

Vernal Pool



**Sawyer School
Bolton, Massachusetts**

Subject Area
Interdisciplinary

Area of Service
Environmental

Grade Level
Middle and High School

Author of Project
Bonnie Potter
email:
bpotter@ma.ultranet.com

Collaborators
Larry Isomaki

In Brief

On the first rainy night in spring, students, teachers and community members appear with wading boots and flashlights to observe the salamanders begin their mating rituals in the vernal pools of Bolton. "Big Night" is the highly anticipated activity in students' efforts to collect necessary information regarding the study and certification of vernal pools. Time is of the essence as communities like Bolton hurry to protect their fragile environmental habitats from encroaching development. Knowing the attitudes and resources relative to conservation in your community will help in understanding how to best organize a vernal pool certification project.

Learner Outcomes

Students learn to:

- Use mapping skills to document vernal pools;
- Collect scientific data;
- Identify vernal pools (flora, fauna);
- Understand life cycles of vernal pool inhabitants;
- Present their observations—written, verbal and visual; and
- Advocate for protection of community natural resources.

MASSACHUSETTS CURRICULUM FRAMEWORK CONNECTIONS



This unit is aligned with the Massachusetts Curriculum Frameworks. Listed are the subject areas and the learning strands addressed:

Science & Technology

Inquiry Strand: 1

Domains of Science Strand: 2

Science, Technology and Human Affairs Strand: 4

Mathematics

Number Sense Strand 1

Patterns, Relations and Functions Strand 2

Geometry and Measurement Strand 3

Statistics and Probability Strand 4

History and Social Science

Geography Strand: 4, 6

Arts

Connecting & Contributing Strand: 6, 7

OVERVIEW

The Need

Bolton is a small community of approximately 20 square miles in east-central Massachusetts. In Bolton the study and certification of vernal pools is a perfect vehicle for connecting community needs for land and species protection with learning at the Florence Sawyer School, a K-8 elementary school. Historically there has been strong support in the community for purchasing open space and protecting the town's natural resources. Because of this prevailing attitude, community service-learning projects with an environmental focus have been especially successful, and enjoyed strong support from community volunteers. The geologic history of Bolton is rich as evidenced by its glacial till soils, exposed striated bedrock, ground moraines, drumlins, and other physical characteristics. This glacial action produced many depressions such as kettleholes, which were left behind to form what are now called vernal pools.

What are vernal pools anyway? Vernal pools are contained basin depressions generally holding water for at least two months in the spring and summer and supporting the activities of amphibian and invertebrate species. "Vernal" means "spring" in Latin so these pools are filled with spring snow melt and spring rains, usually drying up by late summer. Certification is becoming an increasingly important activity because of the habitat destruction many communities are faced with today. Students can play an important role in supporting local conservation commission's efforts to certify as many vernal pools as possible in their towns.

Students have an innate curiosity and fascination with vernal pools. The certification process provides a meaningful context for students to develop a variety of skills while gaining a deeper understanding of the challenges around the protection of our natural resources."

Bonnie Potter,
Environmental Educator



Students documenting and observing Vernal Pool activity.

Cover Excerpt from Wicked Big Puddles

Science is a system for exploring truth and gathering information. Graphics is the art of the presentation of information in an attractive and enhancing package. Scientists are not noted for their graphic arts skills.

For years scientists have ignored the graphic and visual art while thinking the quality and value of their work would be sufficient for its acceptance. After all, if we discover the truth, what more is required? Perhaps, among scientists such was once true. Certainly, today, we value the impact and clarity of a well designed presentation, be it report, poster, transparency or slide program. Accuracy is still the baseline, but understanding can be enhanced by emphasis, illustration, layout, color and design. Just as we must be trained to think clearly, we must be trained to present clearly. Communication goes beyond the oral or written word; it is visual, very visual.

OVERVIEW continued

A CSL Response

The certification process provides a living, real world curriculum for students to learn about their community and for teachers and volunteers to model important attitudes about land protection and field study techniques. Individual projects give students the opportunity to collaborate with others while exploring their own interests and developing new skills. Students are encouraged to learn about the issues surrounding vernal pools, such as land development pressures, and to ponder possible solutions. Project-based learning of this kind can provide a multitude of experiences for students to develop a sense of community. From explorations and observations emerge their stories that they eagerly share with each other and the community. Through the process of reflection students are encouraged to analyze, hypothesize and ponder the mysteries of the natural world. Documenting their observations in journals enables students to record and reflect further on their experiences of their community. Vernal pool certification enhances Bolton's watershed approach to teaching and crosses all subject areas particularly domains within the sciences.

Vernal Pool Certification involves the following:

- Learning about vernal pools
- Understanding certification, protection and the law
- Locating a vernal pool
- Assessing the vernal pool
- Documenting the findings
- Mapping the pool
- Collating the information
- Submitting material to Natural Heritage Program
- Practicing stewardship

Service Component

When the certification material has been submitted and individual projects are completed, students share their accomplishments with community volunteers, town boards and other classes. In Bolton, town boards have been receptive to help from students and appreciative of their efforts to meet the needs of the town. Student presentations have generated lively discussions of other ways students can participate in town matters. These presentations to community volunteers, parents and other classes give all students the chance to practice their public speaking skills and to take pride in their accomplishments.

Celebration

The ideal celebration includes representatives of Natural Heritage and Endangered Species division, a representative from state government and members of town government gathering to applaud and acknowledge the accomplishments of the class. Also to be included are parents and volunteers who need to be thanked for their participation. A certificate of participation for students further enhances the special nature of the project.

OUTCOMES

Academic Gains

- Learning collaborative skills
- Collecting, collating and evaluating data
- Presenting findings
- Understanding state and local wetland laws
- Connecting classroom skills with real life relevant activities
- Learning through interdisciplinary, integrated strategies

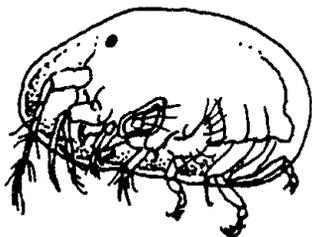
Societal Gains

Volunteers and community groups are inspired to come together to support student activities that make significant contributions to the community - increased land protection and awareness of natural resources. This collaboration expands awareness in both groups of the effectiveness of working together toward a common goal.

Community Partners

Every community has numerous potential partnerships. The challenge is to facilitate these partnerships and the communication necessary to sustain the relationships. In Bolton a community coordinator and teachers have worked as a team, meeting regularly. The coordinator has helped make connections between student projects and specific community needs and resources, such as local speakers who have specific knowledge of topics like GIS mapping and wetlands protection.

One of the most exciting events in the study of vernal pools is "Big Night." This is the first rainy night in the spring when the temperature is 40 degrees or above, thus triggering the salamanders' migration to the vernal pools to begin the mating ritual. Community volunteers play a critical role in organizing students at different locations so they may all experience being at a vernal pool on this special night. Each student is instructed to wear boots and bring a flashlight (covered with cellophane, which is less disturbing to the salamanders). Those documenting the event bring tape recorders, cameras, camcorders, and the like. When students finally have the opportunity to observe the salamander migration and their "congressing" on the pool bottoms, interspersed with individual salamanders gracefully undulating to the surface for gulps of air, they are totally captivated.



The color copier, color printer, and the personal computer with its word processing and drawing programs provide us with the tools of effective communication.

Now, we need to learn the effective use of these tools. Just as a person with inappropriate vocabulary and bizarre syntax might be considered functionally illiterate, someone who uses multiple fonts, overcrowded text and garish clipart could be considered visually illiterate. In neither case, does the individual communicate in a manner they understand. Just as spoken language has rules which must be learned and practiced, so too, does visual communication.

In the following pages, we (a biology teacher and a visual arts teacher) present a few activities which are useful for presenting information about vernal pools effectively. The topic is interesting and locally important. The activities involve technology, writing, design, community involvement, group work, peer review and critical thinking.

Leo Kenney and
Mike Harney, 1996

TIES TO THE MASSACHUSETTS CURRICULUM FRAMEWORKS		
LEARNING STANDARDS/ OUTCOMES	ACTIVITY	ASSESSMENT
<p>Science and Technology</p> <p>INQUIRY</p>		
<p>Standard: Describe relevant details, patterns and relationships.</p>	<p>Observe several vernal pools – flora, fauna, water levels.</p>	<p>Students identify flora and fauna using field guides as a key.</p>
<p>Use more complex tools to make observation and gather data.</p>	<p>Students test vernal pool for pH and dissolved oxygen.</p>	<p>Students follow correct scientific procedure to perform chemical analysis.</p>
<p>Represent data and findings using tables, models, demonstrations and graphs.</p>	<p>Students collate leaves from bottom of a vernal pool and classify percentage of each leaf.</p>	<p>Students identify the species of plants in their vernal pool and calculate their distribution.</p>
<p>DOMAINS OF SCIENCE</p>		
<p>Standard: Explain situations in which short-term changes in available food, moisture, or temperature of an ecosystem may result in a change in the number of organisms in a population or in the average size of the individuals in a population.</p>	<p>Students chart water levels and temperature to show effects on amphibian survival.</p>	<p>Students explain the relationship of weather and water to the survivability of amphibians.</p>
<p>Explore and illustrate that in both the short and long term changes in the environment have resulted in qualitative and quantitative changes in the species of plants and animals that inhabit the earth.</p>	<p>Students study the impact of the glacier on the evolution of the Jefferson Salamander.</p>	<p>Students demonstrate their understanding of the genetic differences in the Jefferson salamander through class presentations.</p>
<p>Explain the importance of reproduction to the survival of the species.</p>	<p>Students discuss variables required for amphibians to reproduce and survive.</p>	<p>Students demonstrate knowledge of amphibian life cycles and environmental requirements for reproduction.</p>
<p>Observe and illustrate the variety of ways in which plants, animals, fungi and microorganisms interact.</p>	<p>See slides and video of the energy cycle.</p>	<p>Students diagram and illustrate energy cycles in vernal pool.</p>
<p>Present evidence that species depend on each other.</p>	<p>Compare food chains, food pyramids and food webs in vernal pools.</p>	<p>Students illustrate and describe food chains, pyramids and webs in vernal pool.</p>
<p>Standard: Give examples of decisions that we (as individuals, groups and communities) can make that change the natural environment.</p>	<p>Brainstorm ideas about how land development impacts habitats such as vernal pools and how wetlands by-laws can help to protect these habitats.</p>	<p>Students demonstrate their understanding through presentations and reports.</p>

TIES TO THE MASSACHUSETTS CURRICULUM FRAMEWORKS		
LEARNING STANDARDS/ OUTCOMES	ACTIVITY	ASSESSMENT
<p>The Arts</p> <p>Students integrate the arts and make connections among the arts and other disciplines.</p>	<p>Students sketch vernal pool fauna and flora as part of the certification process.</p>	<p>Students keep these sketches in a portfolio and use them in their presentations.</p>
<p>English Language Arts</p> <p>Standard 3: Make oral presentations that demonstrate appropriate consideration of audience, purpose and the information to be conveyed.</p>	<p>Students design projects related to vernal pools. This will include using a vehicle to present the project in an oral presentation.</p>	<p>A performance assessment is used for student oral presentations.</p>
<p>History and Social Science</p> <p>HISTORY</p> <p>Standard 4: Students analyze how and why some things change while others persist. They evaluate factors that lead to change, the pace of change and its impact.</p>	<p>Students explore with the help of experts and community members how laws can protect habitats and species.</p>	<p>Students will research how local development has been and will be impacted by local, state and federal laws.</p>
<p>Standard 6: Students will use the concept of space to analyze people and environment.</p>	<p>Students will map a vernal pool using USGS Assessors and Color Infrared (CIR) maps.</p>	<p>Students will be evaluated by a lab practicum using these maps.</p>
<p>Mathematics</p> <p>NUMBER SENSE</p> <p>Strand 1: Use computation, estimation and proportions to solve problems.</p>	<p>Students map the pool and collect/collate data regarding fauna/flora populations in their vernal pool.</p>	<p>Accuracy of data collected.</p>
<p>STATISTICS AND PROBABILITY</p> <p>Strand 4: Collect, organize and describe data systematically. Construct, read and interpret tables, charts and graphs.</p>	<p>Collect and compare pH and dissolved oxygen levels of several vernal pools.</p>	<p>Evaluate student interpretation of data.</p>
<p>GEOMETRY AND MEASUREMENT</p> <p>Strand 3: Describe the meaning of perimeter, area, volume, angle measure, capacity, density, weight and mass.</p>	<p>Students map the vernal pool using these measurements as guidelines.</p>	<p>Students assessed on accuracy of computation and measurements.</p>

LESSON PLAN Mapping a Vernal Pool

Objective

Accurate mapping of a vernal pool is a necessary part of the certification documentation. In order for the staff from the Natural Heritage and Endangered Species Program or the local conservation commission to find the vernal pool in the field, the pool must be located precisely. Distances and compass bearings from at least two permanent landmarks should be used as reference points. These distances and compass bearings (metes and bounds) should be shown on a sketch map of the pool, as well as any other pertinent information about the vernal pool.

Learning Standards

Inquiry: Strand 1

Social Studies: Strand 6

Mathematics: Strand 6

Materials

Each student or group should have:

Topographical map

Compass

Tape measure or trundle wheel (Note: Students can also pace the distance)

Procedure

Note: This activity should be done after students have become familiar with topographical maps and feel comfortable using a compass.

Divide students into pairs or groups.

Write clear and concise directions to your pool using compasses and two permanent landmarks as reference points.

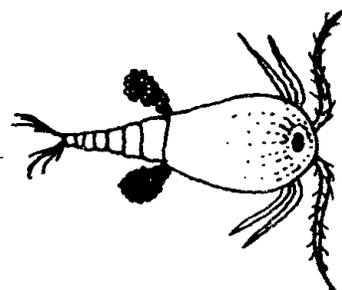
Draw a sketch map of your pool, noting its location in relation to the permanent landmarks.

Measure the pool and record its dimensions on the map.

Locate vegetation, egg masses and any other relevant details of the pool.

Assessment

Students' sketch maps



LESSON PLAN Observing Vernal Pool Species

Objective

To observe, identify and document the species that live in vernal pools as part of the certification process. (See "Vernal Pool Observation Form" Addendum) This is done in the spring after the amphibians have migrated.

Learning Standards

Domains of Science: Strand 2

Explain the importance of reproduction to the survival of the species.

Observe and illustrate the variety of ways in which plants, animals, fungi and microorganisms interact.

Present evidence that species depend on each other.

Materials

- Nets and scoops for collecting invertebrates
 - Trays (preferably white)
 - Watercolor brushes for handling invertebrates
 - Hand Lenses
 - Viewing microscopes
 - Field Guides
 - Notebooks
 - Camera to document species
-

Procedure

From the edge of the pool have the class look for and count salamander and wood frog egg masses attached to submerged branches or vegetation.

Collect invertebrates from the pool - diving beetles, caddisfly larvae, fairy shrimp-to observe up close with hand lenses and viewing microscopes.

Students should look at what they find and try to classify the organisms and understand their relationships with other organisms.

Questions to be answered by observation:

How does the organism eat? How does it get oxygen? How does it move through the water?

Questions for further research:

Is the animal an herbivore? Carnivore? How does the organism deal with seasonal drying up of the pool?
How does it reproduce?

Assessment

Student journals, sketches and oral presentations.

Assessment

Assessment of the vernal pool unit should include students' journals, portfolios, sketch maps and student projects. Additional tools could include the Vernal Pool Assessment (see Addendum) and student, community partner worksheets.

Student Projects

Students are required to design a project that will address some aspect of vernal pools. They will research and work either alone or in collaborative learning groups with the understanding that the ultimate goal will be a public presentation. A portfolio is used to collect students' best work.

Sample topics:

- How federal, state and local laws impact vernal pools

- Amphibian life cycles / mutation research

- Photography (still photos, videos, displays) for certification and presentations

- Mapping of Vernal Pools (USGS, CIR, Assessors) for planning, land protection

- Raising public awareness (video, local cable TV, public service announcements)

- Design a T-shirt and sell it to raise money for vernal pool work

- Help organize town wide certification procedures and data base of vernal pools

TIMELINE

This project can be adapted to many different timelines. It could be condensed for a spring project, but ideally it would be ongoing throughout the entire year, being integrated into all discipline areas. A suggested time line follows.

FALL

Visit a vernal pool

Introduce the idea that vernal pools are magical, unique habitats that can be revealed in fascinating ways. Begin by demonstrating the presence of life where none is obvious.

- Ask students to collect the detritus (muck and debris) from the bottom of a vernal pool, place this material in an aquarium, and observe the growth of aquatic creatures over time.

- Have students collate the leaves from the bottom of a pool and classify the percentage of each type of leaf represented.

- Discuss mass in relation to nutrient value of each specific species of leaf (see *Diving into Wicked Big Puddles*, p. 16-17)

- Discuss energy flow within the ecosystem (see *Pond and Brook*, by Michael J. Caduto, pp 23 - 31)

- Show slide presentation from *Wicked Big Puddles* on certification.

- Begin mapping activities. (see Vernal Pool Lessons and Activities p. 19-29, p.51-52)

- Discuss Wetland Protection Act and local bylaws (see *Certified*, Mass. Audubon, pp 94, 105-110)

- Review certification process - determine materials and procedures to follow.

- Choose vernal pool project.

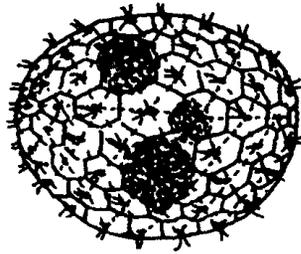
CONNECTING TO MCAS: OPEN RESPONSE QUESTION

Give two major reasons why vernal pools are important to protect.

Define the terms "obligate" and "facultative" as they relate to vernal pools and give one example of each.

Watch the delight of a student meeting their first spotted salamander from a vernal pool and witness the making of a naturalist for life.

Pat Huckery,
Natural Heritage
Program of
Massachusetts
Division of Fisheries
and Wildlife.

**TIMELINE****WINTER**

Return to the vernal pool to observe any changes since fall.

Through directed research in class students:

Become familiar with organisms that live in vernal pools.

Learn how to identify obligate and facultative species.

Discuss amphibian life cycles.

Explore ways to document the vernal pool - photographs, written descriptions, journal drawings and audio/video recordings.

Work throughout winter on projects.

SPRING

Visit the vernal pool on "Big Night" to document amphibian activity.

Return to pool during class to do more in-depth study.

Identify and inventory egg masses.

Observe and document obligate and facultative species.

Monitor water level; test pH and D.O. of vernal pool.

Complete mapping of the pool.

Collect and collate certification material.

Complete projects, display and present work.

Celebration - make presentations to community groups and other classes



Challenges

Solutions

Management and coordination of the project

A team approach works well. Teachers with the support of community volunteers can help students set goals, develop projects and monitor their progress.

Student motivation.

In order for students to develop ownership of their work, they need to be encouraged to choose a topic that best captures their interest.

Transportation to and from the vernal pool, if there isn't one close to the school.

Volunteers can be recruited to help.

Permission from the parent/guardian in the project.

Emphasizing support from community and school in letters sent home.

Support from local and central office administration.

This project addresses the Common Core of Learning and the Learning Standards of Curriculum Frameworks.

Cost considerations for equipment and materials.

Funding possibilities include a CSL grant, local conservation and parent groups.

Extending the Vision

Students will work with the Conservation Commission and the Bolton Conservation Trust to create and maintain a data base for the vernal pools in the town of Bolton.

Students will create permanent displays to be set up in prominent places in town to educate citizens about vernal pools.

Students will work together with volunteers and town boards to educate other students and citizens about the value of these important town resources, understanding that their involvement can make a difference.

Students will network via computer with other schools involved in vernal pool certification to compare data and share experiences.

Students will have the opportunity to attend conferences and make presentations on their work.

IN CONCLUSION: School's Role in the Community

This project brings together diverse constituencies in the community to address a community need - certifying vernal pools. In this process relationships are forged with other students, volunteers and town boards while students gain a sense of place and pride in their accomplishments.