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:

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 metholemt>0.a

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).

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

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

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. St

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 specifihed curkSnme -0o0uht 6c -0.0013 Tw 17.5712 s2toed c5 0 Tdwrit

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

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/

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.

Figures & Tables-

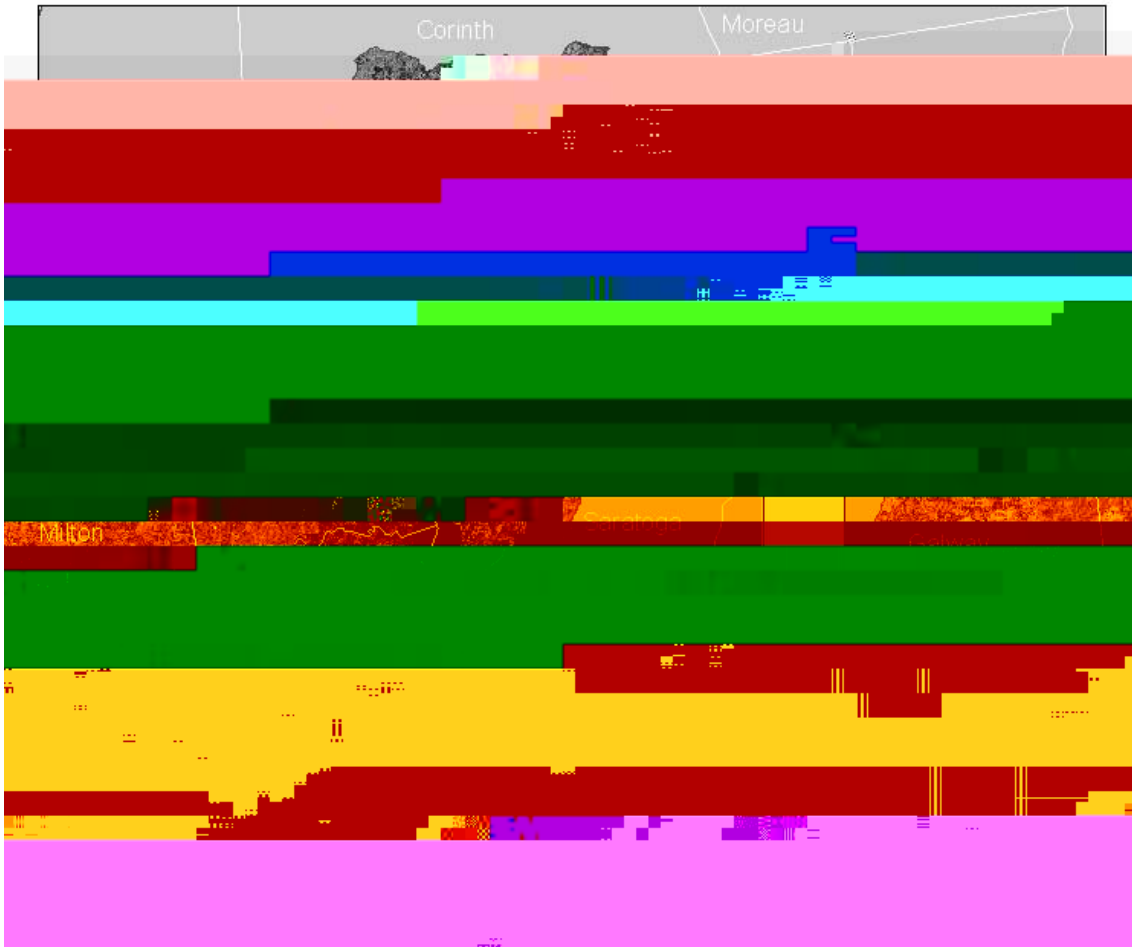


Figure 1- Saratoga Lake Watershed map showing the location of the watershed, the focus of the Education Guide, within Saratoga County, New York. The area within the watershed is comprised of aerial imager

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).

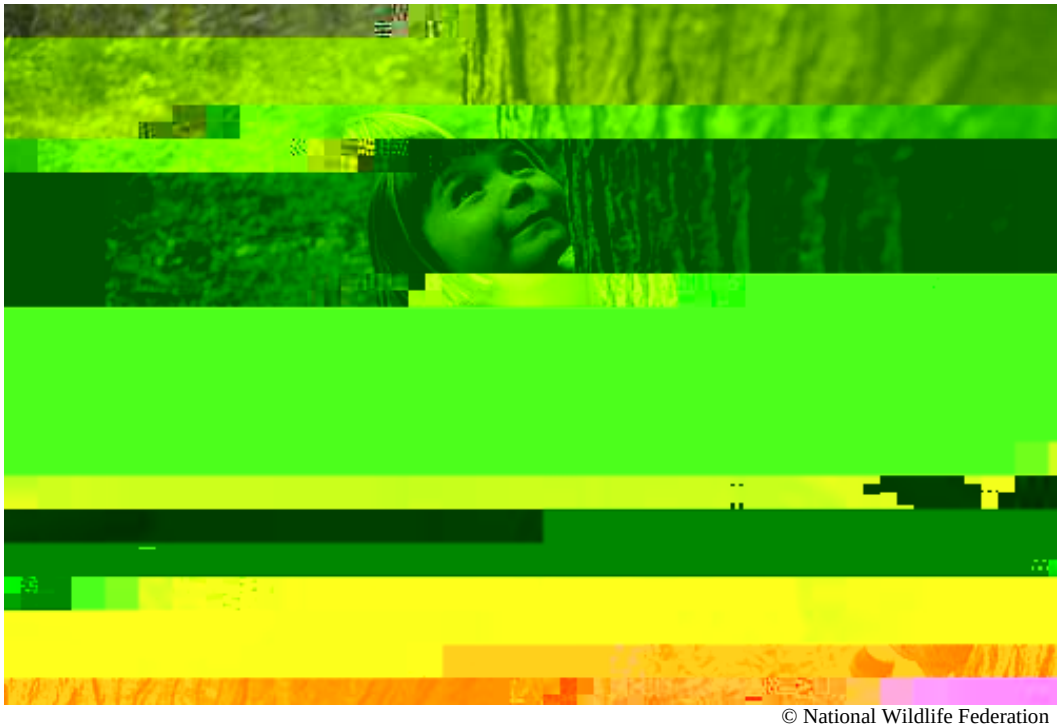
Curricula/ Lesson Plans	Year	Age Range	Publishing Organization	Focus Level
Adopt-a-Watershed	2008	K-12	Non-profit	General
Center for Global Environmental Education	2001	K-12	Public	General
Deep Subjects, EPA	2006	3-6	Public	General
Disappearing Water, EPA	2006	4-6	Public	General
Dobson	1999	K-12	Private	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	Lo
US Dept of Health, Ed. & Welfare	1968	K-12	Public	St
Water Education Foundation	2008	K-12	Non-profit	Gene
Wood	2007	-	Private	Gene

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 O

Appendix 1-

The Saratoga Lake Watershed Education Guide Activities



Activities Table of Contents:

Activity Title	Description	Location
A Day in the Life of a Raindrop	Using an interactive game, students learn the movement of water through the water cycle and [illegible] opportunities to the [illegible]	

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	Teacher Notes: 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
- 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.

Concluding Activities-

Water Cycle Table continued…

STATION	DIE SIDE LABELS	EXPLANATION
[illegible]	[illegible]	[illegible]
gravity; it filters into the soil.	Lake	one side *ground water*	Water is pulled by
water.		one side *animal*	An animal drinks
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	one side *clouds*	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Ground Water	one side *river*	Water filters into a river.
	two sides *lake*	Water filters into a lake.
	three sides *stay*	Water stays underground.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

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 immedi

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.

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,

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!

WARNING: 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.

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 09ace ass44 they areirha Tr85Tw Trte5(tjourney?)-15.T6(at the(i)-2(c strip, 15ach box 44 arking

Guess the pH

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									

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

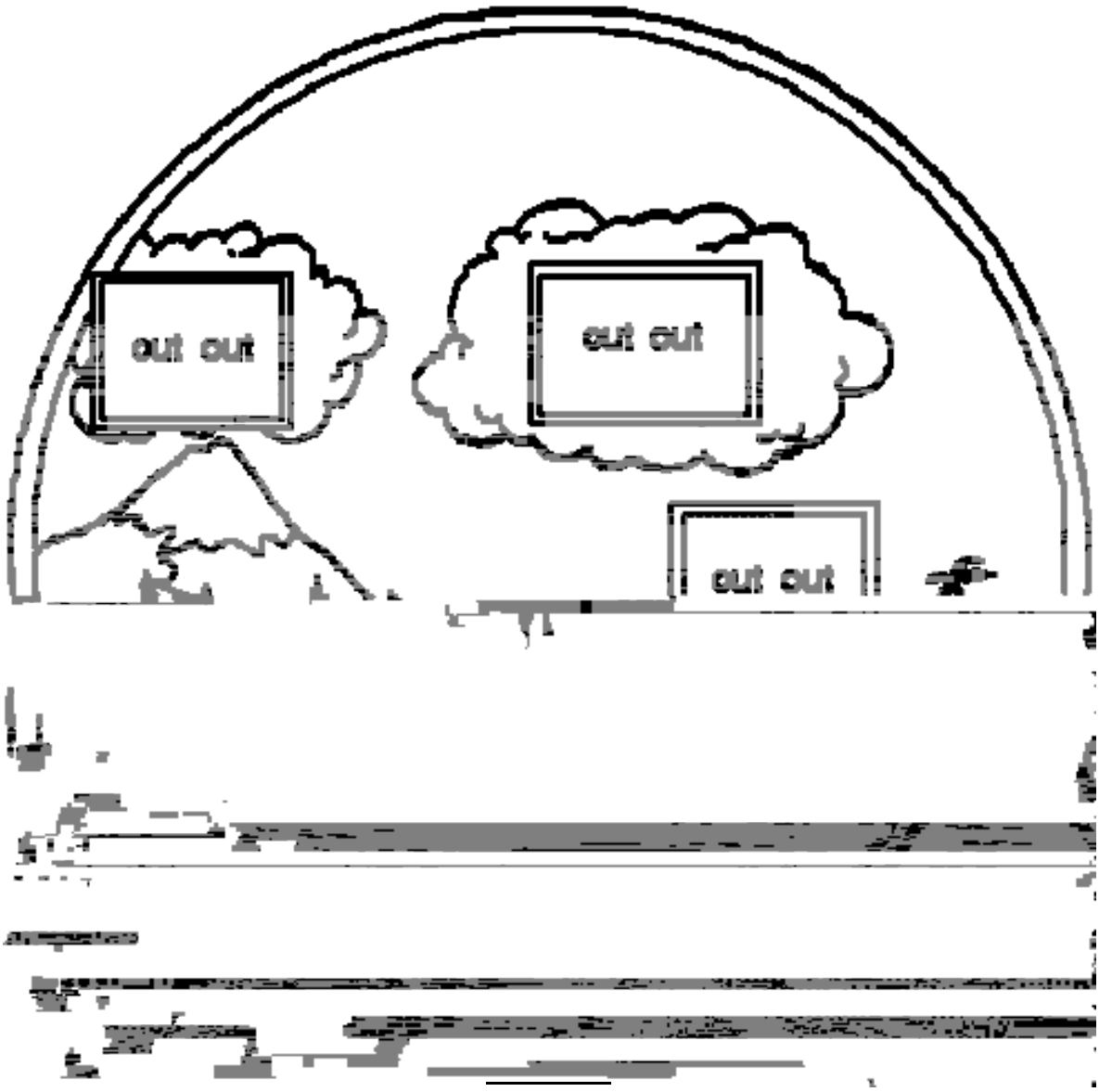
Materials-

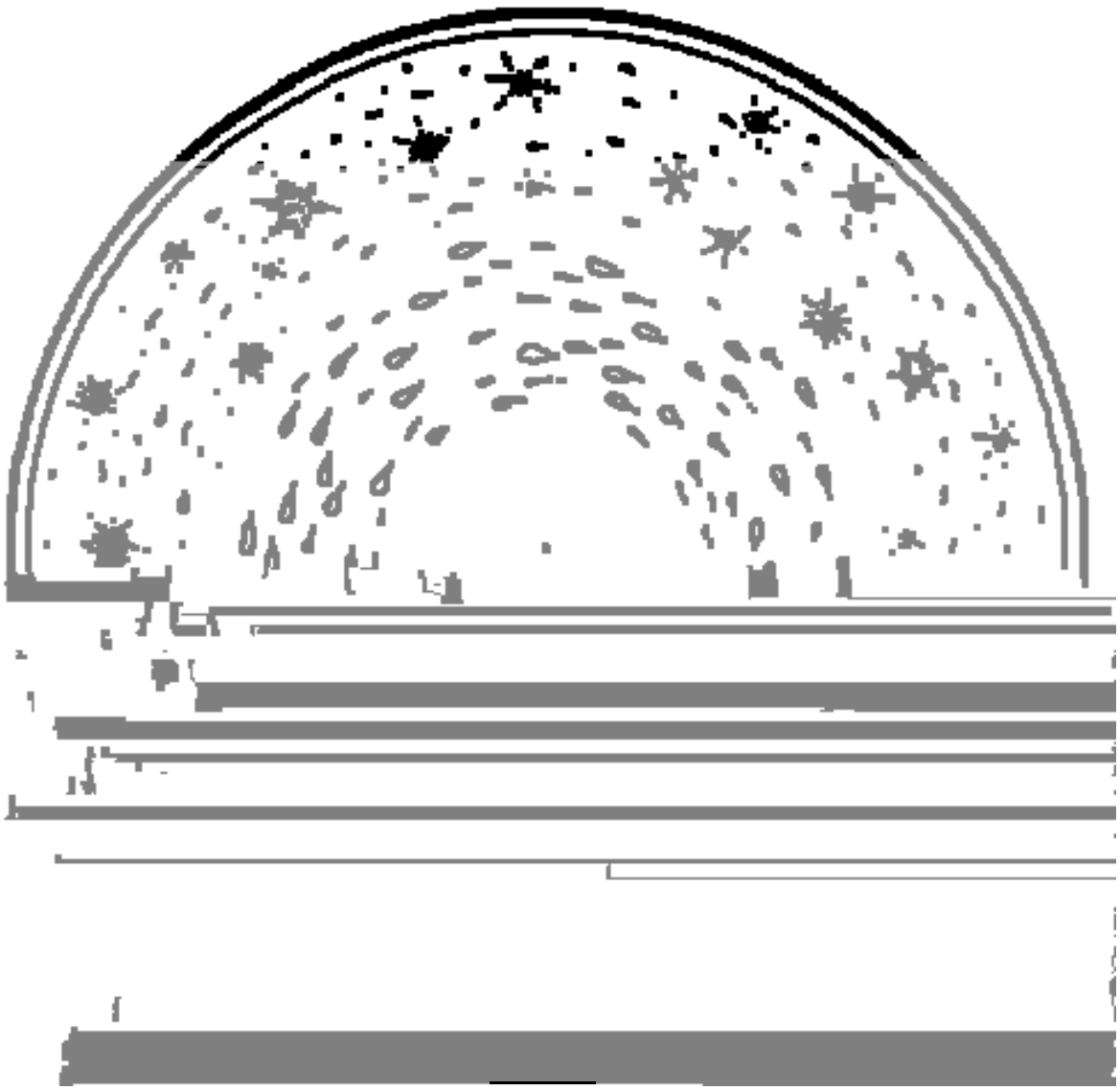
- Photo copies of the water wheel
- Markers, crayons, or colored pencils
- Paper fasteners (brads)
- Scissors

Procedure-

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 sprinngat(.84 w 0 -1.15 TD[166 6534.64)TjEM[ts todrops not eva as o62 eo)6(abs002 Tbed


out out
out out
out out



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

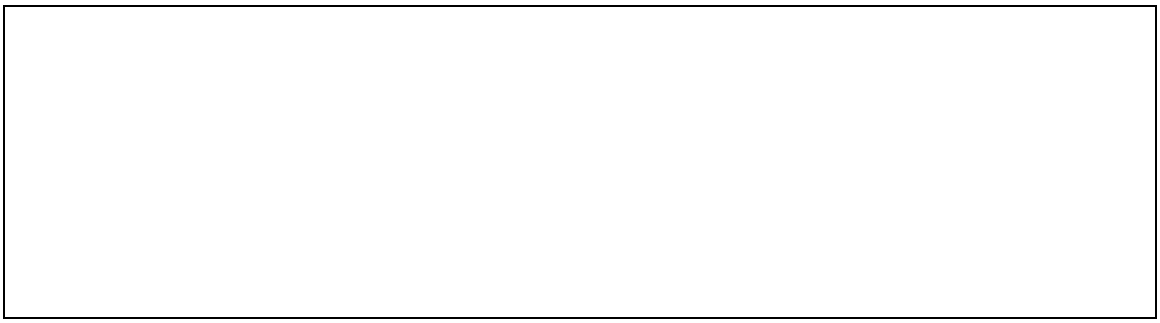
Materials-

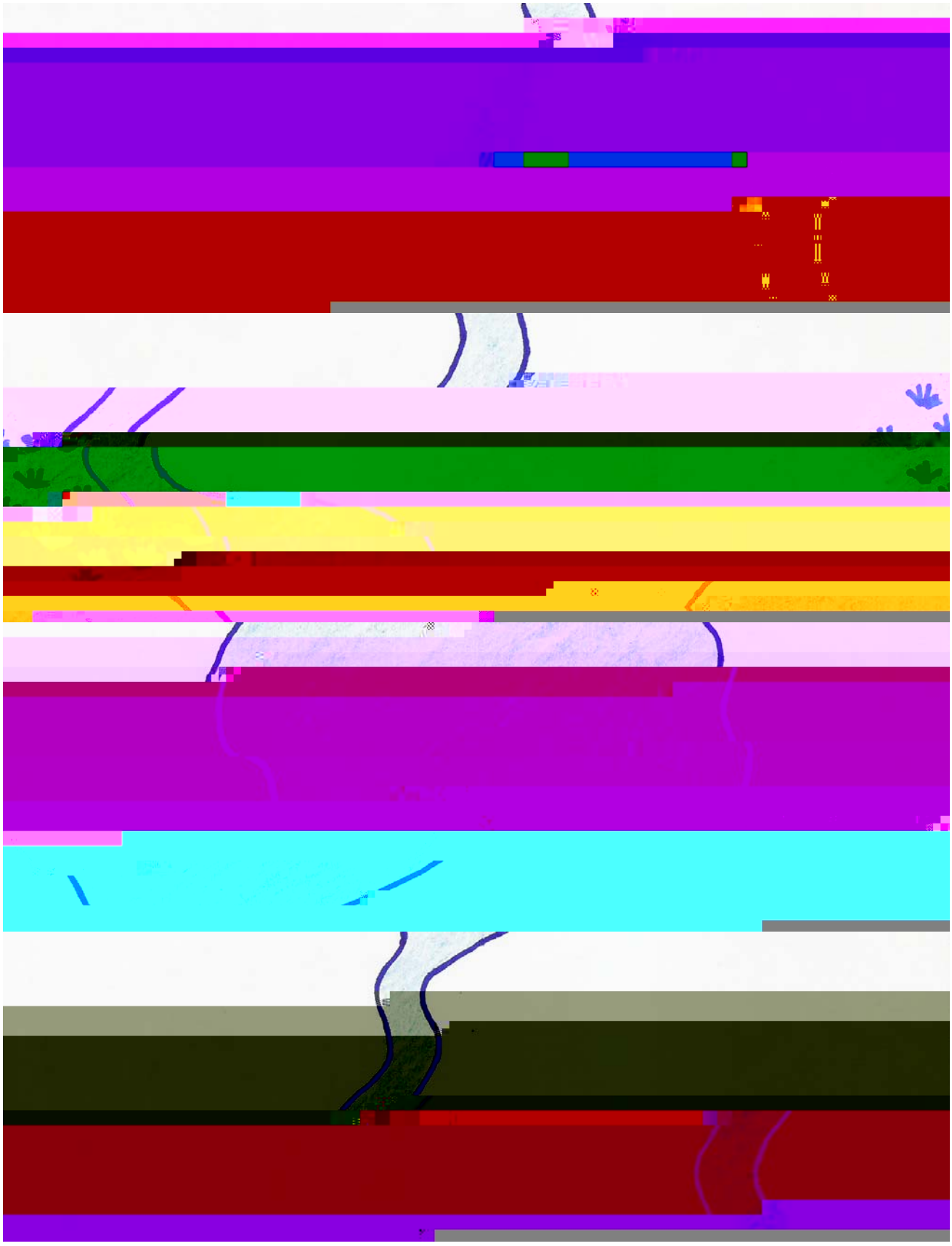
- Scissors
- Masking tape
- Paste or glue
- Sets of land use cutouts
- Karner Blue Pond cutouts
- Large pieces of paper to attach the cutouts to

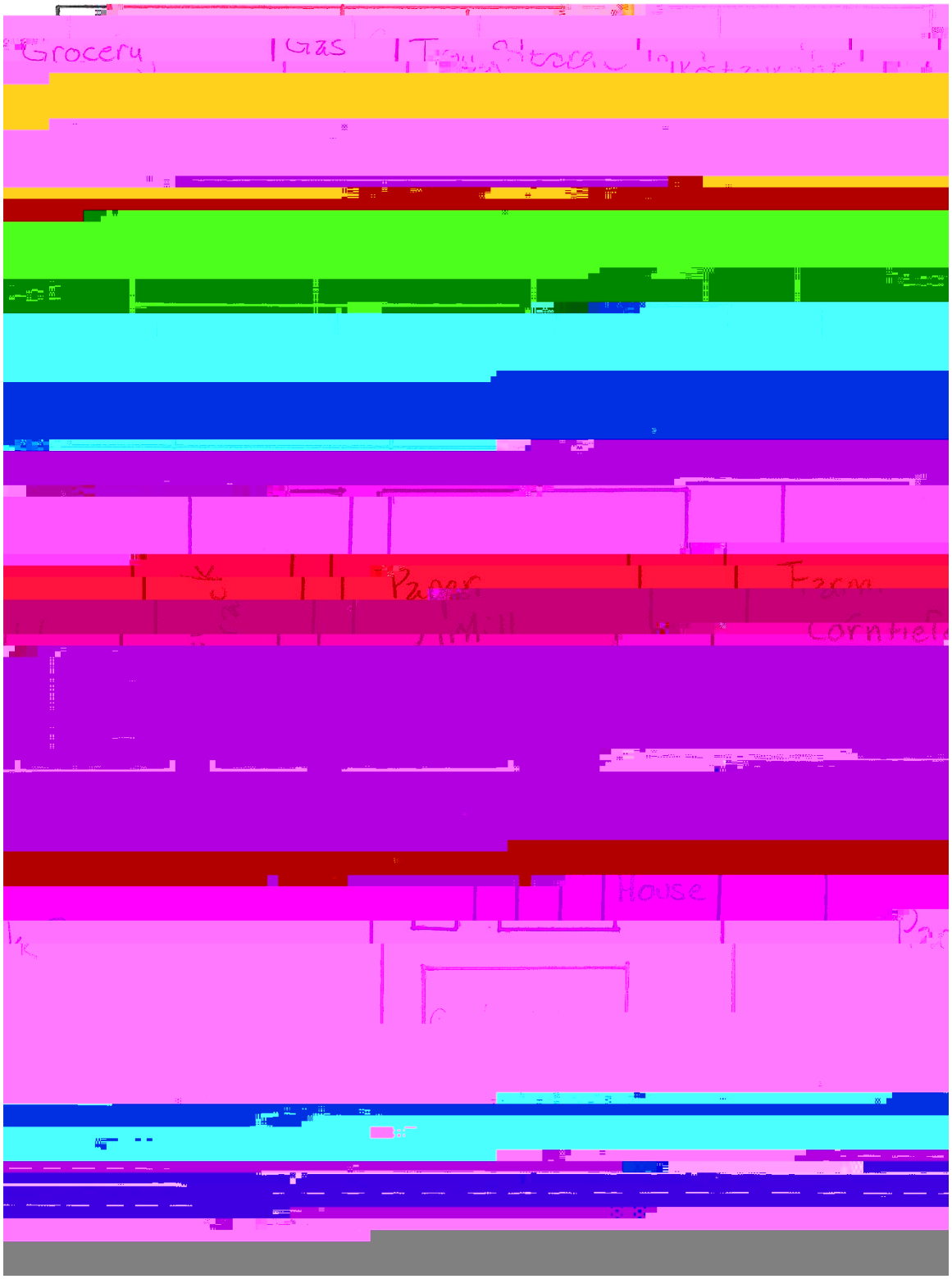
Background Discussion-

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.

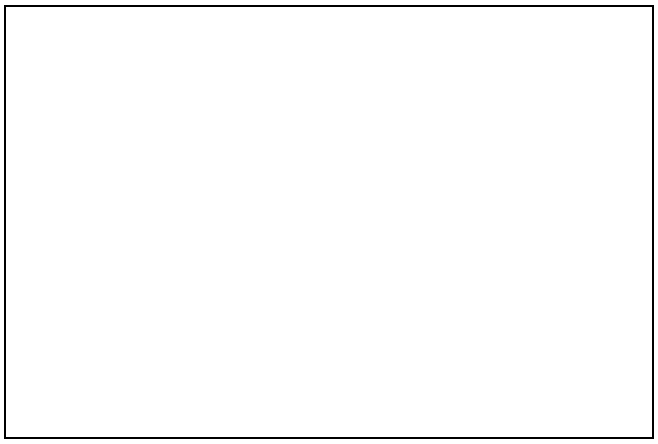


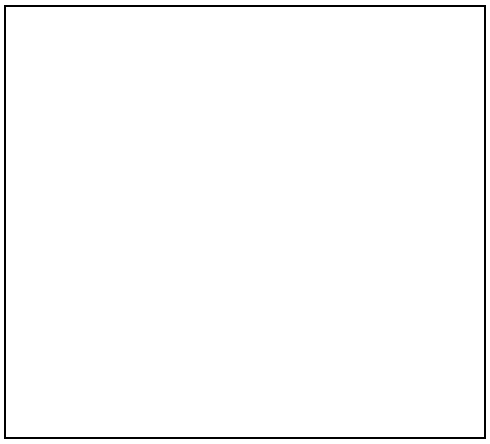



Grocery
Gas
Pizza
Farm
House

Life in Saratoga Lake

Adapted from San Francisco Bay Watershed Curriculum, 2005





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-

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

Estimated Time-

- V 45 Minutes

Materials-

Filter materials: *1 set for each team*

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

Contamination Materials

- V Large bucket filled with water and the following items:
- V Food coloring, about 6-8 drops
- V Raisins or dried beans, about ½ cup
- V Soil, about ½ cup
- V Baking soda about 3 tablespoons
- V Soy sauce, about 6 – 8 drops
- V A paper plate, torn into small pieces
- V 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.

Suggested Journal Entries, continued-

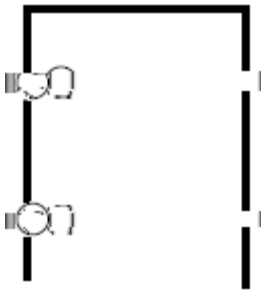
ii. Write a letter to a friend about what you have learned? Describe the Saratoga Lake Watershed to them. How would they get to your house if they could only travel along waterways?

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.

Many 0.0up wirci1 Td me in(Maup w)Tjpeopleg9 708.96 Tm( )Tj30022 Tc 1.3can do

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)

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 penc

Mat Mials-

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.

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

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!

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.

Lay/P /MCID 45 >>BDC T( )TjEMC /P /MCID 46 >>BDC 0 -1.all amounts of

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.

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

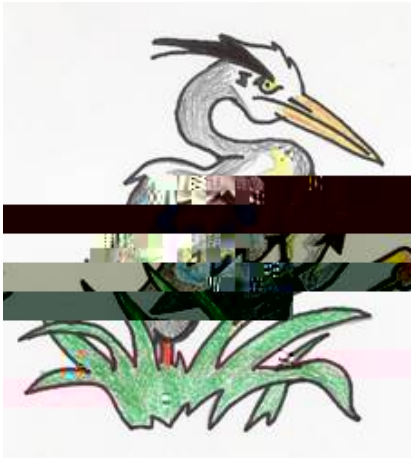
Through creating a wetland model, students will become familiar with the processes of wetlands and their ecological function.

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 traditiona

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.

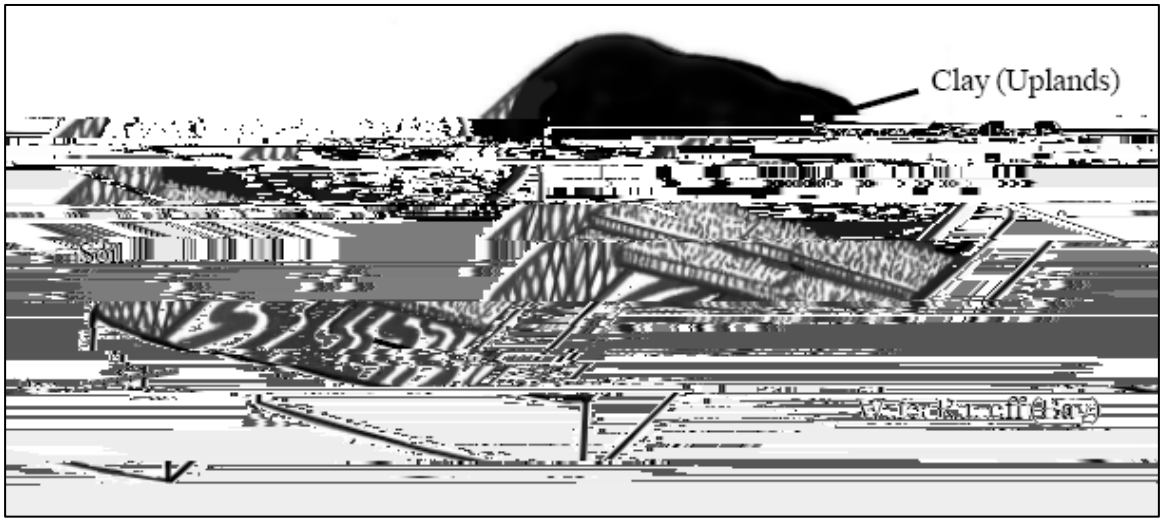
Procedure-

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)

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 2)w0aTârTf00005 T

Poros/TT00.83sp area where w26 ineen pard

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 a

2)above D 5 >3 Tc -0
2)

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
- 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)

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

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

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

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)

Rain, Rain, Soil Away

Adapted from Wood, 2007

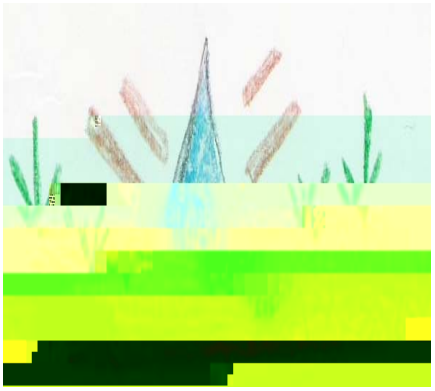
This activity allows students to better understand erosion by testing different soil types to measure the resilience against erosion.

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
-

- Stop watch
- Ruler
- Protractor
- Contains of fresh water (or easy access to a sink)
- Clean up rags

Infiltration Experiment-

T8s5r5C0 T8s5rh4Td0039>Tj/TT1 1 Tf0.785 0 Td( )T3BoRcj(So00 Tw -15 -1.15 27)ity785 0 Td( )Tj/TT0 1 Tf0.0009 Tc -0.0

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.
- Impervious – a surface that is unable to be penetrated.

iv. Quality Control

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?

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.

Watershed Explorers Checklist

Take notes on what you see as you walk around your watershed!

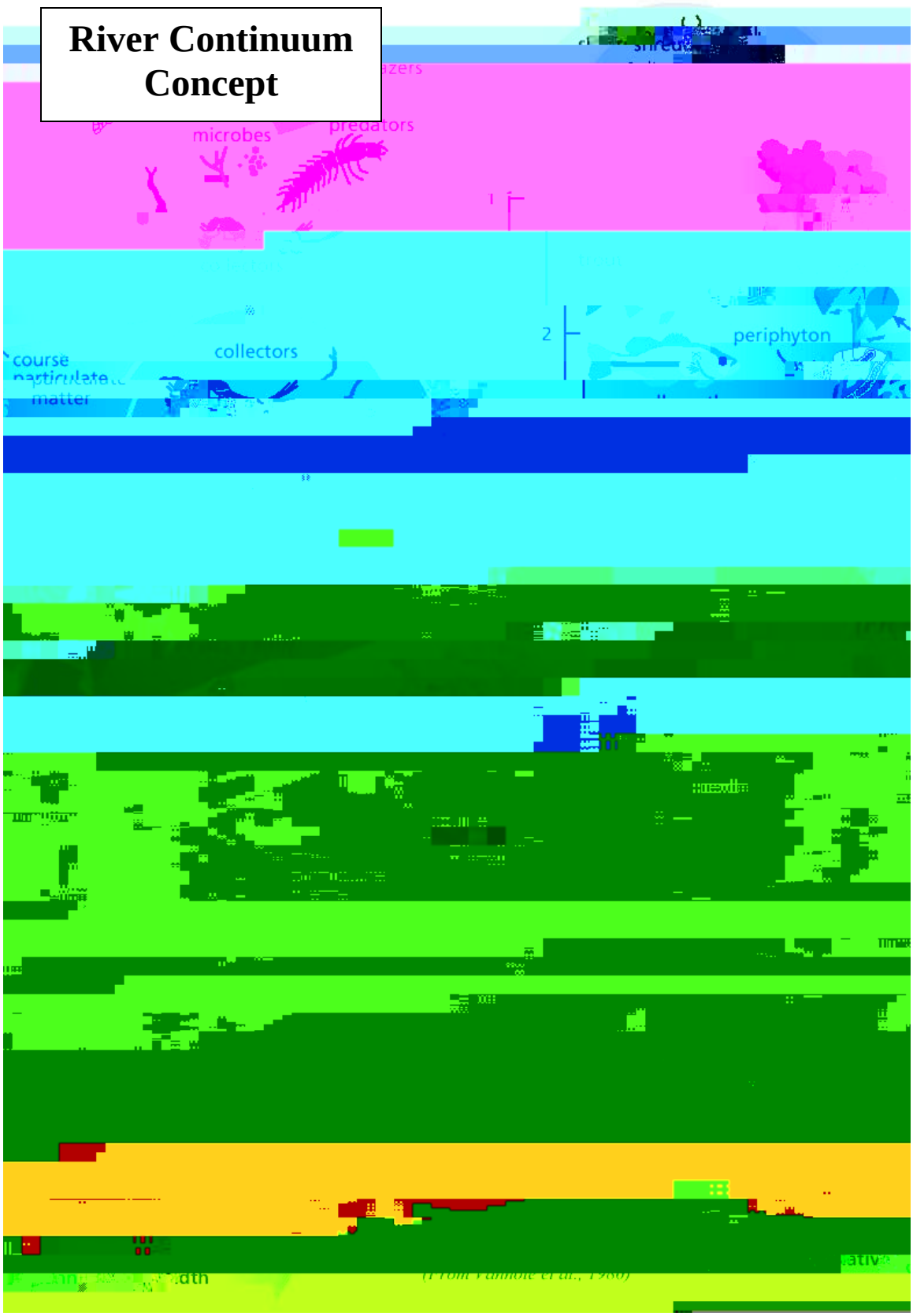
	How many of these do you see?	What condition are they in?
Playgrounds & Parks		
Homes		
Stores or Restaurants		
Police or Fire Stations		
Parking Lots		
Schools		
Sewage Treatment Plants		
Rivers, Ponds, or Harbors		
Open Land or Farm Land		
Factories		
Other		

Aquatic Insect Wate

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

River Continuum Concept

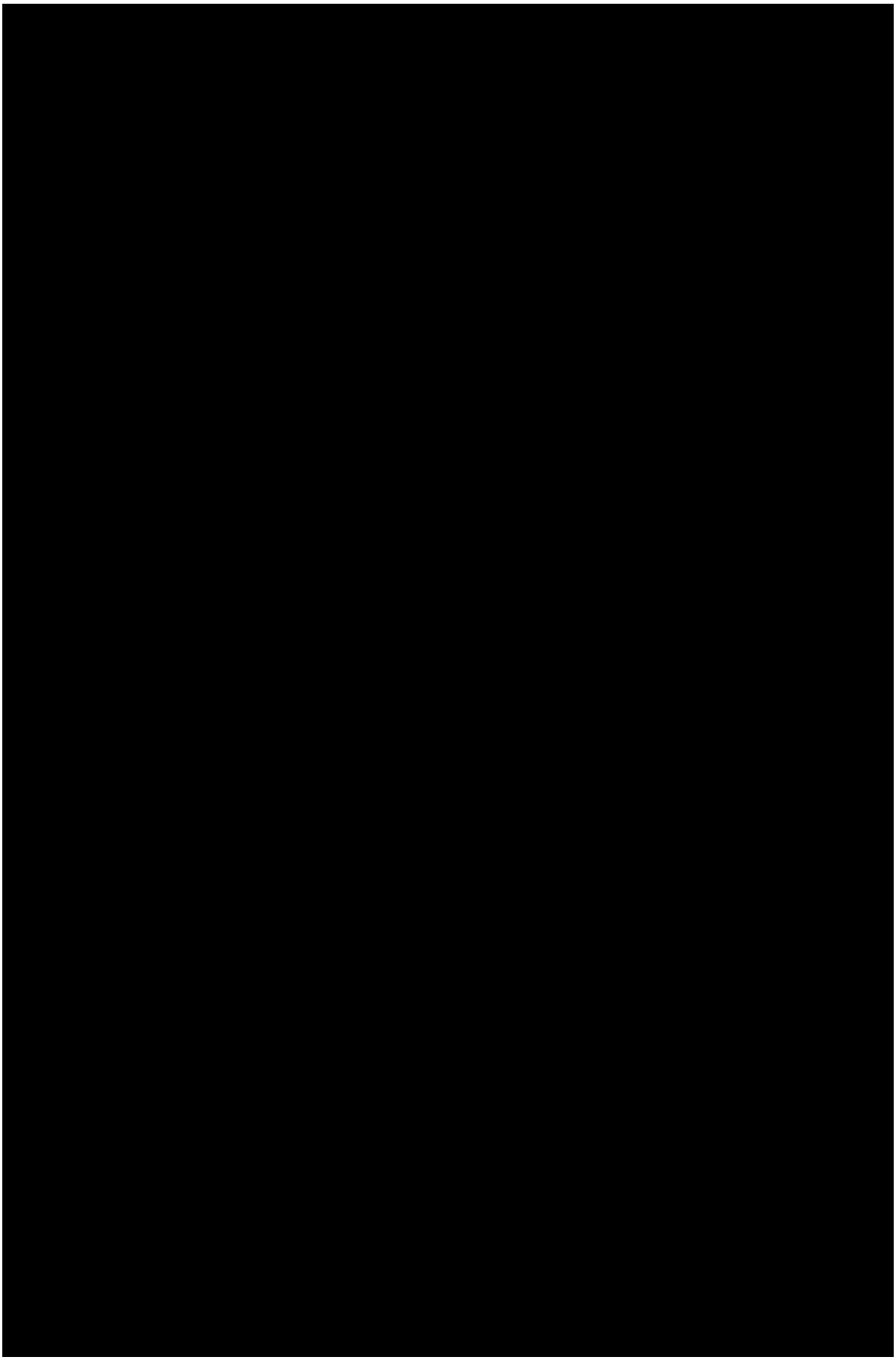


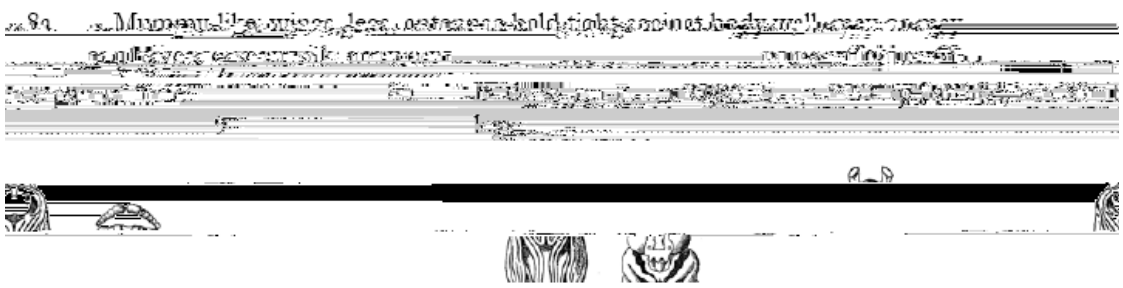
Procedure-

1)

Student Handout #2

3a. Wing buds present; not worm-like..... 4





11a. ...Worm-like body with a distinct head capsule and no structures on the end of the

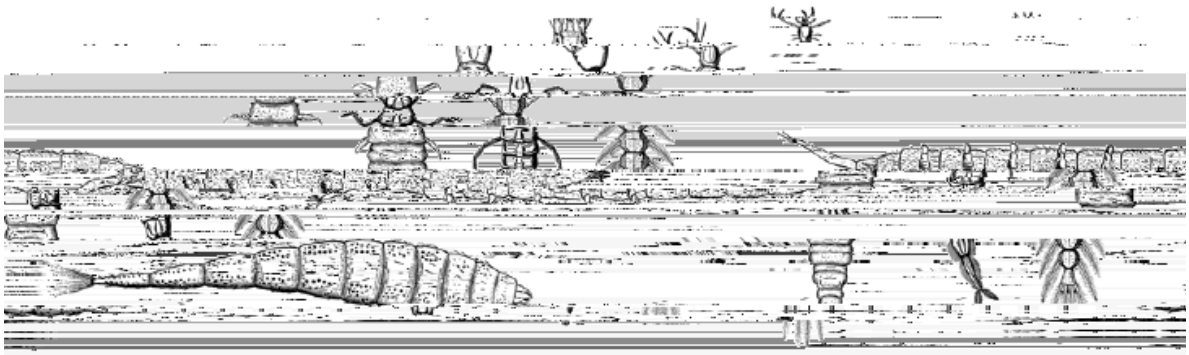


Figure 9.

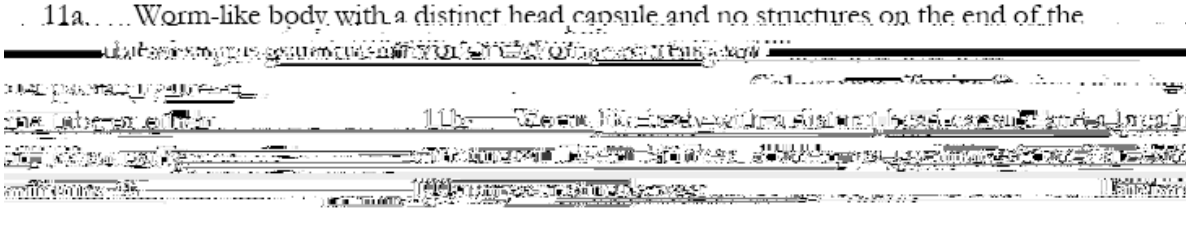
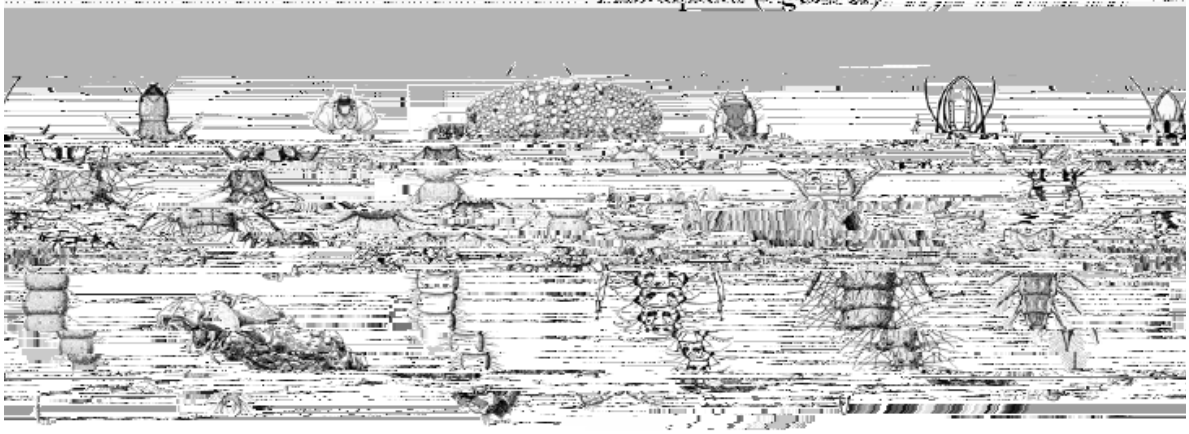


Figure 8.

Trichoptera (Figure 11)



Erosion: Causes & Effects

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!

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.

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!

Investigating Saratoga Lake Watershed!

Adapted from The GLOBE Program, 2005

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?

Saratoga Lake Watershed Survey

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

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

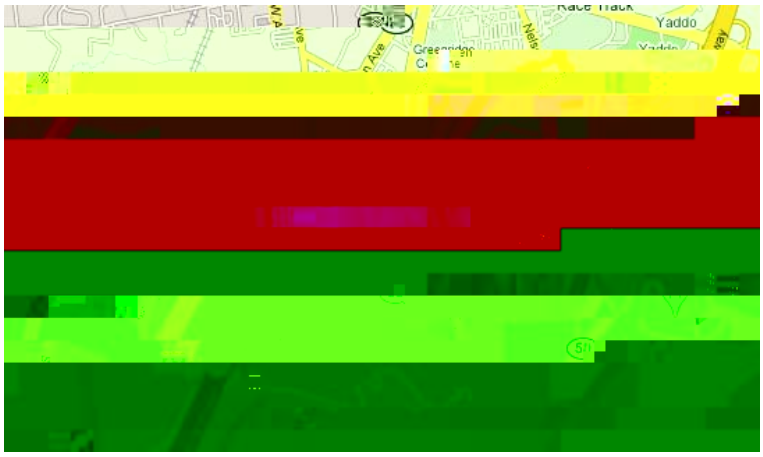
Watershed Factors	**What We Found**: Indicate what you found; be sure to include amounts where applicable	**What Could It Mean?** Possible problems or threats	**Why is it like this?** Possible causes of the problems or threats
Agricultural Crop Production Animal Grazing Manure Piles Other			
Residential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

Land Use Observations, cont.

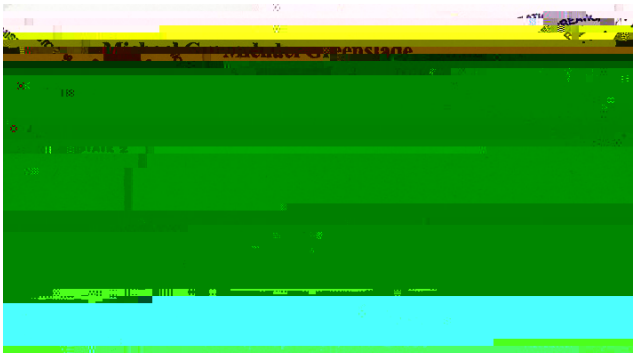
What We Found: Indicate what you found; be sure to include amounts where applicable	**What Could It Mean?** Possible problems or threats	**Why is it like this?** Possible causes of the

Saratoga Spa State Park-

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



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



Appendix 2- *The Daily Gazette*