabulary.

Objectives-
- ✓ Understand the movement and processes affecting groundwater

Estimated Time-
- ✓ 45 minutes – 1 hour

Materials-
- ✓ 2 clear cups
- ✓ Sand, gravel and aquarium rock
- ✓ Pitcher of water

Vocabulary-

1) Groundwater - water contained under the ground's surface, between particles of and in the cracks of sand, soil and gravel; a common source of water for drinking and irrigation.

2) Aquifer – the geologic formation of sand, soil and gravel where groundwater is stored.

3) Surface water – any body of water above ground: lake, pond, stream, river etc.

4) Contamination – an impurity in air, soil or water that can cause harm to human health or the environment.

5) Water table – the top of the saturation zone.

6) Saturation zone – the area where water fills the spaces between soil, sand and rock underground.

7) Infiltration - to increase the amount of groundwater through precipitation or surface water that absorbs into the aquifer, also called recharge.

8) Recharge – (infiltration)

9) Porosity – spaces between grains of sand, soil and gravel for water to travel through and the amount of connectedness between those spaces.

Vocabulary, continued-

10) Permeability – any material that allows water to penetrate through

Procedure-

1) Fill 2 cups with layers of sand and gravel to about 3/4ths from the top of each cup. Remember that in nature, aquifers consist of layers of sand, gravel and rock.

2) In one of the cups, pour water slowly into it. Watch how the water fills the spaces between the particles of sand and gravel. Does the water appear to move faster through the sand or faster through the gravel? Why?

3) Now continue to fill this cup with water to the top (above the top of the sand and gravel). Water that is located above ground, like rivers and lakes, is called surface water. Water below the ground's surface is called groundwater

4) In the second cup, pour water into the cup until the water line is about one inch below the top of the sand/gravel. Look closely at this line created by the water. This line is called the water table. Water below the water table is called the saturation zone.

5) Now pretend that your pitcher of water is a large rain cloud and pour some more water into your second aquifer until the water table is about one half an inches below the surface of the gravel. Your groundwater supply has just been recharged. This is what happens when it rains or snows and water infiltrates (or sinks) into the ground.

Procedure Extensions-

1) Use liquid food coloring or powdered drink mix to represent a source of groundwater contamination.

2) Sprinkle or pour the contamination on the surface of the gravel. Sprinkle water to represent rain on top of the gravel and contaminant. Observe and discuss what happens.

What is a Watershed?

Adapted from Wood, 2007

This activity will allow students to easily observe the movement of water through a watershed and help define what a watershed is.

Objectives-

- ✓ Understand the distribution of water in a watershed.
- ✓ Understand the importance of water in daily life, and where water comes from.
- ✓ Recognize different land-usage in the Watershed and their basic effects on water quality.

Estimated Time-

- ✓ 1 ½ hours

Materials-

- ✓ Brown paper bag
- ✓ Spray bottle
- ✓ Newspapers
- ✓ Food Coloring
- ✓ Paper towels
- ✓ Peanut butter (beware of allergies!)
- ✓ Saltine crackers
- ✓ Napkins
- ✓ 100 Pennies
- ✓ Clear jar
- ✓ Aerial map of local watershed
- ✓ Paper
- ✓ Crayons

Vocabulary Words-

- ✓ Watershed – a region or area bounded peripherally by a divide and draining ultimately to a particular
- ✓ Herbicide – chemicals used to kill and control plant growth
- ✓ Pesticide – chemicals used to kill and control pests and insects harming crops or other plant matter
- ✓ Point Source Pollution - pollution that can be traced back to a single origin or source such as a sewage treatment plant discharge.
- ✓ Non-point Source Pollution - pollution that occurs when rainfall, snowmelt, or irrigation runs over land or through the ground, picks up pollutants, and deposits them into rivers, lakes, and coastal waters or introduces them into ground water

Procedure-

1) Discuss the limitations on available fresh water, and how it gets recycled to end up as fresh water we drink and use daily: take a jar with 100 pennies and explain that over 97% of the earth's water is found in the oceans as salt water, about 2% is stored in glaciers and ice caps and only 1% of water is available for us to use.

2) Hold up the jar with 100 pennies and remove three, explaining that those represent all the fresh water on earth. Put two back because they are frozen and hold up one to represent the amount of fresh water we can use.

3) Ask students to give ideas to create a list on the board of daily activities that require water. Once they have given the direct usage (showering/bathing, brushing teeth, and washing hands) suggest some indirect uses (growing/preparing food, washing clothes, manufacturing).

4) Then ask the children to pick one of the activities on the board, and draw themselves engaging in that activity.

5) While they are drawing, spread peanut butter on (or simply hand out) a saltine cracker for each student, and wait until they ask for a drink of water. Once they have drank some, remind them of the penny jar, and how small an amount of freshwater we have available, and how important it is to keep that water clean.

6) Look at the aerial map of the watershed, and point out recognizable features and talk about the activities, industry, agriculture and recreational locations in the watershed.

7) Crumple the paper bag (to show topographical differences) and use the food coloring to represent different land-uses and the pollution associated with them. Sprinkle water all over simulating rain, and watch the food coloring run together as run-off, and eventually to an outlet (off the end of the paper bag).

8) Finally, discuss the differences between point and non-point sources of pollution and how that affects the water bodies, and the places of discharge within the watershed.

Concluding Discussion Questions-

1) What happens when people pollute?

2) Where does all the water in the watershed drain?

3) Come up with a list of possible pollutants we see in Saratoga Springs.

4) Discuss differences in their created watershed and our local watershed.

5) Ask students if they would want to swim or fish or go boating on a water body affected by the amount of pollutants that have drained out of their system.

What Rocks about Soil?

Adapted from The GLOBE Program, 2005

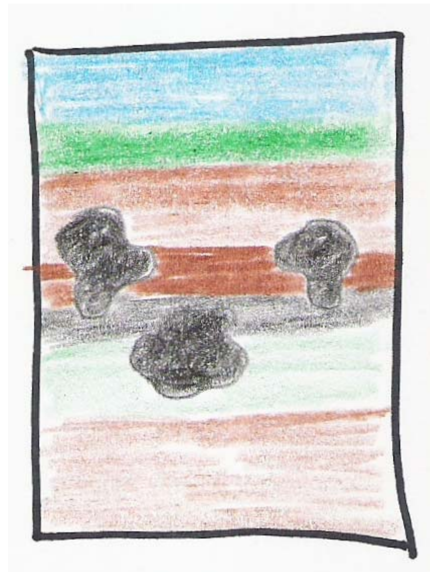
This activity will introduce students to soil, the five soil-forming factors and help them understand how little soil we actually have on Earth.

Objectives-

- ✓ Introduce the importance of soil and why it needs to be studied
- ✓ Understand how soil properties are determined by the five soil forming factors
- ✓ Appreciate the relative amounts of usable soil that exist on Earth

Estimated Time-

- ✓ 45 minutes to 1 ½ hours



Materials (*for each team of 4-5 students*)-

- ✓ Apple and small knife
- ✓ Soil medicine examples (e.g. diarrhea medicine, antibacterial gel or cream, facial masks)
- ✓ Soil art examples (e.g. mud cloth, sand painting, pottery)
- ✓ Soil building material examples (e.g. red brick, photos of adobe and Earthship house)
- ✓ Makeup (e.g. foundation, blush)
- ✓ Soil Samples (if available, especially soils that match the colors or textures of the medicine, art, building material, or makeup samples)
- ✓ Plant

Activity 1 Procedure- *Why are soils important?*

1) Collect as many materials and tools as possible from the list.

2) Ask the class "why are soils important?" and "Why do you think it is important to study soils?"

3) Record their answers on a blackboard or somewhere that all students can read the responses.

4) As students give answers that relate to the collected materials, bring out those materials and show them to the class. For example, if a student says that we

use soil as art, have a clay pot available for viewing. If the students run out of ideas about the uses of soils, ask them about soil as art (and bring out an example) or soil as medicine. Also bring out soil samples that resemble these materials for comparison.

5) Lead the discussion to the many possible reasons why it is important to study soil.

Activity 2 Procedure- *Are soils all the same?*

1) Have students look Online, in the library, or other sources of soil photographs and soil profiles.

2) Ask students why one soil profile look different from another? What are some factors that would make a soil look the way it does?

3) Handout the Five Soil Forming Factors (attached) to read and help guide responses.

4) Have the students identify the 5 soil forming factors at their school and ask how they might differ at other locations within the watershed or around the world.

5) Discuss the concept that every soil tells a different story based on the properties that have formed it because of the 5 soil forming factors. As an example, use the following Maryland Flood Plain Soil Photograph and Story (attached)

6) Ask students to try to come up with "stories" about how other soils may have formed and the properties that they have.

7) Introduce the concept of diversity in soil which states that because every soil is different, each one can only be used in a certain way. For example, which kind of soils would be best for growing crops (flat, fertile, moist, deep, etc.)? Which soils would be best for building a pond or reservoir (clay with massive structure, high density, low porosity, flat or depressed area on the landscape etc.)? Which would be best for filtering wastes (high surface area, lots of organisms, not too cold or wet, etc.)?

8) Have the students think of other land uses and what kinds of soil properties would be best for those uses too cold or wet, etc.)? Have the students think of other land uses and what kinds of soil properties would be best for those uses.

Activity 3- *How much soil is there on Earth?*

1) Take an apple and a small knife to conduct the following demonstration:

2) Teacher says: "Pretend that this apple is the planet Earth, round, beautiful, and full of good things. Notice its skin, hugging and protecting the surface."

3) Ask and discuss:

   a. How much of the surface of the earth is covered by water?
      i. Answer: 75% if the surface

   b. Cut the apple in quarters, toss ¾ (75%) away.

   c. Describe that the ¾ that was just removed represents how much of the earth is covered by oceans, lakes, rivers, streams. What is left 25%, represents the dry land. 50% of that dry land is desert, polar or mountainous regions where it is too hot, cool or high to be productive.

   d. Cut the "dry land" quarter in half and toss one piece away.

   e. Describe that when 50% of the dry land is removed, this last piece is left (12.5%). Of that 12.5%, 40% is severely limited by terrain, fertility or excessive rainfall. It is too rocky, steep, shallow, poor or too wet to support food production.

   f. Cut that 40% of what is left away.

   g. What is left is approximately 10% of the apple.

   h. Peel the skin from the tiny remaining sliver.

   i. Explain that the remaining 10% is a very small fragment of the land area, representing the soil we depend on for the world's food supply. This fragment competes with all other needs – housing, cities, schools, hospitals, shopping centers, landfills, etc., and sometimes, it does not win.

   j. Discuss with the students some ways in which they could be more mindful of the soil and the way soils are being use at their homes or here in our watershed. For example, discuss the idea of composting to recycle wastes and help make the soil rich in organic matter, and about keeping soil covered with vegetation so that it will not erode away or be compacted.

The Five Soil Forming Factors:

1. Parent material: The primary material from which the soil is formed. Soil parent material could be bedrock, organic material, an old soil surface, or a deposit from water, wind, glaciers, volcanoes, or material moving down a slope.

2. Climate: Weathering forces such as heat, rain, ice, snow, wind, sunshine, and other environmental forces, break down parent material and affect how fast or slow soil formation processes go.

3. Organisms: All plants and animals living in or on the soil (including micro-organisms and humans!). The amount of water and nutrients, plants need affects the way soil forms. The way humans use soils affects soil formation. Also, animals living in the soil affect decomposition of waste materials and how soil materials will be moved around in the soil profile. On the soil surface remains of dead plants and animals are worked by microorganisms and eventually become organic matter that is incorporated into the soil and enriches the soil

4. Topography: The location of a soil on a landscape can affect how the climatic processes impact it. Soils at the bottom of a hill will get more water than soils on the slopes, and soils on the slopes that directly face the sun will be drier than soils on slopes that do not. Also, mineral accumulations, plant nutrients, type of vegetation, vegetation growth, erosion, and water drainage are dependent on topographic relief.

5. Time: All of the above factors assert themselves over time, often hundreds or thousands of years. Soil profiles continually change from weakly developed to well-developed over time.

Creek Bed Soil Profile Story, College Park, Maryland, USA

This soil profile is from a creek bed in College Park, Maryland, USA in the Chesapeake Bay watershed. When the soil scientists were studying this profile, they noticed that there was a black layer right in the middle of the profile. When the scientists looked at this layer with a hand lens (small magnifying glass) they could see that the black color was due to many tiny bits of charcoal and ash. Using different kinds of tests, they learned that this material was deposited about 300 – 350 years ago.

Where would charcoal and ash have come from about 300 – 350 years ago? What was going on in the Chesapeake Bay region at about that time? Settlers coming to this region for the first time were burning the forests to make room for farms. The residue from those forest fires flowed down into the rivers and creeks and eventually some of it was deposited in this creek bed and became part of this soil profile. The soil above this layer was created after flooding of the river and the addition of sediments eroded from the local area on top of the charcoal layer deposited the ash and charcoal. In soils, the youngest materials are found at the top of the profile. After the flooding water deposited the sediments, soil processes took over to form structure, color and other soil properties that we can see and measure.

The scientists also noticed that in the horizon below the charcoal and ash layer, there were clam and oyster shells (as well as some pebbles rounded by washing down the river during flood events). With careful testing, they learned that the objects in this horizon were deposited here about 400 – 450 years ago. What was going on in the Chesapeake Bay about 400 – 450 years ago?

The indigenous people who lived in this area before the settlers came would come to the Bay for their holiday feasts and they would celebrate and eat lots of clams and oysters. What we see here was what was left behind. These shells eventually flowed down into this creek bed and became part of the soil profile.

The last part of the story takes us to the beginning. The lowest two horizons in this profile are of an earlier soil that was buried under the river sediments of the newer soil. The buried soil shows structure, colors and other features that indicate it is many thousands of years old and was in a swampy area before the river changed its course and began to bury it.

This is an example how a soil can be a record of the history of the area around it and can tell us its story.

Make a Watershed Model

Adapted from The GLOBE Program, 2005

This exercise will introduce students to a watershed and allow them to explore the topographic changes that alter the water pathways.

Objectives-

- ✓ Introduce what a watershed is and how it works
- ✓ Understand the water pathways and how watersheds can change by manipulating the model
- ✓ Help give examples how their model relates to the real world topographic features

Estimated Time-

- ✓ 1- 1 ½ hours

Materials-

- ✓ Sand, wood, rocks, etc (for outdoor model)
- ✓ Buckets, bowls, paper towels, etc (for indoor model)
- ✓ Spray bottle
- ✓ Sponges
- ✓ Red food coloring
- ✓ Permanent marker (able to write on plastic)
- ✓ Ruler
- ✓ Topographic map of Saratoga Lake Watershed
- ✓ Plastic sheet (2mx2m)

Creating the Model-

1) Find an area about 1 meter square to build a watershed model. This could be a tabletop or plywood sheet if you are working inside or a grassy or sandy area outside.

2) You and your students gather the various objects to make the model, such as a plastic sheet, rocks buckets, sponges, spray bottles with water, and food coloring.

3) Have the students arrange objects of various sizes inside the area. The tallest objects will become 'mountains'. Shorter objects or buckets or bowls may become hills, likes or plains.

4) Cover the entire area and all of the objects with a plastic sheet. Have the students use their hands to mold the plastic loosely around the covered objects. This is a model of a landscape with hills, valleys, and connections between them.

5) Have the students predict what will happen if it 'rains' on their model. Where will the water go? Will it go faster in some places? Will some places form pools? How do you know?

6) Use the spray bottle to 'rain' on the top of your highest 'mountain'. Continue raining until you can see where streams, rivers and lakes form.

7) Have students choose a small pool on their model to be a Hydrology site. Mark the site with a marker, stone or other object.

8) Ask the students to make it rain by using the spray bottle. Ask the students, "Where does the water come from that flows to your Hydrology site? Where does water flow away from your site? What things on the landscape determine what will be part of your basin? What determines the watershed? Explain to the students that the places where water hits and flows into their site are in the catchment basin for their site, the watershed is the basin boundary.

9) Ask students: "Where would be a good place on their model to have their school? Where would you like your house to be? Have the students mark these places on the model.

10) Have students explore the consequences of changes in their catchment basin. Here are some things you can do:

    a. What happens if you dam the stream that flows to your water site? (Use a sponge to create a dam).

    b. What happens if you plant a forest above your site? (Use a large flat sponge for the forest – it will soak up water for a time just like soil and vegetation) What happens if you remove the forest?

    c. What happens if someone builds an industry that causes pollution? (Use a small piece of sponge soaked in food color where your industry will be and watch the 'pollution plume' as it rains.)

    d. What happens if someone decides to use water from your stream for irrigation or urban use? (Make 'canals' that take the water away from your stream to other places)

Modeling Topography-

1) Have students use a permanent marker or small pieces of tape to mark points on the model that are 10cm above the surface of the table or ground.

2) Use a marker to connect all of these points to make a ring around the model that is 10 cm above the surface

3) Measure points above the surface at 20 cm. Use a marker to connect them in a ring around the model.

4) Continue measuring points at 30, 40, 50, etc., connecting them until they reach the highest peak.

5) Look at these rings from above. Ask students what they notice. Are the concentric (the higher ones inside the lower ones)? Are they all the same distance apart?

6) Draw the ring on a flat piece of paper as if they were seeing them from above.

7) Examine a topographic map. Ask students if their rings look like topographic lines?

8) Have students identify their previous Hydrology site on a topographic map. Find the elevation of their site from the map.

9) Use the topographic lines and benchmarks on the map to identify areas that are uphill from their site

10) Look for 'ridges' or 'divides'. These are at mountaintops or places where the elevations start to decrease. Ask students to think about whether water falling on that place would flow toward or away from their Hydrology site.

Concluding Discussion Questions-

1) What would happen if you poured a pile of salt on the 'mountain' above their site?

2) What would happen if you poured the pile on the other side of the 'mountain'?

3) Ask students to use a marker to outline the watershed for their Hydrology site.

4) Have students explain 3 things that might happen in their own basin that would affect water quality.

Rain, Rain, Soil Away

Adapted from Wood, 2007

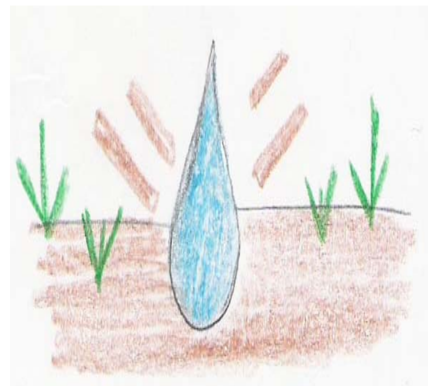
This activity allows students to better understand erosion by testing different soil types to measure the resilience against erosion.

Objectives-

- ✓ Learn through experimentation how land surfaces affect the flow of rain water as it travels through the watershed
- ✓ Apply what they learn in the model to the school yard

Estimated Time-

- ✓ 2 hours to 2 ½ hours



Materials-

Runoff Model-

- ✓ Cardboard milk or orange juice carton with the back panel cut out
- ✓ Plastic cup with small holes in the bottom
- ✓ 3 cups of dirt
- ✓ 3 cups of sod
- ✓ 3 cups of gravel
- ✓ 3” x 6” strips of rooted grass or sod
- ✓ 3 handfuls of straw
- ✓ Small plastic tub for catching runoff water
- ✓ 1 large bucket for disposing of wastewater (or easy access to a sink)
- ✓ 250 ml or larger beaker or measuring cup
- ✓ Pitcher or empty jug for pouring
- ✓ Stop watch
- ✓ Ruler
- ✓ Protractor
- ✓ Contains of fresh water (or easy access to a sink)
- ✓ Clean up rags

Infiltration Experiment-

- ✓ Metal can (or other cylinder) with both ends open
- ✓ Beaker or measuring cup
- ✓ Pitcher or empty jug for pouring water
- ✓ Stop watch

Runoff Mapping Project-

- ✓ Sheets of large paper or poster board
- ✓ Markers, pens, or colored pencils
- ✓ Other needed art supplies

Vocabulary-

- ✓ Percolation - To drain, seep, or filter through a porous material.
- ✓ Pollutant - a substance that pollutes something, e.g. a chemical or waste product contaminating the air, soil or water.
- ✓ Runoff - describes the water from rain, snowmelt or irrigation that flows over the land surface and is not absorbed into the ground, instead flowing into streams or other surface waters or land depressions.
- ✓ Impervious – a surface that is unable to be penetrated.
- ✓ Erosion - the gradual wearing away of rock or soil by physical breakdown, chemical solution, and transportation of material, as caused, e.g. by water, wind, or ice.
- ✓ Groundwater – water contained under the ground's surface, between particles of and in the cracks of sand, soil and gravel; a common source of water for drinking and irrigation

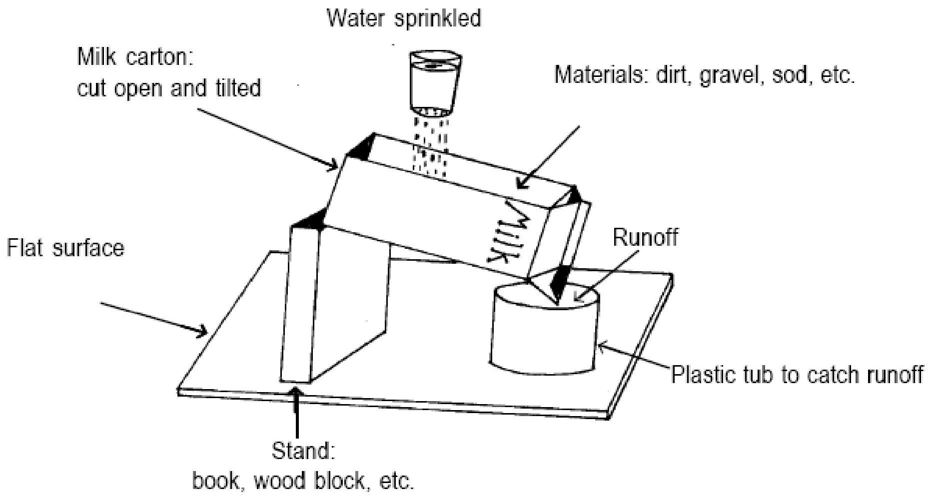
Background-

When rain falls on the land, it either flows over the surface or is absorbed depending on the type of that that it encounters. If rain hits an impervious surface, such as concrete, asphalt, rooftops and even heavily packed soil, it becomes runoff because it cannot soak in. Depending on natural features such as the slope of the land and the volume of water, runoff can easily erode land up pick-up pollutants like oil, fertilizers, and toxins. When water falls on loose soil and vegetated areas it is able to seep into the ground. Water is absorbed and slowed, minimizing erosion, filtering out pollution, and preventing floods. The faster the runoff and the greater its volume, the more pollutants and sediments are carried into Saratoga Lake.

Runoff Model-

1) Explain to students that they will be conducting an experiment to determine the affects of different types of soil on runoff. Be sure to ask students to record their results in the attached table so that the class can discuss them later.

2) Either set up an example of the runoff model shown below, or photocopy this diagram for students. The students will be filling the milk carton with a material, creating a rainstorm using the plastic cup, and timing and measuring the runoff flowing out of the milk carton.



3) The only thing that should change between each repetition of the experiment is the material within the carton. Discuss with students that the angle of the carton and the amount of rain from the 'storm' must stay the same to ensure experimental control.

4) Each group should do a trail run of their experiment using only the bare surface of the milk carton and then choose 3 of the following materials to test:

    i. sand
    ii. gravel
    iii. straw
    iv. sod
    v. dirt

5) Each group should make predictions about which materials they think will produce the most and the least runoff.

6) Each of the students should be in charge of a specific area of the experiment. Have the children decide who will play what role in the process using the following job descriptions:

    i. <u>Water Manager</u>- Measures water quantities, sprinkles water for each trial, and disposes of wastewater

    ii. <u>Timekeeper/Recorder</u>- Times each trial, records all data in the chart, keeps group on time.

    iii. <u>Materials Manager</u>- Organizes all materials, places materials in milk carton for each trial, cleans the carton after each trial use, and returns all materials after use.

iv. Quality Control- Makes sure the procedures are followed correctly, makes sure everyone has a chance to speak, and makes sure everyone understands the experiment.

v. Cleanup Crew- Washes materials, desktops, and floor area.

7) Once the students have completed the experiment with the different materials, ask students to review their data table and mix materials to create the least and most runoff. The students must follow a new rule: They can only fill the carton with 3cm of the combined materials. Be sure to add the new combinations to the data table.

8) Once all the groups have completed the experiment, bring the class together to discuss the results. Which is the fastest? The slowest? What combinations of materials provided what results? Where the student's predictions correct? Are there any materials in the schoolyard that might produce similar results to the materials you tested?

Infiltration Experiment-

1) Divide the students into groups. You can use the same groups from the runoff model. Groups can choose whether or not to assign specific tasks to each member. The necessary jobs are timer, recorder, can twister, water pourer, and observer.

2) Each group should choose various land surface types around the schoolyard such as gravel, packed dirt, loose dirt, pavement, mulch, etc. Be sure to record these in the infiltration data table.

3) Make sure the groups twist the can into the ground a little bit so that the water cannot escape out the edges. Pour a predetermined amount of water into the can and use a stopwatch to time how long it takes for the water to soak into the ground. Depending on the test surface, the water may never infiltrate. A maximum time period of 15 minutes is a good suggestion. If the water has not infiltrated within 15 minutes, note that in the data table and move to the next test surface.

4) After every group has completed the experiment, come together as a class to discuss the results. Which surfaces soaked up water quickly? Which did not absorb water? Where will water around your schoolyard go after a big rainstorm?

Runoff Mapping Project-

1) Have the students, still within their groups, to create a map of the schoolyard and the different types of land surfaces.

2) Make sure students include a key to make their map easy to read and understand. Students should also make a table of land use and whether or not the water will soak in or runoff.

Land Use	Runoff or Soak In?

3) Ask students how they think the school yard ranks in terms of land uses? Are there more parking lots than fields? What things could be changed to reduce runoff?

Runoff Data Table

Test Material	**Predictions**		**Amount of Water Added**	**Amount of Runoff Collected**	**Time for Runoff to slow to one drop every 3 seconds**	**Observations**
	Time for runoff to slow to one drop every 3 seconds	Amount of Runoff				
plain carton						
final combination						

Infiltration Data Chart			
Land Surface/ Location	**Amount of Water Poured**	**Time for Water to Soak In**	**Observation**

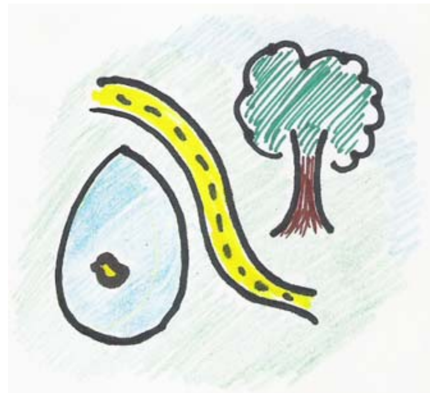
Watershed Explorers!

Adapted from Earthforce, 2007

This activity will teach students how to observe and analyze watershed conditions to make conclusions regarding its health.

Objectives-
- ✓ Understand what causes erosion and the effects it has on terrestrial ecosystems
- ✓ Understand how erosion increases sedimentation in streams and it's effects on aquatic ecosystems

Estimated Time-
- ✓ 1 to 1 ½ hours



Materials-
- ✓ Pens and pencils
- ✓ Notebooks or clipboards
- ✓ Map of immediate area
- ✓ Camera (optional)
- ✓ Chart paper and markers

Procedural Considerations-

1) Make sure students are very clear on what is meant by conditions and problems before starting the activity. (Point vs. Non-Point pollution, human/industrial activity etc.)

2) If the watershed exploration area is large, assign different parts of the grounds to different groups.

3) If necessary, arrange for extra adult supervision

Procedure-

1) Divide students into small groups.

2) Distribute maps, clipboards, and pens to each team.

3) Instruct students that they will have 40 minutes to explore part of the watershed near the school, and that their task is to observe and record the conditions they see, and note any questions they have about what they observe.

4) Reconvene in class and have each group report the environmental conditions they saw; record their responses on chart paper (attached).

Concluding Discussion-

a. Lead a group de-briefing about what students found in the different areas within the watershed.

b. Ask questions like-

    - Which items might suggest a problem in the watershed?

    - How similar/ different are the areas within the watershed?

    - What would you change within the watershed to make it healthy?

Watershed Explorers Checklist *Take notes on what you see as you walk around your watershed!*		
	How many of these do you see?	What condition are they in?
Playgrounds & Parks		
Homes		
Stores or Restaurants		
Police or Fire Stations		
Parking Lots		
Schools		
Sewage Treatment Plants		
Rivers, Ponds, or Harbors		
Open Land or Farm Land		
Factories		
Other		

Aquatic Insect Water Quality Assessment

Adapted from The U.S. Department of Health, Education and Welfare, 1968
and The Stroud Water Research Center, 2007

This activity will give students an opportunity to spend hands-on time in a stream and introduce them to aquatic insects. Students will also learn to estimate the health of the stream, and the relative width of the channel, using the insects.

Objectives-

- ✓ Understand the larval stage of common insects and how to identify them.
- ✓ Learn how to properly examine the streambed for insects.
- ✓ Understand the relations between the type of insects found and the health of the stream.

Estimated Time-

- ✓ 3 hours

Materials-

- ✓ Petri dishes or any small, clear dish
- ✓ Hand lenses
- ✓ Microscopes (optional)
- ✓ Paintbrushes
- ✓ Aquatic insect identification guides
- ✓ Plastic spoons
- ✓ Flat pans (preferably white so insects can be easily seen)
- ✓ Mesh bags (optional, can use mesh bags that onions are sold in)
- ✓ Kick nets, D-nets, or dip nets (optional)
- ✓ Buckets

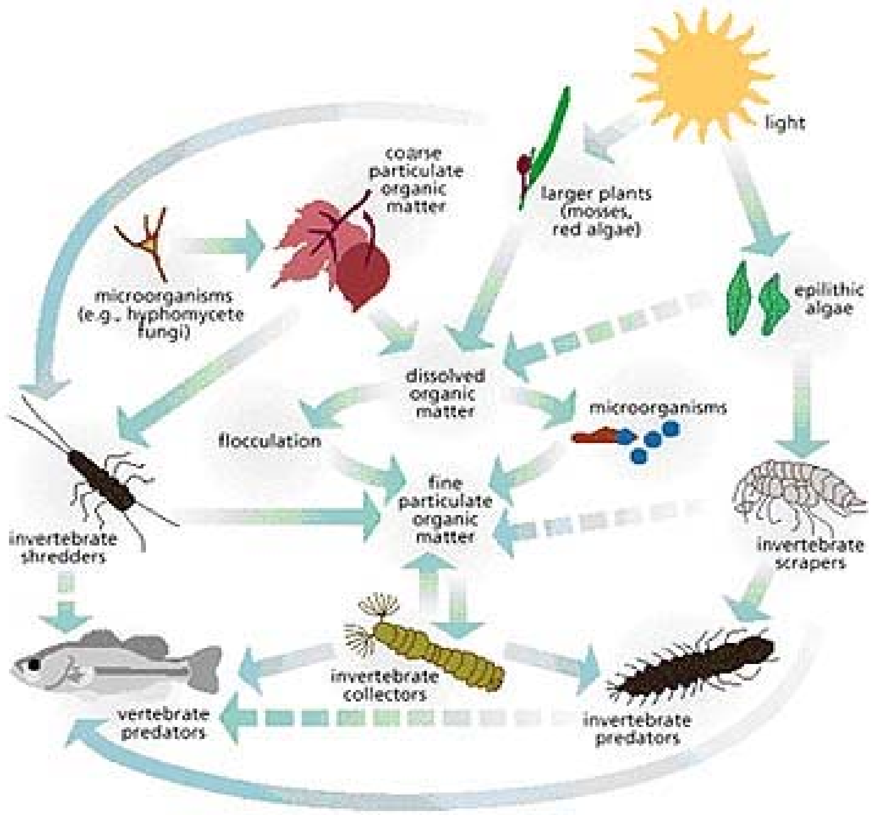
Background-

An abundance and variety of benthic freshwater macroinvertebrates are imperative to healthy streams. They are defined using the following:

Benthic	=	living on the bottom/ in the substrate
Freshwater	=	Live in streams, rivers, lakes and ponds
Macro	=	'large' size (>0.2-0.5mm)
Invertebrate	=	Animal without a vertebrae

Background Continued-

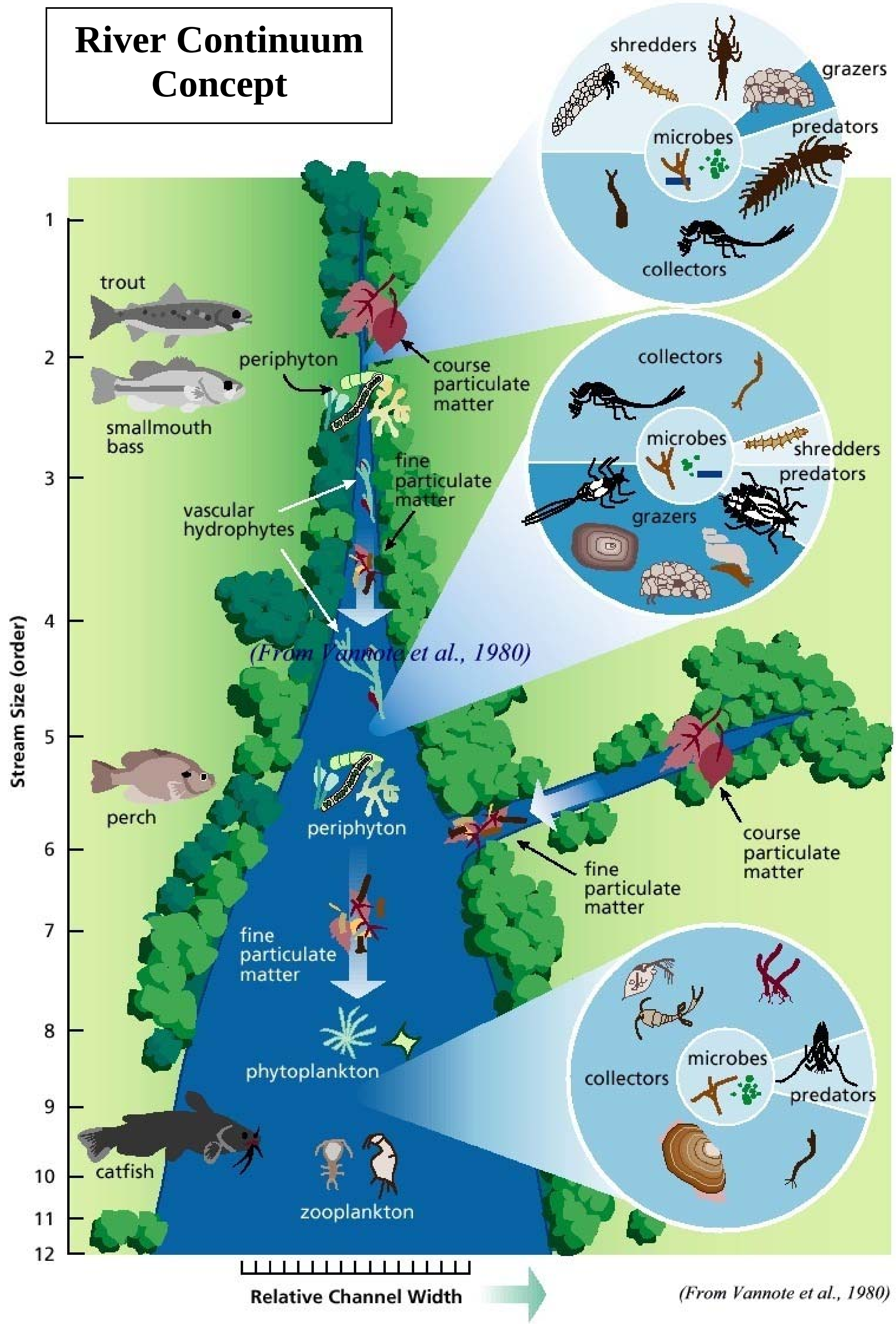
Benthic freshwater macroinvertebrates are important because they occupy the bottom of the food chain. Without them, the larger animals would have nothing to eat. The presence of lots of different benthic macroinvertebrates implies that the stream is healthy.



Small stream food web

These macroinvertebrates have different strategies for eating. Shedders get food by eating the fungi and bacteria that live on the surface of leaves in the stream. Craneflies, stoneflies, caddisflies and aquatic sow bugs are common shredders. Small piece of leaf chopped up by the shredders are eaten by collectors like netspinning caddisflies and blackflies. Grazers/scrapers are another feeding group. Examples are snails, limpets, certain mayflies and case-building caddisflies which are adapted to eating algae that is growing on rock surfaces. Filtering collectors, like mussels and clams, get nutrition by filtering out fine particles that are floating in the water. The presence of these groups changes as the stream changes because different types of food sources become more or less prevalent. This is known as the river continuum concept and is shown below.

River Continuum Concept



(From Vannote et al., 1980)

Procedure-

1) Have students visit a ripple area of a local stream to collect insects (refer to attached *Water Access Points*). Collection can be done using multiple techniques. Remind students to be gentle with the insects as they will be released into the stream after identification.

    a. Picking Up Rocks- Have students wade into the stream and pick up rocks. Using a paintbrush, wipe the underside of the rock and knock any insects into a pan of water. Insects can be hard to see sometimes, so be sure to look closely. Also, insure that students return the rock to the stream with the same area underwater so that any insects they missed can survive.

    b. D- Nets (D-frame or Dip Nets)- Have one student hold the kick net downstream about a foot or two from another student stirring up the small rocks and sediment with their feet. Be sure the bottom of the kick net is nestled against the bed of the stream. After a few seconds, turn the net inside out in a bucket full of water and be sure to release all the bugs that were collected.

    c. Leaf Packs- Fill mesh onion bags with leaves and submerge them in the stream for approximately 3-4 weeks. Be sure the secure them so they are not lost in the stream. The leaf packs can be tied to large rocks or cinder blocks using strong fishing line. If a cinder block is used, be sure to align the holes so they are parallel to the stream bank. Leaf packs are naturally created when leaves get stuck on rocks in ripple areas. The most successful leaf packs, or the control leaf pack, should be placed in the ripples. Check on the leaf pack once a week to ensure that it is decomposing properly and that is hasn’t been washed away. Once the time period has passed, bring the leaf packs into the classroom and ‘dissect’ them to locate the insects (for more information about leaf packs, or joining the Leaf Pack Network, visit www.stroudcenter.org/lpn/index.htm).

2) Have students identify the insects they found using the identification guides. Remind students again to be gentle with the insects; the spoons can be used to move them into the Petri dishes rather that accidentally squashing them between fingers. Ask the student to keep track of the type of insects they found and the numbers of each type.

3) Create a class-wide list of the numbers of each type of insects found. Discuss with students whether they think this is shows a healthy stream or not. Are they any interesting characteristics students noticed about the insects? What kind of feeding groups do they fit it? What does this say about the stream?

4) Be sure to release the insects back into the same spot in the stream that they were collected from.

Student Handout #2-
Dichotomous Key for Aquatic Insects

1a. More than three pair of legs........ **not an insect**
1b. Zero to three pair of legs only........ 2

2a. With obvious wings........ **adult insect (see adult key)**
2b. Without wings or with wing buds only........ 3

3a. Wing buds present; not worm-like........ 4
3b. No wing buds; may be worm-like........ 8

4a. Long, piercing mouthpart begins at the top of the head; ranges in size from 2 to 60mm (true bugs)........ **Hemiptera (figure 1)**
4b. No piercing mouthpart........ 7

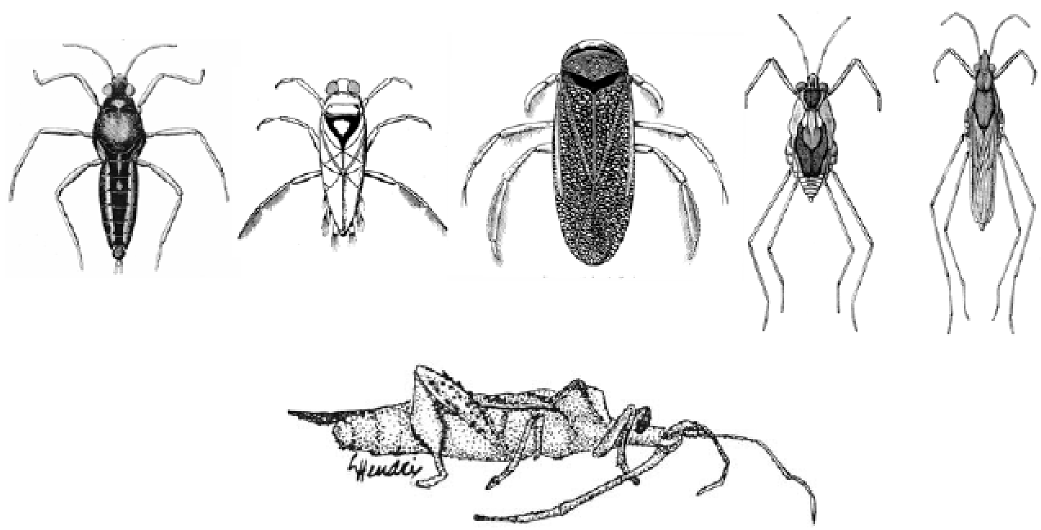


Figure 1.

5a. Underside of mouth with an extension arm that may cover face like a basket, or be flat against bottom of head, but usually with 'teeth' (jagged edges)........ 6
5b. Lower mouthparts not obviously enlarged or able to be extended........ 7

6a. Tip of Abdomen with three leaf like gills; ranges in size from 13 to 68mm, not including antennae or tails (damselflies)................................**Odonata (figure 2)**

6b. Tip of Abdomen with terminal triangular-shaped spines; ranges in size from 13 to 68mm, not including antennae or tails (dragonflies)..........**Odonata (figure 3)**

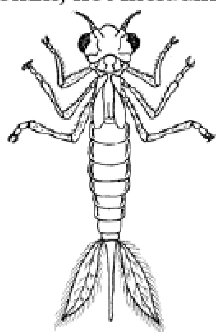


Figure 2.

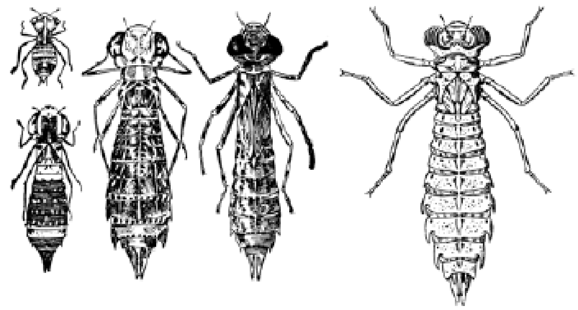


Figure 3.

7a. Abdomen with lateral gills that are 'leaf-like' or 'bushy'; gills can also look like a feather duster located all along the sides of the abdomen; also tip of abdomen with three tails' (rarely with only two); ranges in size from 2 to 32mm, not including antennae or tails (mayflies)..**Ephemeroptera (figure 4)**

7b. Thorax only with gills, never on sides of abdomen; look for feathery or "leaf-like" gills under the "armpits"; tip of abdomen with two 'tails'; ranges in size from 5 to 70mm, not including antennae or tails (stoneflies) ....**Plecoptera (figure 5)**

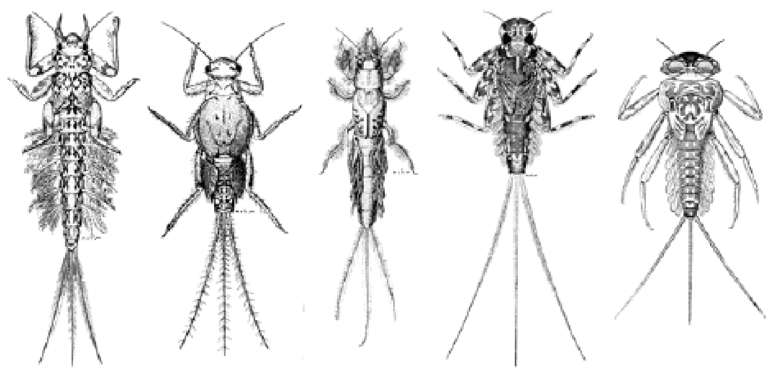


Figure 4.

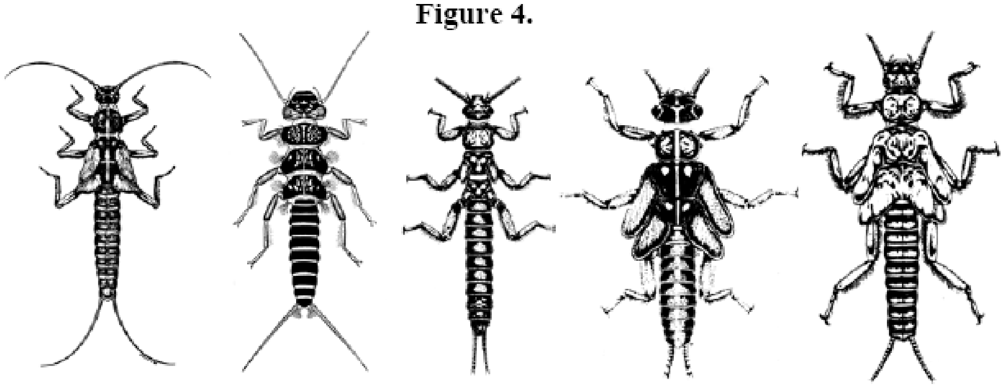


Figure 5.

8a. Mummy-like; wings, legs, antennae held tight against body wall, may or may not have a case or silken cocoon..**pupae (figure 6)**

8b. Body worm-like, maggot-like, or caterpillar-like; zero or three pair of 'true' legs 9

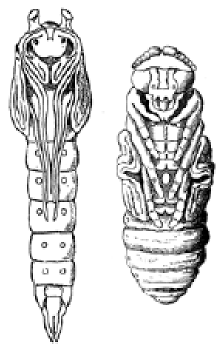


Figure 6.

9a. No true legs on the thorax; may have "false legs" on the abdomen **10**

9b. Three pair of true legs present on the thorax...**12**

10a. Worm-like body without a distinct head capsule; ranges in size from 2 to 25mm, occasionally 100mm as mature larvae (flies)..........................**Diptera (figure 7)**

10b. Worm-like body with a distinct head capsule **11**

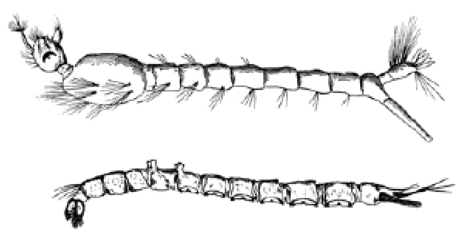


Figure 7.

11a. Worm-like body with a distinct head capsule and no structures on the end of the abdomen; ranges in size from 2 to 70mm, excluding tails .... **Coleoptera (figure 8)**

11b. Worm-like body with a distinct head capsule and a breathing tube or other structure at the end of the abdomen; ranges in size from 2 to 25mm, occasionally 100mm as mature larvae .... **Diptera (figure 9)**

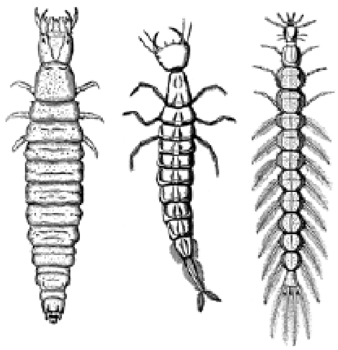


Figure 8.

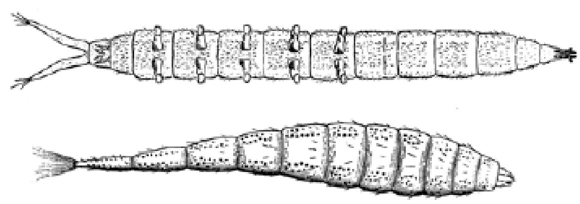


Figure 9.

12a. Large head with strong mandibles; with eight pair of gills, each extending laterally from an abdominal segment; ranges in size from 10 to 90mm (hellgrammites) .... **Neuroptera (figure 10)**

12b. Worm-like body with or without a case that can be made of sand, pebbles, or sticks; ranges in size from 2 to 43mm (caddisflies) .... **Trichoptera (figure 11)**

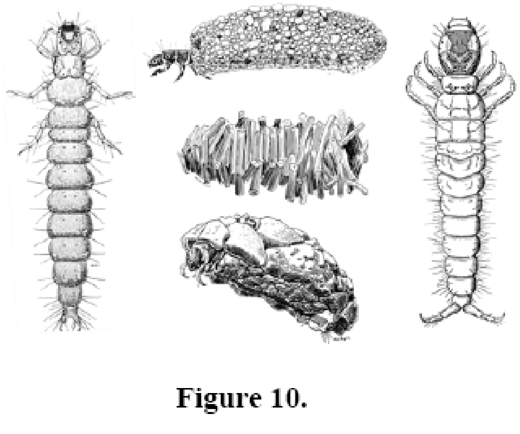


Figure 10.

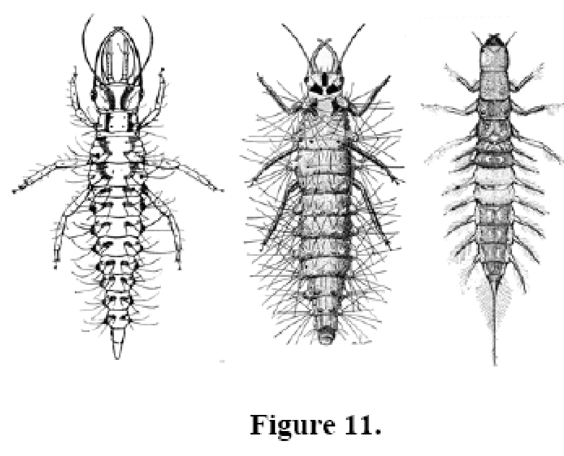


Figure 11.

Erosion: Causes & Effects

Adapted from U.S. Department of Health, Education and Welfare

This activity will introduce students to the causes and effects of erosion through investigating erosion in the outdoors!

Objectives-

- ✓ Understand what causes erosion and the effects it has on terrestrial ecosystems
- ✓ Understand how erosion increases sedimentation in streams and it's effects on aquatic ecosystems

Estimated Time-

- ✓ 45 minutes

Materials-

- ✓ Paper
- ✓ Colored pencils or crayons
- ✓ Cameras (optional)

Background Discussion-

Erosion is the process of solids, like sediment, rock or soil, being moved by wind, water or ice. Ask students if they have ever seen very muddy water flowing into a stream during a rainstorm. Explain that the soil has been carried off the surface of the land by the water as it travels downhill. Erosion can also be caused by bicycles or all-terrain vehicles tearing up slopes.

Some erosion is natural, but much is caused by changes in land use by human activity. Ask students what might happen if too much dirt is carried into the stream. Will the plants and animals have trouble surviving in the water? Will the plants on land have enough soil to take root? If the soil on land is highly polluted, will that pollution end up in the stream as well?

After examining areas with erosion in person, ask students what humans can do to reduce the effects of erosion from construction sites, roadways, agriculture, and other land uses. Erosion decreasing techniques can include planting vegetation, constructing silt fencing (as commonly seen at construction sites).

Procedure-

Take students to a nearby construction site, agricultural field or housing development. Ask them to look around and find evidence of erosion. Once they have found a specific site, they should make a sketch the erosion and photograph it (if cameras are available). Make sure the note where the erosion is beginning, what has caused it (water, wind, or ice) and where the water is carrying the soil.

Have each student give a brief explanation, you could even ask students to prepare a somewhat informal presentation to the class of what caused the erosion, the ecosystems that it may affect, and what humans can do to stop it.

Our Wild Watershed!

A Driving Tour of Saratoga Lake Watershed!

This bus tour will introduce students to Saratoga Lake Watershed and the communities, historical industries, and various creeks within it. The optional collect of water quality data can easily be included.

Objectives-

- ✓ Introduce students to Saratoga Lake Watershed
- ✓ Become familiar with the industry, communities and creeks within the watershed
- ✓ Draw conclusions from the comparison of water quality data.

Estimated Time-

- ✓ 2-3 hours

Materials-

- ✓ Cameras (optional)
- ✓ Water quality testing equipment (optional)
- ✓ Road maps for students (optional)

Notes and Background for Teachers-

This driving tour will introduce students to locations with the watershed. They will visit Bog Meadow Brook Nature Trail, a public fishing location along the Kayderosseras, and three areas of historical and current industry. They will drive past a capped land fill, the drinking water source (Loughberry Lake), the water treatment plant, and Saratoga Lake.

The tour can be done in any order and does not need to begin with Bog Meadow and end with Saratoga Lake.

There are three places to collect water quality data along the tour, and a potential for a fourth. Unfortunately, there are very few safe places to stop along Saratoga Lake and have access to the water. If traffic and the personalities of your students allow, collecting data from Saratoga Lake may be possible.

Student Activities-

1) Keep a notebook of the different kinds of land use, industry and housing you see within the watershed.

2) Take photographs of places you think have negative impacts on stream quality.

3) Give students copies of the attached map and ask them to follow along as you drive.

Driving Directions & Discussion-

1) Begin at Bog Meadow Brook Nature Trail in Rt 29/ Lake Ave.

   i. Take students down the trail to the left of the parking lot. In approximately 100 yards, Bog Meadow Brook flows underneath the trail.

   ii. Discuss the function of wetlands, how runoff from the road may affect the wetland, and ask students for their observations. How does this area look different from a forest?

   iii. Water quality measurements can be taken and used for comparison with other water bodies in the watershed.

2) Take a left out of the Bog Meadow Nature Trail parking area, heading west on Rt. 29

3) At the first light, turn right onto Weibel Ave.

   i. Point out the capped landfill on the left. Ask students about the methane pipes and possible pollutants leaking from the landfill. Where do they think those pollutants will go?

4) At the third light, turn left onto Rt 50, toward Saratoga Springs

   i. After the third light, point out Loughberry Lake on the right and the water treatment plant on the left. Explain to students that this lake is where the water in the school, and their homes, comes from.

5) Remain on Rt 50 South into downtown Saratoga Springs

6) Turn right onto Washington St/ Rt 29 West. Follow through Rock City Falls.

7) After “Double R Farm” on the right, turn right onto Creek Rd. Pull into the Kayderosseras Creek Public Fishing Stream.

    i. Complete water quality testing for watershed comparision.

8) Drive back down Rt 29 toward Rock City Falls.

    i. Point out the old mill on the right. How did industry affect development in the watershed?

    ii. The associated picnic/gazebo areas provide a good place to eat and packed lunch, and perform water quality testing again.

9) Continue on Rt. 29 toward Rock City Falls. Turn right on Rock City Rd.

    i. A bus can easily fit in the side and back parking areas of the Milton Fire District No. 1 parking lot, on the right directly over the bridge.

    ii. Ask students how they think the Cottrell Paper Company has altered the creek? Affected water quality downstream? Discuss the water level fluctuations associated with the operation of the paper company.

10) Leave the fire company, turn left on Rock City Rd. and then right on Rt. 29, heading back toward Saratoga Springs.

11) Turn right on Middle Line Rd. (at the airport sign).

12) Turn left on County Farm Rd.

13) Turn right on Fairground Ave.

14) Fairground Ave veers to the right, but continue straight onto Prospect Ave into Ballston Spa.

    i. As you come down the hill into Ballston Spa, point out the industry on the left. How have these companies altered the creek? The watershed? Water quality?

15) After passing the industry in Ballston Spa, turn left on Milton Ave/ Rt. 50

16) Turn right onto Saratoga Ave and follow it around to the left.

17) Turn right onto Ralph St. After the bridge, turn left into Williams Kelley Park.

i. Williams Kelley Park is also a good picnic/ lunch area and provides a great location for water quality monitoring.

ii. When leaving, turn left out of the park onto Ralph St. and then left onto Malta Ave (right hand turns are not permitted here).

18) When leaving the park, turn left onto Ralph St.

19) Turn left onto Malta Ave at the top of the hill (right turns are not permitted here.

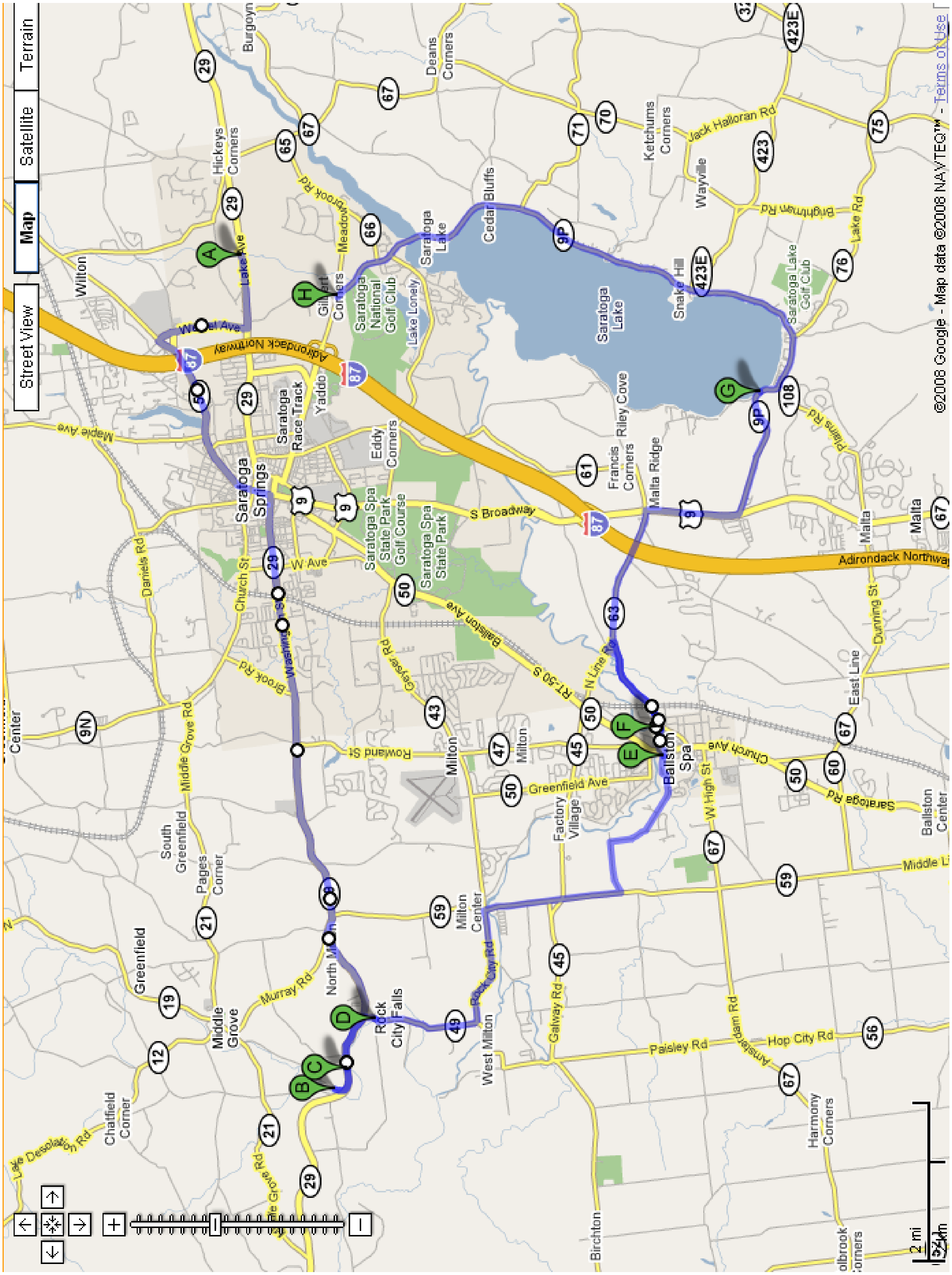
20) Follow Malta Ave to Rt. 9. Make a right turn onto Rt. 9.

21) Make a left onto Rt 9P. Follow Rt. 9P around Saratoga Lake.

i. Ask the students to make observations about the Lake. How would all the things they have seen upstream affect the health of the lake?

ii. Unfortunately, finding a safe place to stop along Saratoga Lake and collect water quality data is quite difficult.

22) Continue to follow Rt. 9N until it meets Union Ave. The tour ends here! Return to the school using the easiest route, or add more stops to the watershed tour!



Street View
Map
Satellite
Terrain
Saratoga Springs
Saratoga Race Track
Yaddo
Saratoga Lake
Saratoga National Golf Club
Lake Lonely
Saratoga Spa State Park Golf Course
Saratoga Spa State Park
Adirondack Northway
S Broadway
Ballston Ave
Ballston Spa
Milton
Milton Center
West Milton
Rock City Falls
Middle Grove
Greenfield
South Greenfield
Pages Corner
Chatfield Corner
Wilton
Hickeys Corners
Gilbert Corners
Eddy Corners
Cedar Bluffs
Snake Hill
Riley Cove
Francis Corners
Malta Ridge
Malta
Ketchums Corners
Wayville
Deans Corners
Saratoga Lake Golf Club
Factory Village
Ballston Center
Harmony Corners
Birchton
Washington St
Church St
W Ave
Rowland St
Geyser Rd
Brook Rd
Daniels Rd
Middle Grove Rd
Murray Rd
North Milton
Greenfield Ave
Galway Rd
Paisley Rd
Hop City Rd
Amsterdam Rd
W High St
Church Ave
Saratoga Rd
Middle Line
East Line
Dunning St
Lake Rd
Plains Rd
Brightman Rd
Jack Halloran Rd
Meadowbrook Rd
Maple Ave
Lake Ave
N Line Rd
RT-50 S
Rock City Rd
Lake Desolation Rd
2 mi
5 km
©2008 Google - Map data ©2008 NAVTEQ™ - Terms of Use

Investigating Saratoga Lake Watershed!

Adapted from The GLOBE Program, 2005

This activity will familiarize students with local hydrology through visual surveys and raise questions about land use and water chemistry issues.

Objectives-

- ✓ Understand local hydrology and local hydrologic issues
- ✓ Relate visual survey information to water related issues in the community
- ✓ Raise questions about aspects that may require further investigation

Estimated Time-

- ✓ 1 hour in the classroom
- ✓ Field trip time

Material

- ✓ Drawing materials for making sketches of the site
- ✓ Compass
- ✓ Measuring tape
- ✓ Other suggested materials: camera or video recorder, plant and animal guides, binoculars

Classroom Preparation-

1) Begin to collect materials pertaining to your hydrology site such as:
   a. Topographic and other maps
   b. Satellite imagery of your site (GoogleEarth provides great imagery)
   c. Newspaper articles, etc., about local water issues
   d. Local plant and animal guides
   e. Invite local experts on water issues to visit your classroom (optional)

Procedure-

1) Ask students about their knowledge of local bodies of water. Begin with questions such as:

   1) Is there a lake, river, pond or stream that you visit?

2) What is your favorite past time at this place?

3) Why is this body of water important to you?

4) Look at maps of the local area to identify water sites

5) Researching water in the community through newspaper articles, periodicals, or books; reports from local, state or federal agencies; or other written sources

6) Interviews with long-time residents of the community about what they remember about your hydrology site

7) Discussions with local experts on water from local agencies or Professors from the Environmental Science Department at Skidmore College.

2) Take a field trip to your Hydrology site:
   1) For beginning levels:

      i. Have the students walk around, observe and ask questions about the water in the site. This includes noticing the direction of flow, the presence of ponds or lakes, residual water from precipitation, springs and soil moisture.

      ii. Encourage students to focus on water in all its forms as they walk around the study site.

      iii. Take a container and collect a sample of the water, ask students to observe the color of the water, whether the water is moving and how fast, what is near the water, whether they can hear the water while they are quiet, whether the water has a smell, whether the water is clear or cloudy.

      iv. Have the students draw pictures and/or take notes about the location and size of the study site. Compare the water location to other features on their study site such as trees, hills, etc. Have your students ask questions about where the water came from.

   2) For intermediate and advanced levels:

      i. Assign teams of students to survey different sections of the hydrology site. In teams composed of a journalist, a sketcher, and a photographer, students should begin to document what they observe about their section.

ii. What is the appearance, smell, and nature of the water in their section? Bordering lands should be noted such as urban, agricultural, residential, wooded, and wetlands.

iii. Students should map the general contours and characteristics of their sections and record the wildlife and plants in and around its water. What is the slope of the land adjacent to their section of water?

iv. Back in the classroom, students should create a composite display of all sketches and maps. Look for similarities and differences and discuss observed patterns. Based on their observations, encourage students to think about how the water got to this location, how it flows through the study site, where it goes from there, how the area surrounding the water influences the properties of the water particularly during periods of rain, snowmelt and flooding.

v. What questions do they have? Record them on a poster on the classroom wall.

Concluding Discussion Questions-

1) Did you see any discharge into your water body?

2) What land-use activities did you observe and list?

3) How do you think these activities would change the water characteristics?

4) Would these activities influence water properties?

5) What type of water appearance was recorded most often and what might this indicate about the water?

6) Was there evidence of human uses of the water?

7) Is there evidence of wildlife and other animals using the water?

Saratoga Lake Watershed Survey

Adapted from EarthForce, 2007

This exercise will allow students to conduct visual surveys and scientific measurements to help determine the health of the Saratoga Lake Watershed.

Objectives-

- ✓ Help students define and describe the conditions they see in the watershed using scientific and visual inquiry.

Estimated Time-

- ✓ 2-3 hours of field trip time

Materials-

- ✓ Waterproof containers and plastic bags
- ✓ Pens and paper
- ✓ Transportation to a field site in the watershed
- ✓ Attached handouts
- ✓ A camera for each group of students
- ✓ Water Monitoring Kits (estimate a group of five students per water monitoring kit) – *kits can be purchased at www.earthforce.org and elsewhere online.*
    1) Testing for: dissolved oxygen, fecal coliform bacteria, temperature change, turbidity, phosphate, nitrate, pH, salinity and benthic indicators

Teacher Notes-

1) To save time, you may want different groups to collect information using different approaches (i.e., one group uses cameras; one uses monitoring kits, etc.).

2) Define problem, threat and strength, if needed.

Procedure-

1) Travel to the field site and remind the students or the purpose of the activity: to use monitoring, observation, and photography to begin to find out the condition of the water in part of the watershed.

2) Ensure that everyone has an assigned task.

3) Divide the students into appropriate groups and distribute cameras, water monitoring kits and copies of the handouts.

4) Have students take pictures of anything they see that threatens or strengthens water quality.

5) Help students categorize the pictures into groups such as problem, threat and strength.

6) Have students use the water monitoring kits and record the data.

7) Ask students to use the handouts to record their observations under “what we found” and inform them they are to leave the other columns blank until returning to the classroom to analyze their findings.

Suggested Concluding Discussion Questions-

1) Where did you find more strengths than problems?

2) Where did you find more problems than strengths?

3) Which problems were discovered by all the groups?

Activity Extensions-

Have students create a collage of photos to reflect on at the end of the process.
Research archival photos of the community to look at changes over time.

Water Monitoring Results

Watershed Factors	**What We Found**: Indicate what you found; be sure to include amounts where applicable	**What Could It Mean?** Possible problems or threats	**Why is it like this?** Possible causes of the problems or threats
Water Monitoring			
Dissolved Oxygen			
Fecal coliform bacteria			
Temperature change			
Turbidity			
Phosphate			
Nitrate			
pH			
Salinity			

Physical Observations

Watershed Factors	**What We Found**: Indicate what you found; be sure to include amounts where applicable	**What Could It Mean?** Possible problems or threats	**Why is it like this?** Possible causes of the problems or threats
Green, green-blue, brown, or red coloring			
Orange-red coloring			
Dark red, purple, black, or blue coloring			
Multi-colored, oily sheen			
Muddy color			
No unusual color			
Sulfur (rotten egg) odor			
Chlorine odor			
Musty odor			
Harsh odor			

Physical Observations, cont.			
Watershed Factors	**What We Found**: Indicate what you found; be sure to include amounts where applicable	**What Could It Mean?** Possible problems or threats	**Why is it like this?** Possible causes of the problems or threats
Physical Observations			
No unusual smell			
Evidence of erosion			
Evidence of dumping			
Pipe discharge			
Other foreign objects			
Other unusual conditions			

Land Use Observations

Watershed Factors	**What We Found**: Indicate what you found; be sure to include amounts where applicable	**What Could It Mean?** Possible problems or threats	**Why is it like this?** Possible causes of the problems or threats
Agricultural Crop Production Animal Grazing Manure Piles Other			
Residential High or low density housing Visible septic tanks or drainage Dumping Other			
Schools			

Land Use Observations, cont.

Watershed Factors	**What We Found**: Indicate what you found; be sure to include amounts where applicable	**What Could It Mean?** Possible problems or threats	**Why is it like this?** Possible causes of the problems or threats
Commercial/ Industrial (note type of business or industry)			
Construction Buildings Roadways			
Public Use Racetrack Parks Golf Course Bus Station Train Station Other			

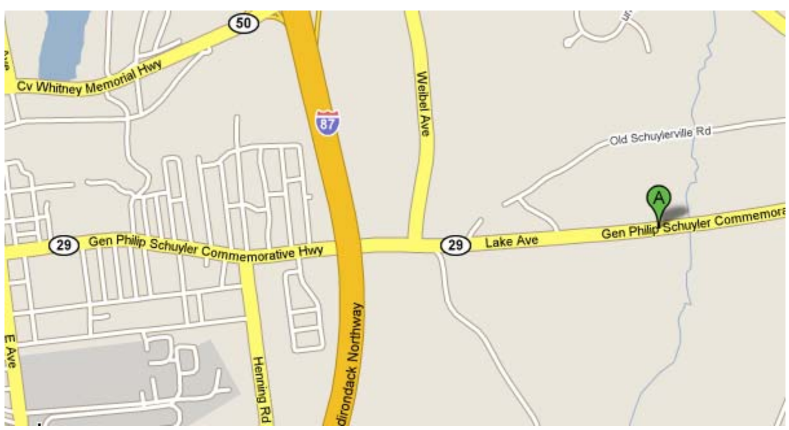
Safe Stream Access in the Saratoga Lake Watershed

Kayderosseras Creek Public Fishing Area-

Stream access from Public Fishing Area at the corner of Route 29 and Creek Rd. There are multiple public fishing areas within the watershed and usually provide safe, secure, stream access.

Bog Meadow Brook Nature Trail-

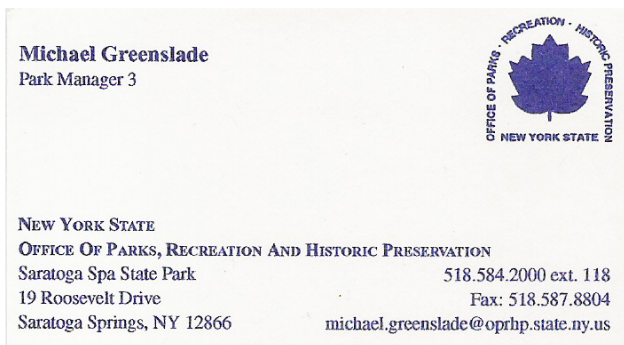
Stream access from Bog Meadow Brook Nature Trail about 100m from the parking area.



<u>Saratoga Spa State Park-</u>

Stream access at the Geyser Picnic Area off Geyser Loop Rd.

Contact Michael Greenslade, Park Manager 3 beforehand to receive a special permit.


Michael Greenslade
Park Manager 3

OFFICE OF PARKS · RECREATION · HISTORIC PRESERVATION
NEW YORK STATE

NEW YORK STATE
OFFICE OF PARKS, RECREATION AND HISTORIC PRESERVATION
Saratoga Spa State Park
19 Roosevelt Drive
Saratoga Springs, NY 12866
518.584.2000 ext. 118
Fax: 518.587.8804
michael.greenslade@oprhp.state.ny.us

Appendix 2- *The Daily Gazette*

BALLSTON SPA

Elementary pupils get a lesson on the environment

BY KATHY PARKER
Gazette Reporter

A pair of Skidmore College seniors spent two days this week doing hands-on experiments on the environment with elementary school children.

Sieglinde Mueller and Lauren Fletcher have already been offered and accepted jobs they will fill after graduation next month.

The women have majored in Environmental Studies at the college. On Friday, they worked with fifth-graders at St. Mary's Elementary School who are learning about the local watershed.

A school parking lot was the setting for demonstrations of how pollutants contaminate rivers and lakes.

"The watershed model was a tablecloth over buckets and bowls which represent the topography of hills and valleys," Mueller said. "The children were able to see how pollutants travel into the lake."

Cotton balls dipped in food coloring represented the pollutants being washed by spray bottle rain into the model.

The college students did similar experiments earlier in the week with children at the Saratoga Independent School.

Fletcher said she enjoyed working with the young students and it was good practice as she has accepted a job in Big Bear, Calif., at an outdoor science school working with sixth-graders.

"We'll be taking the kids into the mountains to teach them about the environment," she said.

Mueller said she is headed to Far Hills, N.J., after graduation where she will be an easement steward for the New Jersey Conservation Foundation, a nonprofit environmental group.

Skidmore College spokeswoman Andrea Wise said the work in local schools done by Mueller and Fletcher is one of a number that students are conducting as part of the Water Resources Initiative, launched three years ago to immerse environmental science students in real world problems.

In one of these other projects, two students found higher numbers and diversity of snails in Loughberry Lake than in their comparison site, Lake Desolation, and they suspect that Eurasian milfoil, plays a role.

"Several projects have taken advantage of Skidmore's geographic-information-systems center, a resource for faculty and students that also collaborates with community groups such as Saratoga PLAN, the Saratoga Spa State Park, and the Hudson River Sloop Clearwater," Wise said.

"Students have used GIS to map the geology of the Kayaderosseras Creek watershed, explore the methodology used to develop the 100-year FEMA flood map for the Saratoga Lake watershed, and analyze problems that could result from channelized streams," Wise said.

ANA N. ZANGRONIZ/GAZETTE PHOTOGRAPHER

St. Mary's School fifth-grader Kevin Hercamp, above, reacts as a classmage places items into a filter during an learning activity about the Saratoga Lake watershed. At right is Jacob Van Patten. Below, Samathan Pellerin, left, and Audrey Schaffer add components to their filter Friday.

Reach Gazette reporter Kathy Parker at 885-6705 or kparker@dailygazette.net.