Discovering the Pond in Our School's Backyard:
An Exploration of a Dover-Sherborn Wetland

A Place-Based Curriculum Unit

Elizabeth Friedman
Dover-Sherborn High School
Science Department

"A lake is the landscape's most beautiful and expressive feature.
It is Earth's eye; looking into which the beholder measures
the depth of his own nature."

-Henry David Thoreau
from the chapter "The Ponds" in Walden

Discovering the Pond in Our School's Backyard: An Exploration of a Dover-Sherborn Wetland

Elizabeth Friedman
Dover-Sherborn High School
Dover, Massachusetts
Submitted August 16, 2010

Subject: Environmental Research (an 11th and 12th grade Science Elective course)
Related subject(s): Biology, Chemistry, Art & Design, Social Studies, Writing

Lesson Title	Duration
1. Meeting the Pond: Introductions	2-3 55-minute class sessions
2. Getting to Know the Pond: Sit Spots	2 55-minute class sessions (followed by multiple independent student visits)
3. Getting to Know the Pond: Pond Succession	2 55-minute class sessions
4. Getting to Know the Pond: Bio-object Biographies	3 55-minute class sessions (followed by multiple independent student research sessions)
5. Getting to Know the Pond: Micro-fishing	2 55-minute class sessions
6. Getting to Know the Pond Better: Charles River Connections	2 55-minute class sessions (followed by multiple independent student research sessions)
7. Getting to Know the Pond Better: The Pond in Historical Context	2-3 55-minute class sessions (followed by multiple independent student research sessions)
8. Getting to Know the Pond Better: The Ecological Value of Wetlands	2 55-minute class sessions
9. Thanking the Pond: Final Site Visit & Pond Journal Construction	3-4 55-minute class sessions

The discoveries which we make abroad are special and particular;
those which we make at home are general and significant.
The further off, the nearer the surface. The nearer home, the deeper.
~Henry David Thoreau
Journal, 7 September 1851

Abstract of Curriculum Unit

This place-based curriculum unit explores a transitional pond/wetland ecosystem on the campus of Dover-Sherborn High School. The intention of this unit is to provide an opportunity for students to interact directly with nature using the pond/wetland as a focal point from which to learn about the pond/wetland, the towns of Dover and Sherborn, and themselves as individuals. Students will explore the scientific concepts of ecological succession, biodiversity, water quality, nutrient cycling, and conservation, while also working to enhance their observation, microscopy, analytical, interpretive, research, collaborative and critical thinking skills. This unit is inter-disciplinary in nature, as lessons incorporate aspects of creative and persuasive writing, social studies, art, literature, design, and naturalist philosophy in the words of Henry David Thoreau.

Reading Materials

Other than the one reading listed below, there are no formal reading assignments students need to complete for this unit. All reading materials are integrated into lessons in the form of independent research opportunities.

History of the Charles River and Watershed Facts (see Lesson #6 for document)

List of Equipment

Almost every lesson in this unit requires student use of computers with Internet access. All other materials are highly specific to the individual lessons, and are listed on the lessons themselves.

What are the natural features which make a township handsome?
A river, with its waterfalls and meadows, a lake, a hill, a cliff or individual rocks, a forest,
and ancient trees standing singly.
Such things are beautiful; they have a high use which dollars and cents never represent.
~Henry David Thoreau
Journal, 3 January 1861

Think of our life in nature,—daily to be shown matter, to come in contact with it,
— rocks, trees, wind on our cheeks!
The solid earth! the actual world! The common sense!
Contact! Contact! Who are we? Where are we?
~Henry David Thoreau
The Maine Woods

When learning is meaningful to students, it is more memorable. This unit strives to make learning meaningful and memorable for students by incorporating aspects of nature, individual reflection, inter-disciplinary study, and the genius of Henry David Thoreau.

In this unit, students will explore the pond/wetland on our school campus, a local natural resource that students probably don't even know about, to learn more about themselves as people, as well as science, and the history of the towns in which they live. Too often biology, environmental science, chemistry, social studies, art, writing, and literature are viewed as mutually exclusive subjects; divorced from each other and unrelated. The opposite could not be more true, and this unit will show students how integral these disciplines are to each other.

What better way to get students involved and invested in their learning than to take them outside? For any teacher that's ever heard "Can we go outside today?" from their students, this unit will help fulfill that request while also providing a rich opportunity for students to learn in an active, explorative, discovery-oriented manner. Likewise, what better way to get students interested in their learning than to teach from the place where they are growing up? For any teacher that's ever heard "How is this relevant to my life?" from their students, this unit will answer that question by instilling a respect for community, a "sense-of-place", and a "sense-of-self" for students.

Throughout this unit, Henry David Thoreau is used as a guide and inspiration to facilitate learning. So much of what Thoreau thought and wrote about is related to the ideas of embracing and respecting nature, being present in the moment, knowing and being true to yourself, and doing the right thing, no matter how hard or isolating that might be. Weaving Thoreau's timelessness and brilliance is my way of providing my students with a role model and a mentor.

In the true spirit of Henry David Thoreau, this unit also has a very pronounced conservation and civic responsibility message. By providing students the rich experience of working in nature; writing, reflecting, observing, and collecting data at our pond, it is my hope that students will learn to respect and appreciate the natural world more. When it comes to making conservation and eco-minded decisions, hopefully these students will draw upon this experience to help guide them towards sustainable and earth-friendly solutions. Similarly, by providing students the reflective experience of working with their town's history; researching, discussing, contemplating, and chronicling the past events of their local communities, it is my hope that students will learn to consider the past, present, and future human element of their environment more. When it comes to making social and civic decisions, hopefully these students will draw upon this experience to help guide them towards responsible, caring, and accepting solutions.

State Standards Addressed in this Unit:

Biology Content Standards: Massachusetts

1. The Chemistry of Life
Central Concept: Chemical elements form organic molecules that interact to perform the basic functions of life.

1.1 Recognize that biological organisms are composed primarily of very few elements. The six most common are C, H, N, O, P, and S.

5. Evolution and Biodiversity
Central Concepts: Evolution is the result of genetic changes that occur in constantly changing environments. Over many generations, changes in the genetic make-up of populations may affect biodiversity through speciation and extinction.

5.2 Describe species as reproductively distinct groups of organisms. Recognize that species are further classified into a hierarchical taxonomic system (kingdom, phylum, class, order, family, genus, species) based on morphological, behavioral, and molecular similarities. Describe the role that geographic isolation can play in speciation.

5.3 Explain how evolution through natural selection can result in changes in biodiversity through the increase or decrease of genetic diversity within a population.

6. Ecology
Central Concept: Ecology is the interaction among organisms and between organisms and their environment.

6.1 Explain how birth, death, immigration, and emigration influence population size.

6.2 Analyze changes in population size and biodiversity (speciation and extinction) that result from the following: natural causes, changes in climate, human activity, and the introduction of invasive, non-native species.

6.3 Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, mutualism) add to the complexity of biological communities.

6.4 Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen cycles through photosynthesis and respiration.

Scientific Inquiry Skills Standards: Massachusetts

SIS1. Make observations, raise questions, and formulate hypotheses.
SIS2. Design and conduct scientific investigations.
SIS3. Analyze and interpret results of scientific investigations.
SIS4. Communicate and apply the results of scientific investigations.

Massachusetts Science and Technology/Engineering Curriculum Framework (2006).

References

About Thoreau: A Brief Chronology. (n.d.). *The Walden Woods Project.* Retrieved from http://www.walden.org/Library/ About _Thoreau's_Life_and_Writings: _The_Research_Collections/ A_Brief_Chronology

Biology High School Learning Standards for a Full First-Year Course. (2006). *Massachusetts Science and Technology/Engineering Curriculum Framework.* Retrieved from http://www.doe.mass.edu/frameworks/scitech/1006.pdf

Burne, J. (2010) Personal communication.

Charles River History. (2008). *Charles River Watershed Association.* Retrieved from http://www.crwa.org/cr_history.html

Charles River Watershed. (2008). *Charles River Watershed Association.* Retrieved from http://www.crwa.org/watershed.html

Enger, E.D. & Smith, B.F. (2004). *Environmental Science: A Study of Interrelationships.* Boston: McGraw Hill.

Explore Walden Woods: Brister's Hill. (n.d.). *The Walden Woods Project.* Retrieved from http://www.walden.org/Explore/Walden_Woods_Ecosystem/Brister's_Hill

Forbes, H.M. (n.d.). *Fuller Forsyth, Charles River House, Charles River (Dover) Massachusetts.* Retrieved from http://www.americanantiquarian.org/images/forbes/000420-0267.jpg

Forbes, H.M. (1939). *William Bull's pig-pen on the Old Phipps Farm, Sherborn, Massachusetts.* Retrieved from http://www.americanantiquarian.org/images/forbes/000420-0482.jpg

Louv, R. (2005). *Last Child in the Woods: Saving Our Children From Nature Deficit Disorder.* Chapel Hill: Algonquin Books.

Pond Succession Mural. (2008). *Project WILD: Activity Guide.* Retrieved from http://www.bgci.org/files/Canada/english_docs/rbg_successionmural.pdf

Reese, J., Stelljes, L., and Zook, D. (2009). *Nature and Me: Explorations in Ecology.* Boston: sedGreen Boston University.

Shaughnessy, A.C. (2007a). *The History of Sherborn.* Retrieved from http://home.comcast.net/~edwperry/1974History.htm

Shaughnessy, A.C. (2007b). *A Guide to Sherborn.* Retrieved from http://home.comcast.net/~edwperry/1974Guide.htm

Thoreau, H.D. (1906). *The Writings of Henry David Thoreau.* Boston: Houghton Mifflin.

Vara, D.H. (2006). *Dover Days Gone By: The Cyber-Millenium Edition.* Retrieved from http://www.doverhistoricalsociety.org/documents/DoverDays_new/cyber_millenium/index.html

Wetland Metaphors. (2008). *Project WILD: Activity Guide.* Retrieved from http://www.bgci.org/files/Canada/english_docs/rbg_wetlandmetaphors.pdf

Zook, D. (2010) Personal communication.

Zook, D. ed. (1992). *The Microcosmos Curriculum Guide to Exploring Microbial Space.* Dubuque: Kendall/Hunt.

Elizabeth Friedman
Discovering the Pond in Our School's Backyard
Lesson #1
Meeting the Pond: Introductions
2-3 55-minute class sessions

Students will be "introduced" to the pond and will begin to explore this relatively unknown natural resource located in a seldom-visited part of the school campus. Students will begin to personally interact with the pond from sensory, imaginative, reflective, creative, and scientific perspectives. This lesson will provide the foundation for the rest of the lessons in this unit.

Objectives
Students familiarize themselves with the school pond.
Students utilize hearing skills and record nature sounds.
Students develop creative interview questions for the pond, using observation and imagination skills.
Students brainstorm and discuss science content that explains basic pond ecosystem processes and functioning.
Students reflect on their experiences to create a name for the school pond.

Materials
thermometer
waterproof field notebook
pH test strips
camera

Procedure

Day 1

1. (One day prior to the first pond visit, the teacher should inform the students that they are going on a mystery trip during the next class, and that they should wear comfortable shoes that can get messy.) When students arrive for class on the mystery trip day, the teacher should tell the students to bring a notebook and a pen, and then hand out some materials to random students: a thermometer, a waterproof field notebook, pH test strips, a camera etc. The teacher should refrain from telling students where they are going, and instead just lead students on the walk to the pond.
2. Once students and teacher arrive at the pond, ask the students where they are. It is important that this question is as divergent as possible, as students may not know what to call this water body because it is in such a late stage of succession. Ask students if they knew that this was here, and if they have ever spent time here before. Most students will probably say they have not been to this place before. Explain that for simplicity's sake, we will be referring to this water body as a pond,

and that as a class, we will be getting to know this pond very closely during this unit by visiting it multiple times.

3. Ask student with physical materials to show them, and allow students an opportunity to say why they think the teacher gave these objects to them. Students should ultimately realize that they should be collecting specific pieces of data and recording it in the field notebook, and that this should be done for every class visit made to the pond.
4. Break students into three groups. Each group will rotate through three stations. Even though students are in groups, some of the station activities should be completed alone. The stations should be spread around the pond, so that each group is distinct from the others. Allow students at least 10 minutes to complete each station activity. As the students are working independently, the teacher should circulate among the groups, taking pictures of students and answering questions.

Station 1 Shhhhh. Listen carefully. There are probably many sounds around you, and if you're quiet enough, you can hear them. If this pond had ears, what would it hear? Make a list of everything you think this pond is "hearing" right now, and another list for everything you predict this pond would "hear" when you're not around. This activity is to be completed individually and silently. Reese, Stelljes, and Zook. 2009.
Station 2 It would be so interesting if our pond could talk. Think about how much you could learn from this pond if you had a conversation with it! After observing our pond for a few minutes, write down at least 10 questions you would ask the pond if you had a chance to interview it. This activity is to be completed individually and silently. Reese, Stelljes, and Zook. 2009.
Station 3 What do you think is going into this pond? What do you think is coming out of this pond? Think about the basics of ecosystem function to make as comprehensive a list as possible: energy flow, nutrient cycling, the "SPONCH CaFe", and organism (both micro- and macro-life) interactions. This activity can be completed individually or with a partner, but should be done as quietly as possible.

5. Once students have finished all stations, the teacher should combine the three groups, and take a picture of the students with the pond before leading them back to the classroom. Written materials should be handed in before students leave for the day.
6. Homework assignment (see below)

Have you ever been to, or even swam in, Walden Pond in Concord, MA? This is where Henry David Thoreau spent time living in the woods, and what ultimatelty inspired him to write his famous book *Walden*. It is not known for sure, but people speculate that Walden Pond got its name from the fact that it is "walled in" by forest, or because the world "wald" means forest in German, and a German person might have "discovered" and then named the water body.

Today's visit to our school's pond might have been the first time you've spent at our school's special water resource. Based on your experiences today, think of an appropriate and relevant name for our school's pond. In writing, briefly explain and justify the relevancy of your choice.

Day 2

1. As students enter the classroom, the teacher will have selected "pond interview" questions displayed on the overhead, as well as selected "pond sounds". Once students are all present, anonymously share the different sounds and questions that people thought of and submitted, and discuss their significance as a class.
2. The teacher should then lead a whole class discussion to review the pond "in and out" lists as a way to review pertinent science content information. The teacher should be sure to explain all content connections to energy flow, nutrient cycling, the "SPONCH CaFe", and organism (both micro- and macro-life) interactions.
3. Before leaving class, the students should hand in their pond name and explanation ideas.

Follow-up activity:
After reviewing the suggested pond names, the teacher selects three of the best submissions for student review. The teacher should put the three pond names on a sheet of paper, and then read each pond name's explanation to the students, being sure to keep the names' suggesters anonymous. The students should than vote on their favorite name. Once tallied, the teacher should share the winner with the class.

This lesson was inspired by, and adapted from, the Nature and Me: Explorations in Ecology curriculum by Reese, Stelljes, and Zook.

Elizabeth Friedman
Discovering the Pond in Our School's Backyard
Lesson #2
Getting to Know the Pond: Sit Spots
2 55-minute class sessions (followed by multiple independent student visits)

Students will use the pond as a venue for quiet, relaxation, reflection and journal writing. In addition to being a thriving and vital local ecosystem, the pond is introduced to the students as a place for solitude, solace, and human emotional benefit.

Objectives
Students interpret a Thoreau quote
Students actively and directly interact with nature, and become more familiar with the pond in the process.
Students reflect on the pond, nature, and their lives.
Students write freely in a stream of consciousness style.

Procedure

Day 1

1. The teacher distributes a Thoreau quote to the students, and asks students to reflect and write freely about their interpretation of the quote. Students are to work on this reflection in class, and may finish it for homework if needed. Otherwise, reflections should be submitted at the end of class.

"A lake is the landscape's most beautiful and expressive feature.
It is Earth's eye; looking into which the beholder measures
the depth of his own nature."

-Henry David Thoreau
from the chapter "The Ponds" in Walden

Interpret this quote. What do you think Thoreau meant by this? What about a lake (or nature in general) would be able to teach a person about themselves?

To help prompt your thinking, consider the following questions:

Why do you think Thoreau considers a lake to be so beautiful and expressive? What does he mean by the "Earth's eye"? Why might "the beholder" be able to measure or acknowledge his nature by looking into a body of water? What is the significance of the word "depth" in this quote? "Nature"? "Expressive"? "Eye"?

Day 2

1. The teacher initiates a whole-class discussion on the Thoreau quote from the previous lesson. The teacher should ask the class: "How can lakes, or ponds, teach us about ourselves? What about ourselves can we learn from them?"
2. After students have shared their thoughts, the teacher should explain that we will be using our pond to explore ourselves by doing sit spot journals. The teacher should review the assignment (see below) with the students and then bring them out to the pond to pick a place to sit and reflect. Students have the rest of the class period to write, and must hand in their journal at the end of class. A few students should collect the pond-visit measurements for the field journal as well (air and water temps, water pH, weather, organisms present).

   Sit Spot Assignment:

What can nature teach us about ourselves?
How can sitting by our pond inspire our thinking, and our being?

The Sit Spot Journal Assignment

Throughout the school year, you will be reflecting and writing in nature, sitting in a specific spot. You don't have to write about nature per se, but instead, you should allow your observations (use all your senses except taste) to inspire your thinking. These resulting thoughts should be recorded in longhand, and turned in. This assignment does not need to follow a specific format (no formal introduction or conclusion needed), but should demonstrate a clear connection to nature and be insightful, thought-provoking, and original.

Today, and for the duration of this unit, the sit spot you choose should be near (but NOT in) the pond. Once this unit is complete, you may choose to continue using your pond sit spot for this assignment, or you may change your sit spot location to a place more meaningful to you (perhaps a different pond?)

Today, we will go as a class to complete our first independent sit spot journals. After this, however, your sit spot journal is to be completed on your own time, and a hand-written sit spot journal will be due every other Friday.

This lesson was inspired by, and adapted from, the lessons Thoreau Exercise and String Journal, both by Janet Burne.

Elizabeth Friedman
Discovering the Pond in Our School's Backyard
Lesson #3
Getting to Know the Pond: Pond Succession
2 55-minute class sessions

Succession is the gradual change of a natural landscape over time, as indicated by the predominant types of vegetation in that area. Ponds are subject to succession and will gradually turn from open freshwater bodies to wetlands to swamps to terrestrial land. This lesson explores how ponds change over time, and how the life near the water body changes with it.

Objectives
Students construct a succession timeline to track past and future changes in our school pond.
Students visualize a pond from a cross-section perspective, and illustrate the ecosystem from a horizontal plane.
Students relate the ecological concept of succession to famous Thoreau quotes.

Materials
pond photograph
forest photograph (should be same location as pond photograph)
4 x 6 index cards with Thoreau succession quotes on them
computers with Internet access and printers
butcher paper
crayons/markers/colored pencils

Procedure

Day 1

1. The teacher should show the students two photographs, one of a pond and one of a forest. Display the two pictures and state "I assert that these two photographs are of the same place." Ask students to agree or disagree with you, and explain why. The teacher should be mindful to not tell students that the photographs are indeed the same location taken at different times.
2. Hand out index cards with Thoreau quotes on them to select students and have students read them out loud to the class one at a time. Once the students have finished reading their quotes, ask students whether their opinion about the teacher's assertion of the photographs has changed and why. Ask students "How are the quotes related to the photographs? What do they both illustrate/describe?"

"I see in the open field … a few pitch pines springing up, from seeds blown from the wood a dozen or fifteen rods off … in a few years, if not disturbed, these seedlings will alter the face of nature here." Journal: 26 November 1860
"No wonder, then, that the white birch is so prevalent and characteristic a tree with us and that the seedling birches spring up every year on so many neglected spots, but especially where the surface has been cleared or burned." Faith in a Seed
"Every part of nature teaches that the passing away of one life is the making room for another. The oak dies down to the ground, leaving within its rind a rich virgin mould, which will impart a vigorous life to an infant forest. The pine leaves a sandy and sterile soil, the harder woods a strong and fruitful mould. So this constant abrasion and decay makes the soil of my future growth." Journal: 24 October 1837
"It is now one of those frosty hollows so common in Walden Woods, where little grows, sheep's fescue grass, sweet-fern, hazelnut bushes, and oak scrubs … At length I see a few birches and pines creeping into it, which at this rate in the course of a dozen years more will suggest a forest there." Journal: 26 October 1860

3. Once the concept of succession has been identified as the common thread between both the photographs and the quotes, review succession with the students. Students will probably remember primary and secondary succession from Biology class, but may not realize that succession occurs in freshwater ecosystems as well.
4. The teacher should lead the students to the pond. Once there, the teacher will provide the students with the following handout and included tasks. The teacher should be sure to check that students understand what a cross-section view is before beginning. The teacher should also have a few students collect and record the pond-visit data.

Our pond sits before you. Has it always looked like this? Will it always look like this?

Sketch a picture of our pond the way it looks to you right now, at this present moment. Be sure to include the pond's surrounding area.

Sketch a picture of what you imagine a cross-section (side-view) of our pond would look like right now, at this present moment. Be sure to include under the water and the pond's surrounding area.

Then, consider the following questions and circle your answer after each statement.
Do you think our pond will be here..... (Reese, Stelljes, and Zook. 2009)

.....next week?	YES	NO
.....next year?	YES	NO
.....in ten years?	YES	NO
.....in 100 years?	YES	NO
.....in 1000 years?	YES	NO

5. Once the students have finished the handout, ask students to arrange themselves into groups of 3. The students should share their sketches and decide on a representative to illustrate the "present" sketch (the teacher should be sure to check in with these sketches to be sure they are fairly accurate). The present sketch should sit in the middle of the other two students, with a student to the left of the present sketch and a student to the right of the present sketch. Once arranged, the students should collectively discuss what the pond might have looked like in the past, and what it may look like in the future. With guidance and input from their partners, the "past" and "future" students should sketch cross-sections that illustrate their predictions on the back of their handouts.
6. Once back in the classroom, students should hand in their sketches so the teacher can scan them into the computer and post the pictures online for completion of the following homework assignment.

Using the following links, research typical pond succession online.

http://www.mbgnet.net/fresh/lakes/index.htm
http://www.sabah.edu.my/csm07010/Form%204/pond.htm
https://www.msu.edu/~armstr81/GroupProject/pond_successoin.JPG

You may access other, reputable sites as well, but you should start with the ones provided to you here.

Access the scans of your group's pond succession cross-section sketches from your teacher's website. Compare your pond succession sketches with the images you saw online. How accurate were your predictions? Make any changes to your sketches to make them more accurate. Also, be sure to "narrate" what is happening the pond in each of the sketches. How can you account for the changes in the past, present, and future sketches? What has caused these changes?

Day 2

1. Students should arrange themselves into their trio groups. Students should compare their homework assignments and their narrative explanations of their past, present, and future pond sketches.
2. Once students arrive at an accepted conclusion, students will be given butcher paper and markers/crayons/colored pencils to construct a pond succession timeline. Working together, students will make a final draft color illustration of our pond at the following points in time: 500 years ago, 100 years ago, present day, 100 years from now, and 500 years from now. Students should be as detailed in their illustrations as possible, identifying at least 1 plant and 1 animal species they would expect at each snapshot. Timelines should be "autographed" by the creators, and will be displayed in the classroom throughout the unit.
3. If finished early, students may begin the following assignment (this should be completed for class the next day regardless of whether it was begun during class time).

"I have great faith in a seed."
~Henry David Thoreau

This quote comes from a lecture Thoreau gave titled *The Succession of Forest Trees.*

Explain what Thoreau meant by this statement. Why would he have included this statement in a lecture on succession? How is this quote connected to succession?

Draw upon the information you learned in our succession timeline activity to help you answer these questions, and be sure to include accurate scientific information in your discussion.

This lesson was inspired by, and adapted from, the lesson Pond Succession Mural by Project WILD. http://www.bgci.org/files/Canada/english_docs/rbg_successionmural.pdf

This lesson was inspired by, and adapted from the Nature and Me: Explorations in Ecology curriculum by Reese, Stelljes, and Zook.

All Thoreau quotes are from *The Writings of Henry David Thoreau* (1906).

Elizabeth Friedman
Discovering the Pond in Our School's Backyard
Lesson #4
Getting to Know the Pond: Bio-object Biographies
2 55-minute class sessions to initiate (followed by multiple independent student research sessions)
1 55-minute class session for presentations

Our pond is full of many different types of life, each with their own bio-stories or eco-biographies. Many of the life forms are recognizable to students, however, the details and ecological significance of these species is unknown. This lesson will introduce students to the details of our pond's macro-life (flora and fauna), providing a more comprehensive understanding of the pond's functioning.

Objectives
Students research a given bio-object to learn about the species the object originated from, and the specie's place in the overall pond ecosystem.
Students utilize print and Internet sources to find information about their bio-objects.
Students compile and organize pertinent content information into a written report.

Materials
various bio-objects (feathers, acorns, leaves, pine cones, lichens, snail shells, cattail reeds, dragonfly/damselfly wings, bracket fungi etc.)
large box
small manila envelopes
computers with Internet access and printers
various biodiversity textbooks, organism identification field guides, and pond habitat resource books
rulers, microscopes, hand lenses, micro-viewers, dissecting scopes, scale, colored pencils, blank paper

Procedure

Day 1

1. The teacher should place a large box on the front lab bench so that it's immediately visible to students upon entering the classroom.
2. Once all the students have arrived and settled in, the teacher should address the box, (if the students have not already done so) by saying "So...what's the story with the box?" Ask students to guess what might be inside. After a few student contributions, the teacher should walk around the classroom with the box, allowing students to pull an envelope out. Inside each envelope is a physical bio-object from the pond. Examples of bio-objects include (but are not limited to): feathers (different types), leaves (different types), acorns, lichens, snail shells, cattail reeds, dragonfly/damselfly wings, moss, bracket fungi, pine cones. All bio-objects should be collected from the pond and surrounding wetland/forest transition areas.

3. When all students have an envelope, ask students to open them up to reveal their bio-objects. Ask students to consider where they think all the objects could have come from. Accept multiple responses, and eventually guide students to the fact that all the objects came from the pond and surrounding terrestrial transitional areas. Explain project to students by reviewing student handout (see below). Once project goals are established, students have the rest of the period to make physical observations, measurements, and drawings of their bio-objects, as well as access the print resources provided in the room.

All life forms in nature have a story.....

What is the "story" of your object? What is its "eco-biography"?

In this activity, you and a partner will use various resources to tackle the central question above and write a journal report about your findings. Your nature object biography is developed through two interacting phases: direct exploration with your hands, eyes, a hand-lens, and your written expressions (notes and sketches), as well as an Internet web quest to find supplemental information about your object. Even though you should work with a partner to discuss ideas and provide assistance with your object, you will develop and write your own narrative. Feel free to turn in or scan in and digitize any of your sketches and/or other visuals/graphics to include as part of your final narrative.

To help focus your exploration, consider the following questions. These should be addressed in your notes and included in depth in your final narrative:

What are the origins and evolutions of the object when it was alive?
How might the object have gotten to be in the condition it is in now?
What is the specific function of the part that you have?
What are the physical dimensions (metrically) of the object you have and what might the dimensions be of the fully-grown living form?
What is this object's niche in its ecosystem? What services does it provide to other organisms?
To which other life forms is this object closely related? How?
What is a summary of this object's life cycle?
From a global ecology standpoint, how is this object significant to the earth? To humans?

STEPS:

1. Examine the object in the envelope provided (be sure to save the envelope and note the number). Observe the object closely with naked eye, hand lens, and dissecting scope provided. Describe, measure and sketch your object using rulers, scale, colored pencils etc. as needed and available. Record your observations, descriptions, and conjectures as to what your object is, your questions, and your interpretations.

2. Discuss with your partner. Exchange ideas, opinions, and knowledge. Your partner is to be used as a resource, but you will each complete your own project with separate, different objects.

3. Research your bio-object using the reference texts provided to gain a preliminary understanding of its biography.

4. Access a computer and using search engines like "Google", place in key words to get to websites that may be pertinent to your bio-object. Examine several of the sites, using the descriptions given. Criteria for this determination is not only which sites give the information/knowledge you seek, but those that are most credible. Criteria can include:

-.edu (University, researchers, labs), .org (Reputable, professional non-governmental organizations) .gov (Governmental organizations)
-Known scientific publications (National Geographic)
-Based at a research field station or laboratory
-Those sites that show specific bibliographic references using refereed journals in the literature
-Sites that appear to have accurate graphics and/or photographs
-Recently published or recently updated sites
-Sites connected or linked to a reputable science society; sites where the author(s) are identified and can be checked by you by going to that university web site, for example, and reading about the author(s)
-Useful websites to help you learn more about evaluating websites:

http://www.library.cornell.edu/olinuris/ref/research/webcrit.html
http://liblearn.osu.edu/tutor/les1/
http://www.quick.org.uk/menu.htm
http://www.cyberbee.com/guides.html

5. After exploring the various sites, you then come up with a "hot list". That is, those sites which you directly find to be the most helpful for tackling your essential question and subordinate questions. This "final" reference with a line or two description of what you are gaining from the site needs to be included in the bibliography of your eventual narrative. It should not be more than a half dozen sites. Be sure to document any images you use with the website as well.

Example: Someone who has what they think is a portion of a bivalve, like a clam, could end up with and access the following web sites to pursue the essential and subordinate questions.

http://www.assateague.com/nt-bival.html
Originated through a field station on the Maryland, USA coast, this site shows anatomical features of bivalves, including functional features. Its menu links to data on identification and niche.

http://www.ucmp.berkeley.edu/mologis/mollia.html
An established direct source for information on the ecology of mollusks and their global distribution.

6. Record and use the final sites to develop your content, focused on your essential question: "What is the story of my bio-object……its biography?" The various subordinate guiding questions should be used as a guide for the elaboration of the biography. Also, include your initial speculations…How did your initial thoughts about the biography of the object align with the information you obtained through your web research?

7. Develop the narrative. Be sure that it is thorough, addresses all necessary sub-questions, and is proofread and edited.

8. Be prepared to briefly present your bio-object and its biography to your classmates in a round-robin style of presentation.

Page 3 Bio-object assignment sheet

Day 2

1. Students continue to work with their bio-objects, using laptop computers to supplement their research.
2. Students have all period to research their objects and begin compiling their narratives. The rest of their research must take place outside of class, as no other class periods will be devoted to this project.

Day 3 (Presentation Day....should be scheduled at least one week from the last in-class research day)

1. Students pair up with their original partner and present the biographical information about their bio-object. It should take about 5 minutes/person.
2. When finished, students should move to their right so that they have a new partner, and they should repeat the biography presentation process. This should be repeated at least 2 more times, so that by the time the presentations are complete, they have biographical information about 4 total species (and objects). Encourage students to continue their bio-object presentations outside of class, especially if there is an object other than theirs that is of particular interest to them.
3. For homework, students should complete the following prompt:

You have been lucky enough to learn about the biographies of 4 other bio-objects from our transitional pond ecosystem. Write a reflection that explores:

1. How all of these organisms collectively contribute to the overall functioning and integrity of the pond.

2. How the pond would be impacted if one of these species was eliminated (hypothetically). What effect would the lack of this species have on the overall ecosystem? Identify the missing species.

This lesson was inspired by, and adapted from, the lesson Bio-objects by Doug Zook of Boston University.

Elizabeth Friedman
Discovering the Pond in Our School's Backyard
Lesson #5
Getting to Know the Pond: Micro-fishing
2 55-minute class sessions

Healthy pond water is **full** of life, most of it microscopic and therefore unseen by most people. When investigated under magnification, an entire world opens up within the pond ecosystem. Antony van Leeuwenhoek observed pond water under simple microscopes that he hand-made, and was surprised to realize the bio-diversity contained in a drop of water. Analysis of the bio-diversity and species identities of a water sample can also help determine the environmental health of a pond.

Objectives

1. Students differentiate between what is considered "healthy" water from a human and an ecosystem perspective.
2. Students reinforce their microscopy skills.
3. Students observe, sketch, and identify micro-organisms present in our pond water.
4. Students recognize the great diversity of micro-life in a typical body of freshwater.
5. Students analyze micro-organisms as bio-indicators of polluted versus unpolluted water.

Materials
1000 mL (or larger) beakers
clear pond water
murky pond water
thin, flexible wire
microscopes
microscope slides
cover slips
pipettes
pond micro-life field guides
water quality micro-organism, bio-indicator field guides
blank paper for sketching
colored pencils

Procedure

Day 1

1. The teacher will begin the lesson by having two samples of water on front lab bench for students to observe. One beaker will contain pond water that is murky, mucky, dark, and full of decomposed vegetation. The other beaker will contain pond water that is clear and devoid of any vegetation or sediment. The teacher should ask student to determine which sample of pond water they think is "healthier" as a natural,

freshwater pond ecosystem. The students will probably say the clear sample, but it is actually the "dirty" looking sample. The teacher and the students should discuss why (scientifically-ecologically) this is the case, and why this misconception exists. The teacher should notify the students that the "dirty" looking water is from our pond.

2. The teacher will then transition to the exploration activity by having students visit the pond to collect samples of our pond water (if the weather does not permit this field visit, the sample from the engagement can be used. If the weather does permit a field site visit, some students should record pond-visit data (temperature etc.).
3. Once the students return, all the pond water should be poured into a large jar.
4. Then, each student should get a microscope slide and wrap a thin, flexible piece of wire (fishing line can be used too) around one end. Pulling off a long thread of wire, the other end of the wire should be wrapped around the slide so that a long loop extends off the slide. Each student should go "micro-fishing" by submerging their slide in the pond water sample and hooking the wire to the top of the beaker. Slides should be left overnight to accumulate a wealth of diverse micro-life.

Day 2

1. Slides should be covered by a cover slip and placed on the microscope stage. Students are encouraged to explore their pond water sample and investigate the micro-world now exposed to them. After about 15-20 minutes of exploration, each student should begin sketching organisms of their selection. Each student must turn in detailed sketches of at least 5 organisms, as well as a total species count in one field of view. Using field guides, the students should try to identify the species they selected (at least the Kingdom and Phylum, if not Class, Order, Family, Genus and Species), and if they can identify their species, they should cross-check their species with a pond life field guide to see if their species indicate polluted or unpolluted water.
2. Using field guides, students will make a list (complete with sketches) of 5 micro-organism species that typically indicate unpolluted water, and 5 micro-organism species that typically indicate polluted water.
3. Students organize all content information and sketches, and turn them in.

This lesson was inspired by, and adapted from, the *Microcosmos* curriculum by Doug Zook of BU.

Elizabeth Friedman
Discovering the Pond in Our School's Backyard
Lesson #6
Getting to Know the Pond Better: Charles River Connections
2 55-minute class sessions, plus additional time outside of class for independent student work

Our pond is part of the Charles River watershed, and actually connects to the Charles River via a seasonal stream. Knowledge of the hydrologic cycle, including watersheds, aquifers, springs, and groundwater is vital to understanding our pond's overall place in the community as a local natural resource, as well as a feature of the local geography.

Objectives
Students learn about the geography and history of the Charles River.
Students relate the terms watershed, aquifer, water table, spring, and groundwater to the Charles River and our pond.
Students conduct web research the Charles River Watershed Association (CRWA).
Students summarize the conservation efforts of the CRWA in a written paper.

Materials
reading: History of the Charles River & Watershed Facts (see attached)
large, thick sponge
cookie sheet
computers with Internet access and printers

Procedure

Day 1

1. The teacher should distribute a handout with a series of 10 true or false statements (see attached). Students are to independently determine if each statement is true or false, and explain why. Students should have completed the History of the Charles River and Watershed Facts prior to this first class, and all of the true/false statements are included in the reading.
2. Once the students finish the t/f quiz, they should compare their answers with a partner. Then, the teacher should lead the class in a discussion to review the answers to the statements.
3. The teacher should then discuss with students how a single drop of water in our pond might have moved through a plant, fallen from the sky, been bonded together in a duck, traveled as a gas into the atmosphere, and/or moved down through the layers of the ground like in an elevator.
4. The teacher should then review the hydrologic cycle with the students to be sure they understand the movement of water through the biosphere, including bodies of water like our pond. The teacher should pay particular attention to describe the underground movement of water, highlighting the terms watershed, aquifer, water table, spring, and groundwater to the students.

5. To illustrate the concept of a watershed, the teacher should perform a demo with the sponge and cookie sheet, continually questioning students to guide them to the realization that the sponge represents the permeable layers of rock underground that hold water, while the cookie sheet represents the impermeable layer of rock that traps water and causes it to be stored.
6. Once the hydrologic cycle has been reviewed, the teacher should ask the students how our pond fits into this cycle, and the Charles River through the local geography.
7. Then, redirect students to question number 10 on the true/false statements handout, and ask students what "EPA" stands for, what they do. Most students will be quite familiar with this. Then ask students what "CRWA" stands for, and what they do. Many students will probably remember the meaning of the acronym from the homework reading, but they probably will not know the extent of this organization's involvement with the Charles River.
8. Introduce research assignment to students to discover the purpose of the CRWA, and allow students to spend the rest of the period working on this project.

How is our pond connected to the Charles River?
The CRWA: A Valuable Organization that Impacts our Pond

1. Access the Charles River Watershed Association website http://www.crwa.org
2. Spend some time (at least 15-20 minutes) just exploring the website
3. Provide a written summary of the CRWA that addresses the following key points
   a. Summary of the overall mission of the CRWA
   b. Overview of the water quality monitoring and water quality flagging projects
      i. Would you be willing to volunteer for the water quality monitoring project? Why or why not?
   c. Overview of the association's public education efforts
   d. Summary of 3 water conservation tips you as a resident of the Charles River watershed could do to help conserve water
   e. Explanation of how the efforts of the CRWA are interdisciplinary (provide 2 examples to illustrate your point)
   f. A overview/summary of the most interesting aspect of the CRWA to you, as presented on their website

Your summary should be organized into a 3 page paper (typed, double spaced, proofread). All information should be in your own words, be organized, and should thoroughly address the key points listed above.

Day 2 (does not have to be consecutive with Day 1, and should actually be about one week later so students have time to finish the assignment).

1. Students turn in their papers, and pair up to discuss their responses to their personal most interesting aspect of the CRWA.
2. Once all students have shared with their partners, the teacher should have students report their partner's opinion with the class, and the teacher should use this

opportunity to discuss the workings of the CRWA with the class. Special emphasis should be continually placed on how our pond is connected with the CRWA and the Charles River in general.

1. Because the Charles River travels from Hopkinton to Boston, the river is only 26 miles long.

2. Water in the Charles River is brownish in color because it passes through so many wetlands.

3. The Charles River only passes through 6 communities which significantly lessens the amount of political complexities inherent to the management of this watershed.

4. There dams that were constructed on the river in the 1800's were mostly used to generate power.

5. The dams on the river had no environmental impact on the river.

6. Charles Eliot was an influential proponent of the Charles River's conservation efforts.

7. Since Charles Eliot's efforts around the turn of the century, the Charles River has been clean and unpolluted.

8. Today, fish have returned to the Charles River and swimming is acceptable in most stretches of the river in dry weather.

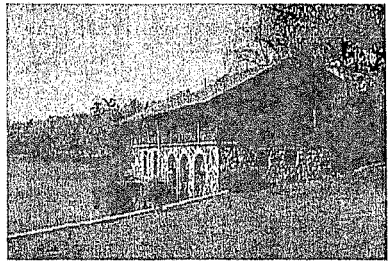
9. The Charles River's water quality rating was improved from a D to a C in 2003.

10. Both the CRWA and the EPA have been instrumental in improving the quality of the Charles River.

True / False Statements
Charles River History + Watershed Reading

History of the Charles River

Profile of the Charles River



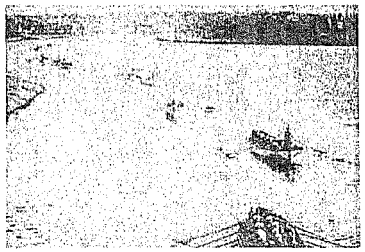
The Charles River is a small, relatively short river, draining a total land area of 308 square miles. Some 80 brooks and streams, and several major aquifers feed the Charles River. The watershed contains 33 lakes and ponds - most of them manmade. The river drops about 350 feet in its unhurried journey to the sea, flowing out to the very edges of its watershed at times. Boston marathoners race 26 miles from Hopkinton the Boston, but the Charles River twists and turns on an-80 mile course between the same points. Because of its meandering nature, the river flows through 23 communities, adding many political complexities to watershed management.

Lacking speed and force, the slow-moving Charles River will always be brownish in color, no matter how clean it becomes. River water literally steeps like tea through the abundant wetlands along its path.

From Water Route to Power Source

Prior to the last century, the Charles River was valued mostly for pragmatic purposes. Native Americans used the river for local transportation and fishing, and as a link in the route from southeastern Massachusetts to northern New England. Early European settlers harnessed the river for industrialization. As early as 1640, entrepreneurs on the Neponset River engineered a diversion of water from the Charles River to power their mills.

Over time, a total of 20 dams were built along the Charles River, mostly to generate power for industry. The dams slowed the flow of the Charles River, hampering the river's ability to cleanse itself with uninterrupted flow. They also flooded pastureland and haycutting areas, and cut off migratory fish from upstream reaches.



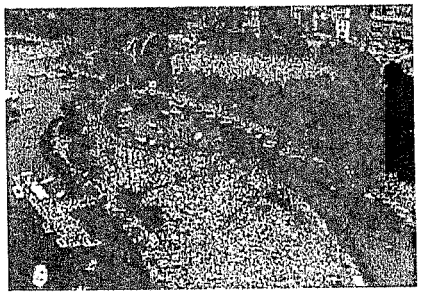
In some places, the dams created new stretches of shoreline, and expanded water and land habitat. The best example is the Lakes District where construction of the Moody Street Dam in 1814 to power cotton mills created a 200-acre "mill pond" with many lovely bays and inlets between Newton Lower Falls and Waltham. This scenic area

drew thousands of boaters from Norumbega Park around the turn of the 20th century. The premier social and recreational spot of its time, Norumbega featured several boathouses, canoe rentals and two steamboats that made trips through the Lakes District in the summertime.

Dams and mills, however, also brought pollution. Byproducts from mill processes were dumped into the river as well as waste from houses, roads, and settlements that built up around the mills. Fish populations, which had been abundant, disappeared. In 1875 a government report listed 43 mills along the 9.5-mile tidal estuary from Watertown Dam to Boston Harbor. The Charles River was so polluted from industrial and domestic wastes that the report recommended abandoning cleanup efforts on the river from south Natick (its midpoint) to the ocean, and focusing instead on the upper half.

Transformation of the Basin

Fortunately, visionaries like landscape architect Charles Eliot came to the rescue. He and others convinced political leaders to move industry back from the Lower Charles River, build a dam at the mouth to keep out tides, and finally in 1908 to turn the stinking tidal estuary into the man-made Charles River Basin. Now a world-famous metropolitan water park, it has replaced the Norumbega Park stretch of the river as a recreational mecca. The basin offers one of the world's largest public sailing programs, is home to several rowing and yacht clubs, and is the setting for a world-class rowing regatta, the Head of the Charles.



The Esplanade, 4th of July celebration

After significant improvements to the basin and its management in the early part of the 20th century, human activity continued to have a major impact on the Charles River with the construction in the 1930's of the Quabbin-to-Boston water supply system. This engineering feat fostered growth density in Metropolitan Boston that would not have been possible for a city dependent on local water supplies.

Fueled by this new, extensive water supply, the area grew faster than the capacity to

Charles River History + Watershed Reading
Page 1

treat domestic, municipal and industrial wastes. The Charles River's capability to cleanse itself was once again overwhelmed. By the mid-1960's the river was in sorry shape after several years of lower-than-average rainfall. Raw sewage flowed from outmoded wastewater treatment plants. Toxic discharges from industrial facilities colored the river pink and orange. Fish kills, submerged cars and appliances, leaching riverbank landfills, and obnoxious odors were routine occurrences.

Citizen Activists to the Rescue

The Charles River Watershed Association (CRWA) was formed in 1965 in response to increasing public concern about the environment and the declining condition of the Charles River. Since its earliest days of advocacy, CRWA has figured prominently in major cleanup and watershed protection efforts, working with other citizen groups and with local, state, and federal officials.

After the passage of the Clean Water Act in 1972, CRWA was successful in promoting construction of modern wastewater plants in the Upper Charles River, and strict limitations on industrial discharges into the river. CRWA advocacy also helped close landfills on the shoreline, and bring smaller polluting manufacturers into compliance. Cleanup efforts intensified in 1983 when Conservation Law Foundation sued federal and state officials to force the cleanup of Boston Harbor. Several billion dollars later, extensive sewer system improvements undertaken by the Massachusetts Water Resources Authority (MWRA) have significantly reduced regular raw sewage discharges into the Charles River, especially near Boston where it empties into the harbor.

Flood control was also an important focus in the 1980's. CRWA was instrumental in preserving 8,000 acres of wetlands under the U.S. Army Corps of Engineers Charles River Natural Valley Storage project. The wetlands prevent downstream flooding, provide extensive natural habitat, replenish water supplies, and filter out many pollutants.

On the Rebound

These initiatives over the past four decades have significantly improved water quality in the watershed and approaches to watershed management. Fish have returned to the river and 74% of the Charles River is suitable for swimming in dry weather. But serious challenges remain. Stormwater continues to seriously pollute the Charles River after heavy rainfall. And unchecked growth in the I495 corridor threatens regional fresh water supplies. CRWA is identifying and promoting long-term solutions to both problems.

With high growth rates in suburbs west of Boston, there is increased demand for public drinking water and/or expanded sewer systems - both of which jeopardize water levels in the Charles River. New public wells tap into aquifers that are already showing signs of stress - as evidenced by restrictions on water use in many suburban communities during the summer. In some towns that use watershed groundwater as their water source, the waste is transported it to the Deer Island treatment plant in Boston Harbor instead of being treated and discharged locally where it can be reabsorbed into aquifers that feed the Charles River. Using innovative computer models, CRWA is conducting a comprehensive analysis of interactions in the watershed so that it can help communities anticipate the long-term impact of development on water supplies. CRWA is advising towns about demand management, conservation, wastewater treatment, land use, and building plans that minimize impact on the watershed.

In addition, CRWA remains committed to reducing point sources of pollution, a major component of US Environmental Protection Agency's (EPA) Clean Charles 2005 initiative. CRWA is working with EPA to implement innovative features in the federal permitting process that will further upgrade wastewater treatment at plants on the river to reduce discharged pollutants. The association is monitoring water quality in the Charles River Basin and measuring the decline in bacterial contamination as the MWRA implements a ten-year capital improvement project to minimize sewage overflows into the river during storms. CRWA also supports EPA's efforts to eliminate illegal hookups of sanitary sewers into stormdrains. We identify pollution "hotspots" through our year-round water quality monitoring program at 37 sites along the river and report them, when necessary, to the state Department of Environmental Management's Strike Force.

Lastly, CRWA promotes methods to abate non-point sources of pollution such as runoff from paved areas and shoreline erosion. Rain water falling on pavement and compacted lawns carries pesticides, herbicides, fertilizer, animal feces, oil, grease, metals, salt, sediments, pet waste and more into stormdrain systems that discharge into the Charles River. In the Lower Charles River, CRWA-designed demonstration projects on Boston University's campus are showing how "best management practices" can slow down and cleanup stormwater before it is discharged into the river. In the Upper Charles River, CRWA has embarked on a similar project in Bellingham in cooperation with American National Power.

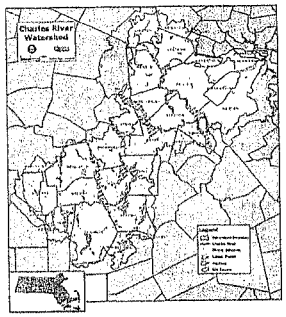
The Balancing Act

In general, CRWA urges that decisions about water quality and usage be based on the watershed as a whole. The organization's goal is to promote watershed management designed to leave the river's natural systems healthy enough to withstand the effects of continuous withdrawals and discharges, and non-point pollution. A healthy river must also be resilient enough to recover from unpredictable shocks from natural events like floods and droughts, and from human-caused spills and accidents.

What is a watershed | Watershed Map and Facts

Charles River History + Watershed Reading
Page 2

Charles River Watershed Facts

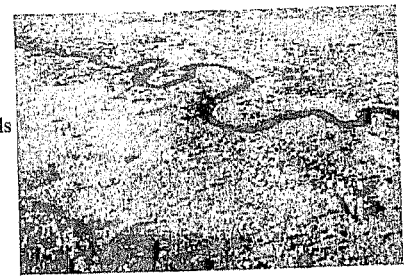


Click image for larger view.

- The Charles River is 80 miles long and flows through eastern Massachusetts.
- The Charles River flows through 23 towns and cities, and 35 towns and cities comprise its watershed. A watershed is the area that drains into a river, lake or harbor. All land surface is in some watershed because all runoff goes somewhere.
- The Charles River is swimmable much of the year, along much of its length. People can and do swim in the Charles.
- The Charles River has 20 dams along its length.
- The Charles River drains an area 308 square miles (its watershed).
- The Charles River drops approximately 350 feet as it travels to the sea.
- There are 20 species of fish found in the Charles River, including two species of River Herring (Alewife and Blueback Herring) that are anadromous (migratory) and swim upriver from the sea to spawn (lay eggs) each spring. These fish must climb a series of fish ladders set up at each of the lower 5 dams on the river.
- Boats seen on the Charles River: power boats, sailboats, sculls and other rowing shells, wind surfers, canoes, kayaks, peddle-powered boats, solar-powered boats, boats made of recycled materials, rafts, inner tubes.
- More than 8,000 acres of wetlands in the Charles River Watershed have been protected forever from development as part of the Natural Valley Storage Project undertaken by the US Army Corps of Engineers.
- The Esplanade, part of the MA Department of Conservation and Recreation's Charles River Reservation, hosts more visitors than any other riverfront park in the nation.

What is a watershed | Charles River History | CRWA Home

What is a Watershed?



A watershed is an area of land that drains to a river, lake, or harbor. Hills organize the land into watersheds. When rainwater hits the ground, ridges channel runoff and groundwater (water that has soaked into the ground) to water bodies, which are replenished. All land surface is in some watershed because all runoff and groundwater goes somewhere.

Watersheds do not conform to political boundaries, so often it does not make sense to focus on a portion of the river that lies within a particular city or county. CRWA strives to protect the Charles River by promoting cooperation between diverse organizations, communities and levels of government.

Massachusetts has 28 distinct watersheds that feed six larger river basins. The Connecticut River drains nearly one third of the state - the land between the peaks of the Berkshires and the Worcester Plateau. The Housatonic River and its tributaries drains most of the land west of the Berkshires. East of the Worcester Plateau, watersheds feed the Charles River, the Merrimack River, and many smaller rivers that that ultimately make their way to the coast.

Everyone has a watershed address. One easy way to determine which watershed you live in is to visit the EPA's Surf Your Watershed website at www.epa.gov/surf3.

Watershed Map and Facts | Charles River History

Charles River History + Watershed Reading
Page 3.

Elizabeth Friedman
Discovering the Pond in Our School's Backyard
Lesson #7
Getting to Know the Pond Better: The Pond in Historical Context
2-3 55-minute class sessions, plus additional time outside of class for independent student research

The towns of Dover and Sherborn have an interesting and rich history. Many connections can be made between these towns' history and the land, as agriculture, milling, river ice harvesting, and dairy farming were dominant livelihoods in the 19th century. Many specific historical connections can be made to the water bodies of these towns as well, indicating the value of these natural water resources to the historical humans who depended on them.

Objectives
Students observe old photographs to gain insight into how 19th century Dover and Sherborn residents lived.
Students research the history of Dover and Sherborn using local town resources.
Students connect historical life to the water bodies of Dover and Sherborn.
Students predict the role of our pond in historical context.
Students reconstruct the history of their town during the mid-1800's.

Materials
old photographs: blown up to 5 x 7 and laminated
computers with Internet access and printers

Procedure

Day 1

1. Arrange desks so that students are sitting across from each other in pairs. Once all students are situated, begin passing old photographs to the students that they can observe and analyze with their partners. The photographs should not have any writing on them, and the teacher should be mindful not to tell the students what or when the photographs are from. Once the students have had a chance to look at all the photos and make speculations about them (about 15 total) the teacher should say "We all have an intimate connection to these photographs. What is the connection?" The teacher should guide the students to the realization that they are all from the towns of Dover and Sherborn, and further, that water is important to each of the activities taking place in them.
2. Once the discussion is complete, the teacher should give one photograph to each student. This photograph is the basis for their assignment, and will provide them with a snapshot of Dover or Sherborn town history (see student handout below). The students have the rest of the period to begin their research using the Internet and the resources provided to them. The teacher should tell students individually which town

(Dover or Sherborn) their photos are from, and should try to provide students that live in Dover with Dover photos and likewise with Sherborn.

3. Students should be prepared to present their photograph to the class in context. Students should be sure to explain how the picture relates to Dover or Sherborn town history, and most importantly, how the photograph depicts the intimate connection and reliance humans had on their local water resources.

Your Historical Photograph: A Snapshot Into the Past

You have been given a photograph of either Dover or Sherborn from the past. Your job is to investigate the general historical context and significance of this photograph, and more specifically how the photograph illustrates the intimate connection and reliance humans had on their local water resources (like our pond!). You will organize all information into a PowerPoint presentation, and you should be prepared to give a 5-7 minute presentation to the class in one week.

You should answer the following questions in your presentation (and therefore begin researching):
What does the photo depict?
Who is in it?
Is this a typical activity/event/occurrence for the time?
What is the importance of this photograph to the overall town of either Dover or Sherborn?
What is the overall contribution the activity in this photograph makes to the town?
When is the photo from (try to be as specific as possible, but if you cannot narrow it down to a specific year, a general timeframe is ok)?
What connection to local water resources is shown in your photograph? Be specific...if you know the name of the water body, include it.

You may want to try using the following resources to help you get started; they all have websites. However, please don't rely solely on the Internet. You will definitely have to go to the library, Town Hall, and the Historical Society to actually speak with Dover and Sherborn history experts. Please be mindful of the hours of these resources, and do NOT leave this project until the last minute. Connecting with people is necessary for this project, and you should expect to communicate personally with community members. Perhaps even your parents or grandparents can provide some insight!

Dover Town Library
Sherborn Town Library
Westwood and Dedham Town Libraries (Dover photos: why would I include these? hmmm)
Holliston and Framingham Town Libraries (Sherborn photos: why would I include these? hmmm)
Dover Town Hall
Sherborn Town Hall
Dover Historical Society (also Westwood and Dedham Historical Societies)
Sherborn Historical Society (also Holliston and Framingham Historical Societies)

Day 2 (at least one week after the initial assignment day)

1. Students come to class with their presentations prepared. All Dover photograph researchers should get together in one group, and all Sherborn photograph researchers should get together in another group. Together the groups should figure out the chronology of the photos....which photo is from the most distant past? Which is the most recent? The chronology of the photos will dictate the order of presentations, starting with the town with the oldest incorporation date (students should realize that this is Sherborn!).
2. For homework, ask students to reflect on the historical information from the presentations and identify commonalities among their historical contexts and connection to water resources.

Day 3

1. Once all presentations are complete, the teacher should initiate a discussion about the commonalities among the photographs, especially in terms of water usage and local natural water resources (this might carry over to another class session). Ask the students whether they think the early residents of Dover and Sherborn would have been so successful if they didn't have water bodies, like our pond?
2. Ask students to speculate about what our pond might have been used for, given that it was surrounded by farm land. Give students a chance to develop a possible scenario for the past of our pond (perhaps allow students to go to the pond to brainstorm scenario ideas). Together with a partner, students should draw a "snapshot" of the pond and their proposed scenario, from a time in the past (they can decide on the year). Students will have learned enough about local history through the presentations to be able to complete this in-class assignment. Once complete, students
3. Give students a chance to explore more of the history of Dover and Sherborn by providing the following homework assignment.

Henry David Thoreau lived from 1817-1862, and spent two years (1845-1847) living at Walden Pond in Concord, MA. Concord is well known today for all the exciting people that lived and events that took place during Thoreau's lifetime, but many exciting things were occurring in the towns of Dover and Sherborn during this point of history as well.

We have already "seen" what our pond was like 100+ years ago, but what was the rest of the community like? In this activity, you will explore the history of either Dover or Sherborn (depending on which town you live in) to learn more about the roots of your community. Imagine that you are a resident of either Dover or Sherborn during the 1800's. What were the main events that occurred during your lifetime?

You may either.....

1. Research and report on events occurring in your town between 1817 and 1862. If you choose this option, you will briefly report (about 3 sentences per event) on many different events (at least 15 separate occurrences) that you find particularly interesting. At least 3 of your events should involve and/or be connected to local ponds (maybe even OUR pond?), lakes, streams, and/or rivers.

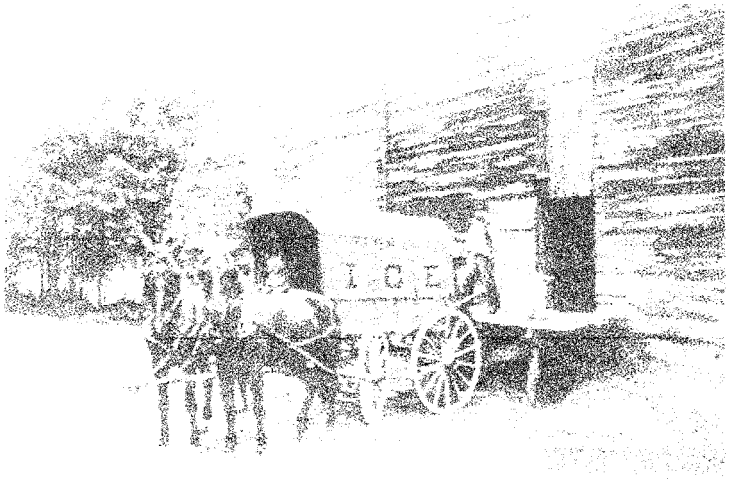
2. Research and report on events occurring in your town between 1845-1847. If you choose this option, you will prepare a detailed narrative (about 100 words) for three events that took place during this timeframe that you find particularly interesting. At least 1 of your events should involve and/or be connected to local ponds (maybe even OUR pond?), lakes, streams, and/or rivers.

Regardless of which option you choose, you will organize the historical information into a journal, like Henry David Thoreau's. Your writing should be done in first person, since you are traveling back in time and therefore writing about events taking place in your "lifetime"!

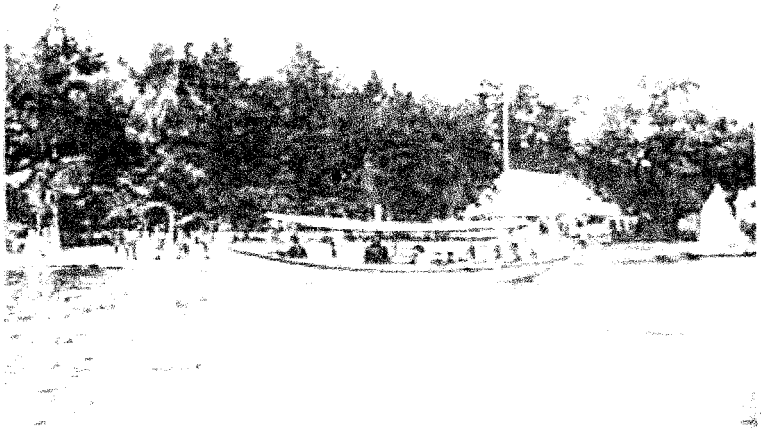
Sample photographs for Day 1 engagement activity

The History of Sherborn by Shaughnessy

The History of Sherborn by Shaughnessy



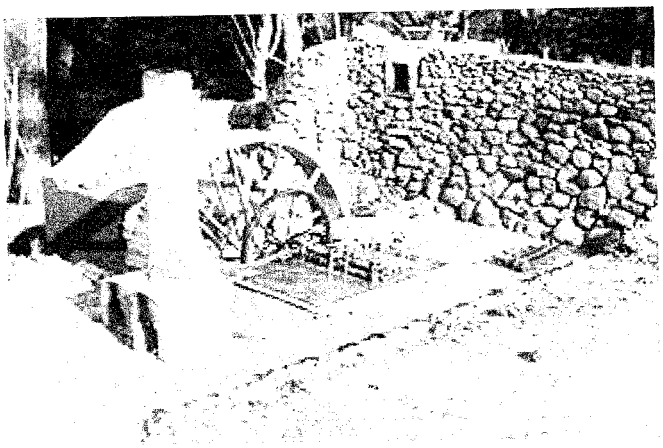
The History of Sherborn by Shaughnessy



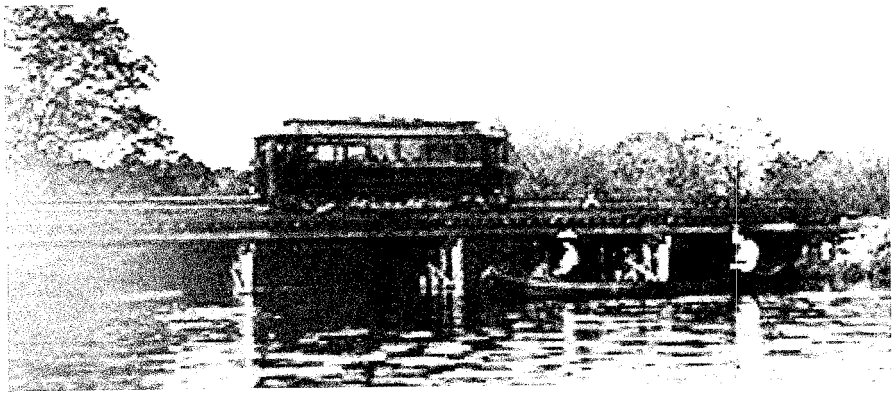
The History of Sherborn by Shaughnessy

American Antiquarian Society

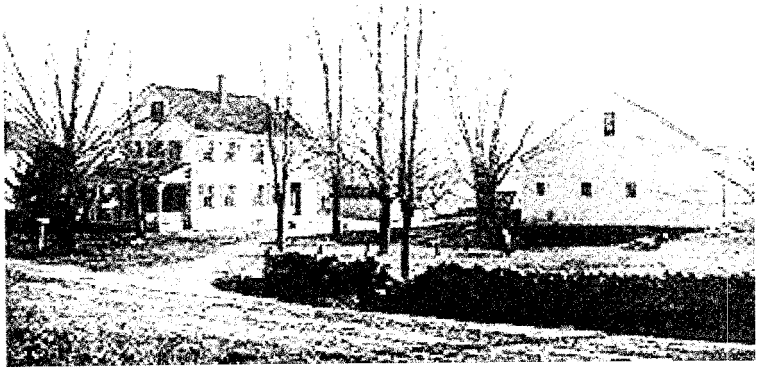
American Antiquarian Society



Dover Historical Society



Dover Historical Society



Dover Historical Society

The History of Sherborn by Shaughnessy

Elizabeth Friedman
Discovering the Pond in Our School's Backyard
Lesson #8
Getting to Know the Pond Better: The Ecological Value of Wetlands
2 55-minute class sessions

Our school pond is currently in a late stage of succession, and could be characterized as a freshwater wetland. Wetlands are extremely valuable, productive, and diverse ecosystems that perform many vital and beneficial functions and services for surrounding ecosystems. Unfortunately, however, wetlands are also negatively impacted by man on a regular basis. The immense value of wetlands should be considered for land use and conservation decisions.

Objectives
Students explain the function and value of wetlands by analyzing physical objects.
Students utilize critical, creative, and collaborative thinking skills to interpret metaphors.
Students apply their knowledge of wetland function to guide land use and conservation decisions.

Materials
pillowcase to serve as a bag
sieve/strainer
travel-size box of cereal
sponge
small pillow
soap
eggbeater/mixer
small doll cradle
paper coffee filter
antacid tablets
Ecology textbooks
Computers with Internet access and printers

Procedure

Day 1

1. The teacher should bring all the students out to the pond (field-site data should be taken), bringing the bag of "metaphorical objects". Once at the pond, the teacher should arrange students into pairs, and allow pairs to select one object from the bag. The objects include: sieve/strainer, travel-size box of cereal, sponge, small pillow, soap, eggbeater/mixer, small doll cradle, paper coffee filter, and antacid tablets. The teacher should allow the students to observe the other objects the students pulled out of the bag. The teacher should then ask the students what the significance and connection of all the objects (collectively) is. As a hint, the teacher might suggest that students think about the stage of succession, and therefore age, of the pond, and if

it's actually even appropriate to refer to it as a pond anymore. The teacher should help guide the students to the fact that each object represents one major function, and ecosystem service, of a wetland.

2. Student pairs should then work together to brainstorm the details of how their object represents a wetland function/service. Students should record their ideas to check later against resources.
3. Once students have a substantial list of ideas recorded, the teacher should bring the students back to the classroom to check their ideas against reliable wetland resources provided (textbooks, Internet).
4. Together, the students should bullet point the ecosystem service/function their object represents on a piece of paper to be used in the next day's follow up activity. Both the function list and the object should be turned in at the end of class, and should be checked by the teacher before use in the next day's lesson.

Day 2

1. When the students arrive at class the next day, all objects and bulleted lists will be exhibited on the lab bench in the back of the classroom. On the board will be written the questions "What is the ecosystem value of wetlands? What functions/services do they perform?" Students should be instructed to write these questions as a heading in their notebooks.
2. Students, traveling in pairs, should rotate through the object stations, discussing the objects and information at each exhibit, and taking notes for future use. Students should be allowed to spend about 5-7 minutes at each exhibit.
3. Once complete, the students should obtain and respond to the following prompt (to be finished as homework if not completed in class).

Imagine that a real-estate developer has approached the Dover-Sherborn School Committee about buying our pond and the land adjacent to it to develop an apartment complex, stating that this wetland is actually just wasteland.

Horrified for many reasons, you decide to attend the next School Committee meeting to protest this proposal. Because you have such limited time to speak before the Committee, you decide to focus on the value of wetland natural functioning to the health of surrounding ecosystems, like our school grounds!

From this perspective, what will you say in your argument to SAVE OUR POND? Be sure to identify and describe at least 3 functions/services of wetlands in your "speech".

This lesson was inspired by, and adapted from, the lesson Wetland Metaphors by Project WILD.
http://www.bgci.org/files/Canada/english_docs/rbg_wetlandmetaphors.pdf

Elizabeth Friedman
Discovering the Pond in Our School's Backyard
Lesson #9
Thanking the Pond: Final Site Visit & Pond Journal Construction
3-4 55-minute class sessions

This lesson serves as the final site visit and formal culminating activities in the Pond unit. Throughout this unit, students have had many direct and indirect experiences with the pond, including multiple site visits. In this lesson, students will say goodbye to the pond by thanking it, and will also design and construct a field journal/memory book of their class' experience with this unit and the pond itself.

Objectives
Students synthesize a thank you and goodbye letter to the pond by reflecting on their experiences during this unit.
Students collaborate to design and develop a field journal/memory book dedicated to the pond that incorporates and summarizes all aspects of the unit.

Materials
computer with Internet access and color printers
samples of student work from this unit
digital camera
digital photographs of students from unit
pond-visit field data collected from all pond site visits

Procedure

Day 1

1. Bring students to the pond for their last formal site visit, and instruct them to bring their binders with all pond unit materials in it. Review student assignment (on handout below) with students, and then ask them to go to their pond site sit spots and complete the activity. Students have all period to do this activity, and should rewrite (in longhand) their letter for homework and bring it to class tomorrow.

Thank you, pond!

You have spent a lot of time with our pond during this unit. You are now pretty much an expert on this pond. You should be proud of yourself; knowing so much about one specific place is quite an extraordinary accomplishment.

Think back to the different activities we've done throughout this unit. Use your notebook to help guide and inspire you, and refresh your memory. Once you have done this, make a list below of all the reasons you should thank our pond. Think about the things this pond has done for you, or helped you with, throughout this unit. Some of these things may be really general (the pond made you go outside and spend time in nature more) or they may be more general (the pond allowed you to visit the Historical Society and meet interesting history buffs in your community), or maybe a combination of both!

Reasons to thank our pond:

Once you have completed your list, write a thank you letter to our pond to let it know how much you appreciate it!

Dear _____ ,

Sincerely,

_____

Handout adapted from Thank You, Tree! by Reese, Stelljes and Zook, 2009. Nature and Me: Explorations in Ecology, pages 121-122.

Day 2

1. When students arrive, ask students to pull out their pond unit notebooks, and specifically their thank you letters. Ask students to each read their favorite reason for thanking the pond, or one of their favorite sentences from their thank you letters.
2. After students have finished, tell them that they will be constructing a summative field journal/memory book of the unit and their experiences with the pond. Ask students to brainstorm what they think should be included in this book, using their notebooks as guides. As the students make contributions, the teacher should record all ideas on the board.
3. Once ideas have been exhausted, ask students if any of the ideas can be grouped together to consolidate them. Students should have at least the following categories to include in the book: cover page, dedication page, sounds of the pond, questions to ask the pond (at least one from each student), all pond-visit field data, photographs, pond/wetland ecosystem functioning (including a summary of the ins/outs of the pond, it's functions/values, and a succession timeline/explanation/sketch), favorite sit-spot journal quotes (at least one from each student), pond bio-diversity sketches, Charles River connections, local town history connections, relevant, applicable, and appropriate Henry David Thoreau quotes, and favorite thank-you letter quotes (at least one from each student).
4. Once categories have been established, students should brainstorm the organization of the book, and develop a layout scheme to focus book production efforts.
5. Then, students should break into committees to begin compiling all the information/ materials/samples of student work/photos etc. and start producing the book with the teacher's assistance.

Days 3-4

1. Students should continue to produce, and ultimately complete, their portions of the book with assistance from the teacher. Once finished, students should e-mail their final draft "chapter" of the book to the teacher for final edits and assembly.
2. The teacher should have multiple color copies of the book professionally made, and bound to preserve it for future viewing and use.

Follow-up activity: Have students make invitations for the administration and faculty to come and meet their pond, and see the outcomes of the pond unit. Have students lead participants to the pond, and have students explain the various aspects of the unit to the new visitors. Have the students present a copy of the book to the administration as a thank you for allowing them to do this unit, and for continuing to protect this resource on school property. If the weather does not cooperate for a pond visit, students can display their outcomes in the classroom, and present the book to the administration there.

This lesson is inspired by, and adapted from the Nature and Me: Explorations in Ecology curriculum by Reese, Stelljes and Zook, as well as by the Thoreau Exercise lesson by Janet Burne.