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Integrating Vernal Pool Investigation into the 5th Grade Science Curriculum
A New Approach

INTRODUCTION

"We must somehow take a wider view, look at the whole landscape, really see it, and describe what's going on here"
***Pilgrim at Tinker Creek,* Annie Dillard**

Science is essentially the study of the world around us. Traditionally we have done life and nature study in the classroom with occasional field trips. While this practice does give students the chance to (hopefully) observe in the wild what they have studied in the classroom, it has limited value, in that the observations, of necessity, represent a single moment in time. We are fortunate to have our school placed next to a public forest which includes several examples of vernal pools within easy walking distance. A class can walk to a pool, make observations, and return within a 45 minute class period. A "field trip," rather than being a holiday-like day trip, takes on more of the meaning it would have to a professional scientist, a regular and necessary part of the study of nature. We are proposing integrating the vernal pool year into the science curriculum as much as possible. As a way of focusing student activity, we suggest that each classroom choose different pools or different times and that the students be randomly broken up into small investigative teams of no more than four individuals.

While modifications to curricula are usually meant to target perceived weaknesses, what we are proposing is an enhancement which makes use of a unique local resource. The challenge to our students that we are addressing here is in learning techniques of scientific observation and reporting, While this has been addressed since 1st grade, (they have learned to observe, keep records and make labeled drawings), we believe that this process can be greatly enhanced by making a series of observations of the same local area over time, to observe how the cycles that they have been studying play out in one area throughout the school year. Instead of a series of unrelated subjects, their science notebooks can become true journals describing the characteristics over time of a rich site. We are proposing that the students spend as much time as possible out in the natural laboratory. This provides both the hands-on experience so necessary for science

education and also a differentiated learning approach for students to get out of the books and the classroom and into the space whence the science is derived. According to the National Science Teachers Association, in their 2002 position statement, students learn and value science the most when, "they are involved in first-hand exploration and investigation and inquiry/process skills are nurtured.," and "a variety of presentation modes are used to accommodate different learning styles, and students are given opportunities to interact and share ideas with their peers." Another positive aspect of the integration of the vernal pools is that it moves the subject away from teacher-centric, didactic classroom instruction into a more free-flowing, dialog-oriented learning process which encourages student voice. Allowing students to engage in dialog with teachers enhances the learning process (Martin and Hand, 2007). The use of small groups in the field promotes cooperative learning, which has been shown to have a powerful positive effect on student learning (Marzano, et al., 2005). Finally, working in the field with a teacher allows modeling of a variety of scientific methods, including observation, data collection and recording, the use of field guides, etc. This is in accordance with current national standards for science education (National Research Council, 1998).

The state forest is a living laboratory for many of the standards we must teach to. The forest base is highly glaciated. There are several glacial features still visible nearby, including eskers and drumlins. Water-worn cobbles of non-local origin abound, with mostly igneous outcroppings of bedrock visible. Well-developed, layered temperate forest soils, freshwater swamp and open marshland, streams and, of course, the vernal pools provide habitats for a variety of plants and animals, including several rare or endangered species. Examples of all of these features can be found on the walk to the nearest vernal pool.

We are limiting this proposal to the 5th grade, as we are addressing the standards set for that grade by the Commonwealth. Teachers in K-4 may want to integrate some of these ideas into their studies, as well. Also, while we strongly suggest that 4th grade teachers coordinate with the 5th grade teachers to have at least one mid spring season visit to the pools. This provides a basis for the 5th grade comparison of the fall low water or dry pool with how it looked the previous spring.

The assessments for the Vernal pool curriculum are based almost entirely on the production of the descriptive science journal each student is required to keep. This journal includes predictions, observations, conclusions, illustration and some special projects. It is our belief that a well-ordered and organized set of field notes shows mastery levels as clearly as content tests.

CURRICULUM MAP

As an example of how the vernal pools areas can be integrated, we have included appropriate science units from the current 5th grade curriculum with modifications of the activities. The starred entries are new units.

GRADE & UNIT	SAMPLE ACTIVITIES (These are the Vernal Pool related activities. Existing activities may be retained.)	ASSOCIATED STANDARD(S) From the state standards document	ASSESSMENTS and opportunities for differentiation
Being a Scientist: Keeping a Journal	• Create 2 science notebooks, 1 for vernal pool observations, 1 for other science work.	• **Skills of Inquiry, Experimentation, and Design:** -Keep accurate records while conducting simple investigations or experiments.	• Name and subject matter on front cover (req) • Proper organization of notebook pages (date, predictions, observations) (req) • Decorate each notebook cover appropriately. Students can draw or glue/tape/paste illustrations
Dichotomous Keys	• Create a dichotomous key to differentiate two relatively close species of plants or animals (eg., wood frog and leopard frog, wood frog and American toad, spotted turtle and slider, maple tree and oak tree). Illustrate with sketches, drawings, or printed pictures.	• **Skills of Inquiry, Experimentation, and Design:** - Recognize simple patterns in data and use data to create a reasonable explanation for the results of an investigation or experiment. • **Characteristics of Organisms - 1**	• Can't be silly! No comparing a spider and a fish! • Key in notebook (req) • Create a skit using dichotomous keys to differentiate
**** Re-introduction to Vernal Pools/The Vernal Pool in Fall***	• Watch vernal pool video (source?) • List of significant terms • Review state of pools at last visit in 4th grade (Coordinate with 4th grade teachers to have this visit and video in late spring.) • Brainstorm predict what conditions will be found when visiting pool sites	• **Skills of Inquiry, Experimentation, and Design:** -Ask questions and make predictions that can be tested. -Keep accurate records while conducting simple investigations or experiments. -Record data and communicate findings to others using graphs, charts, maps, models, and oral and written reports.	• File predictions and in the field corrections/observations (req) • Finish worksheets and file in science notebooks (req) • Make a picture/poster/write up/Power Point on changes to vernal pool over the summer. File in notebook. (choose 1)

	after the summer. • Visit to late season pool and to dried-up pool. Note changes, including animals that have migrated from the drying pool. Explain why. Note in workbooks accuracy of predictions. • Observe soil characteristics of dried pool bottom compared with surrounding forest. Dig 18" test holes in each spot. Write down thoughts on soil formation. • Worksheets on what makes a vernal pool.	• **Soil – 4 and 5** • **Earth's History – 12** • **Adaptations of Living Things - 7 & 8**	• Write up/picture/poster on differences in soil at dried pool bottom and surrounding forest. File in notebook.(Poster work can be done by the same small groups and mounted) (choose 1) • Defend thoughts on soil formation to class. • "Found" poem of significant terms: Put the terms on post-its, rearrange on a sheet until the student likes the flow of words, tape down. File.
**** The Vernal Pool in Winter/Tracking***	• Visit to the pool to observe changes – water level, ice formation, evidence of hibernation (chipmunk holes, squirrel nests, disturbed mud). Also look for animal activity markings (tracks, fresh pine cone leavings, scratched or nibbled bark, etc. Note changes and observations. • Predict the animal tracks you might expect to find around the pool in winter, using past knowledge of hibernating and migrating vs. winter awake species. Note down predictions. • After a good snowfall, go to pool to observe tracks. Using guide, identify and sketch tracks. Include measurements. Look for domestic animal and human tracks. Make deductions about what the animal were doing (running, walking, escaping, hunting.)	• **Skills of Inquiry, Experimentation, and Design:** -Ask questions and make predictions that can be tested. -Keep accurate records while conducting simple investigations or experiments. - Record data and communicate findings to others using graphs, charts, maps, models, and oral and written reports. • **Characteristics of Organisms – 8 & 9** **Adaptations of Living Things**	• Journal pages. (req) • Make a model of a winter trackway. Include more than one species. • Make a diorama or draw a picture illustrating one or more types of hibernation. • Defend predictions on which tracks are expected and why, and which are not before class. • Make a simple chart of the animals of the vernal pool in winter showing migrating, hibernating, awake, in egg or larval form. • Write a poem about the winter pool. • Power Point on the vernal pool animals' response to winter.

**** The Vernal Pool in Spring***	• Field visit to observe early spring characteristics of pool – look for evidence of egg masses, insect larvae, etc. Collect small number of frog eggs, bottom material, etc for classroom observation of frog life cycle. Collect insect egg cases for observation in terrariums.	• **Skills of Inquiry, Experimentation, and Design:** -Ask questions and make predictions that can be tested. -Keep accurate records while conducting simple investigations or experiments. • **Characteristics of Organisms – 4 Structures and Functions**	• Journal pages (req) • make a chart of frog or salamander development • make a model of frog development showing at least 4 stages.
Food Web/Classification of Animals/Energy Transfer	• Field visit to pool to observe organisms. Try to find examples of each of the following: detritivore, primary & 2ndary carnivores, herbivore, scavenger. Use nets and buckets for collecting, observation trays and hand lenses for examination, clear metric rulers for measurement estimates. Collect sample for microscopic examination. Identify plant species, such as duckweed and algae in pool. Make notes and drawings on journal pages. • Make a food web illustration using macro and microscopic organisms from journal. Animals not observed can be included but must be labeled as such. (eg – a snake eats frogs but we didn't see the snake) • Observe and record example(s) of each of the following during trip to pool: -Insect -Arachnid -Crustacean -Amphibian (frog, toad, salamander) -Reptile -Bird -Mammal • Create a simple chart of the animals of the vernal pool.	• **Skills of Inquiry, Experimentation, and Design:** - Ask questions and make predictions that can be tested. -Keep accurate records while conducting simple investigations or experiments. -Record data and communicate findings to others using graphs, charts, maps, models, and oral and written reports - Select and use appropriate tools and technology (e.g., calculators, computers, balances, scales, meter sticks, graduated cylinders) in order to extend observations • **Characteristics of Organisms – 12 Energy and Living Things**	• Journal pages about site visit. (req) • Food web, classification and energy web charts in vernal pool notebook. • Classification observation in notebook • Create a dance or skit about the VP food or energy web. • Create a poem about food or energy web.

	• Take observations and notes about energy transfer. Include food energy sources such as the sun, detritus and heat from the earth. Create a chart to show the energy transfer web around the VP.		
Introduction to Ecosystems	• General discussion on ecosystems. • The Vernal Pool as a temporary ecosystem. Obligate vs. Facultative species. Predict which species studied so far will fit in one or the other category. • Field visit to pool to observe ecosystem characteristics. Make notes on what aspects are unique to this ecosystem.	• **Skills of Inquiry, Experimentation, and Design:** - Ask questions and make predictions that can be tested. - Keep accurate records while conducting simple investigations or experiments. - Recognize simple patterns in data and use data to create a reasonable explanation for the results of an investigation or experiment. • **Characteristics of Organisms – 4 Structures and Functions**	• Journal pages about site visit. (req) • Brainstorm the reasons some species might be in trouble, in addition to the ecosystem-related reasons Already discussed. Are there any ways in which human activities might affect the lives of animals? Write up conclusions and include in journal • Brainstorm why wetlands like the vernal pool are important to humans. Write up conclusions and include in journal. • Play the Critical Component Game: assign roles to class members (eg Oak Tree, Vernal Pool, Squirrel, Wood Frog,), then ask one to sit down. All other roles that rely on the one sitting down have to sit down, as well. Play in different configurations until students show understanding of critical components. • Create a large jar aquarium with layers of bottom detritus, water and surface plants. • Create a large jar terrarium with small verge plants from the pool.

Animal Adaptations	• What adaptations (behavioral and/or physical) have the animals of the vernal pool made, if any, to adapt to this particular ecosystem? Predict how individual species will respond when the pool dries up. Research predictions and modify based on findings.	• **Skills of Inquiry, Experimentation, and Design:** -Ask questions and make predictions that can be tested. -Keep accurate records while conducting simple investigations or experiments. • **Characteristics of Organisms – 4 Structures and Functions**	• Journal entry (req) • Write a story or a poem about human adaptations to the environments they choose to live in. Include in journal. • Poster or PP on human or animal adaptations. • Research describe and illustrate the panda's "thumb."
Conservation vs. Land Development Case Studies	• Investigate local efforts to preserve land and especially wetlands.	• **Earth and Space Science - 10 The Water Cycle**	• Write a report on a local effort to protect the environment. Copy in journal. • Write a letter to the governor explaining why vernal pools are important wetlands and why protections for them should be strengthened. Copy in journal. • Design a campaign to increase public awareness of the importance to the water table of the pools on their land.

A rubric for the assessment of the science journals:
Point values can be assigned by individual teacher.

	Beginning level needs to progress	Progressing towards expected skill level	Has reached expected skill level	Goes beyond skill level – subject mastery
Spelling/Grammar	Frequent errors	Three to five errors	No more than two errors	No errors
Legibility and neatness	Illegible writing and/or messy/stained pages. Journal covers severely torn or missing.	Legible but poorly formed writing. Writing wanders on page. Some messiness of pages. Both journal covers present with minimal damage.	Legible and mostly neat writing, Some wandering of text. Journal covers present and undamaged.	Straight, well-formed, neat handwriting lines. Pages in excellent shape and covers nearly new.
Correct Format	No pages dated or numbered. Entries are made haphazardly. Pages skipped or torn out. Illustrations and text randomly entered.	Some pages dated and numbered. Entries made in timeline order. Illustrations and text mostly separated.	Most pages dated and numbered No pages missed or torn out, Illustrations and text are separated.	All pages dated and numbered. Each page separated correctly into prediction, observation, conclusion and illustration areas as appropriate.
Illustrations	Hastily and poorly drawn. Few in number. Illustrations are not identifiable. Labeling is incorrect or/not present.	Some obvious effort made with illustrations, which are identifiable. Labeling present. 3-5 errors allowed in labeling	Illustrations are carefully drawn, neatly and correctly labeled. No more than two labeling errors	Illustrations are very neat and well-labeled. All labeling is correct,
Field Notes	Few observations. Many inaccuracies.	3-5 observations-2 errors. 5-10 observations-4 errors	5-10 observations-2 errors Over 10 – 3 errors	More than 10 observations – no errors.
Predictions	Not based on existing knowledge. Do not address any questions raised.	Not based on existing knowledge. Addresses few questions.	Based on existing knowledge. Addresses some questions.	Based on existing knowledge. Addresses most questions.
Conclusion	Illogical explanation. Does not address any questions raised.	Illogical explanation. Addresses few questions.	Logical explanation. Addresses some questions.	Logical explanation. Addresses most questions.

Summary

The implementation of this new approach to the curriculum requires a lot of planning, coordination and new learning by 4th and 5th grade teachers. We propose the formation of a Vernal Pool Resource Committee to look into issues of supplies and training courses. Fortunately, there are a number of websites available dedicated to Massachusetts vernal pools, so most of the necessary information can be gleaned informally. A list of good websites is included in the Resource section of this proposal. We also propose the use of "A Field Guide to the animals of Vernal Pools," published through the coordinated efforts of the Massachusetts Division of Fisheries and Wildlife and the Vernal Pool Association of Reading, as the definitive text and field guide. We propose the purchase of twenty of these texts, one for each 5th grade teacher and four for each 5th grade classroom, as well as one for each 4th grade teacher and two for the library. Needed supplies will include six large dip nets, or one for each small group of students, an aquarium for each classroom for the frog life cycle exercise, collecting buckets and viewing trays. Pill bottles make great small water collecting containers. Large jars, preferably plastic, can serve as small, temporary aquaria or terraria. Large serving spoons, small, aquarium-style dip nets and turkey basters are all useful tools to bring along . Small, clean plastic jars for safely holding and observing specimen organisms should be available. Students will need a pair of rubber boots each. Teachers may want to keep some extras (from yard sales or PTA donations). A cart or big-tire wagon to haul the gear would be a nice addition. That would allow, for instance, the aquaria to be brought out to the pools to be filled, lessening the impact on the frog eggs in the "Vernal Pool in Spring" unit.

Teacher support will be provided by the Committee, which will produce informational materials and do several runs-through to familiarize teachers with the various sites used. Feedback, questions, requests for more information and support and any complaints or difficulties should be directed to the Recorder of the Committee. During the early stages of implementation, the Committee will meet twice monthly to assess the program's progress.

Resources

National Science Teachers Association. (2002). *NSTA Position Statement: Elementary School Science.* Retrieved 10/07/2009, from National Science Teachers Association Web site: http://www.nsta.org/about/positions/elementary.aspx.

Martin, A. & Hand, B. (2007). *Factors Affecting the Implementation of Argument in the Elementary Science Classroom. A Longitudinal Case Study.* Research in Science Education (2009) 39:17–38: DOI 10.1007/s11165-007-9072-7.

National Research Council (1998). *National Science Education Standards.* Washington, D.C.:National Academy Press. Retrieved 10/05/2009 from The National Academies Press. Web site: http://books.nap.edu/openbook.php?record_id=4962&page=R1.

Marzano, R., Pickering, D. & Pollock, J. (2005). *Classroom Instruction that Works: Research-Based Strategies for Increasing Student Achievement.* Upper Saddle River: Pearson Education, Inc.

Web Sites

MassNature: "Mass Nature's aim is to document species occurring in Massachusetts and to provide information that may be used for identification and educational purposes. "
http://www.massnature.com/Wildlife/Vernalpoolcreatures/vpinfo.htm

The Vernal Pool Association – Lots of information, activities, dates to remember, etc
http://www.vernalpool.org/vernal_1.htm

Mass Audubon – Good information on protecting vernal pools
http://www.massaudubon.org/printwildlife.php?id=59

Salamanders and vernal pools on Cape Cod: An isolated site with a concentration on salamanders:
http://ux.brookdalecc.edu/staff/sandyhook/dgrant/field/CC-Vernal%20Pools/Vernal%20Pools.html