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An elementary habitat curriculum for the Santa Rosa Plateau Ecological Reserve

Linda Jan Matthews

AN ELEMENTARY HABITAT CURRICULUM FOR THE SANTA ROSA PLATEAU ECOLOGICAL RESERVE

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Education:

Environmental Education

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Approved by:

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Dr. Darleen Stoner, First Reader — Feb 20, 2006 Date

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Dr. Gary Negin, Second Reader

ABSTRACT

This place-based curriculum, developed to address the alienation that children often feel from the natural environment around them, is an inquiry-based, hands-on teaching module for third and fourth grade children. It is designed around a one-day fieldtrip to vernal pool habitat at the Santa Rosa Plateau Ecological Reserve. Three pre-visit and three post-visit lessons are included. The lessons enable students to acquire required California academic content standards, and also incorporate education principles stated in California's Education and the Environment Initiative.

ACKNOWLEDGMENTS

Great appreciation goes to the many people who contributed their time, support, patience, advice, scholarship, and materials to this project, and without whose help this project would not have been completed.

Firstly, warm thanks go to Dr. Darleen Stoner for two years of guidance and support. Secondly, vast recognition and esteem go to Rob Hicks and the staff at the Santa Rosa Plateau Ecological Reserve for making this project viable and useful. Thanks to Wildlife Habitat Council for providing the construct upon which this project was built. Thanks to Classroom Clipart for the wonderful photography and illustrations that were used in the Santa Rosa Plateau Field Journal. Thanks to Dr. Gary Negin for graciously consenting to be a second reader.

Lastly, no acknowledgement could be complete without the inclusion of family, whose support and love gave this project heart. Donn and Carey, this one is for you.

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CHAPTER ONE

BACKGROUND

Introduction

In this increasingly globalized and urban world, there are strong pressures for communities to accept a uniform, popular cultural identity. The prevailing culture is one that glorifies insatiable economic growth and wealth accumulation while turning a blind eye to widespread industrial pollution, habitat loss, accelerated extinction rates, and the impoverishment of our water resources. It is clear that a change must be made in the way human beings and communities visualize and externalize their relationship to the earth.

Environmental place-based education is one avenue that can create strong family and community relationships with the local environment. It is in these newly rediscovered connections to local place and region that people can begin to create the sustainable, ethical, and spiritual foundations needed to break free from their passive observation of environmental devastation. Part of this passivity and lack of community bonding may come from the way children are educated, in spending most of their weekdays closed up in classrooms, sitting still on chairs.

They are not actively learning about and interacting with their local places; they are compliantly receiving information about other places unconnected, unfamiliar, and far away.

Teachers need to find ways to infiltrate the mandated curriculum with as many place-based, outdoor experiences as possible. One such resource in Southern California is the Santa Rosa Plateau Ecological Reserve. The Santa Rosa Plateau Ecological Reserve is a cooperative management project of the Nature Conservancy, the Riverside County Regional Park and Open Space District, the California Department of Fish and Game, the U.S. Fish and Wildlife Service, and the Metropolitan Water District of Southern California. Within this 6,925 acre reserve lies some of the region's last vernal pools, (seasonal ponds) as well as pristine oak woodlands, bunchgrass prairie, coastal sage scrub, and chaparral habitats.

The curriculum, *An Elementary Habitat Curriculum for the Santa Rosa Plateau Ecological Reserve,* was planned with the intent of creating a bond of love between this environmental reserve and the local community. In connecting this place with its people, there is hope that the reserve will be preserved for posterity, and that

children may learn to imagine the way to a sustainable future.

Purpose of the Project

The purpose of the project is to develop a place-based curriculum that can begin to address the alienation that modern children often feel from the natural environment around them. This curriculum is designed to be implemented around a one day fieldtrip to the Santa Rosa Plateau Ecological Reserve, and consists of pre-visit, visit, and post-visit lessons. By creating a natural bond between a local ecosystem and children, it is proposed that the children will have more interest in learning, increase their scores on mandated standardized assessments, and develop a conscientious stewardship and renewal of their local communities.

Significance of the Project

The significance of the project is that place-based approaches to learning preserve academic and intellectual standards while heightening ties to community, thus bonding a respect for the natural world to a commitment to becoming a better citizen. Instead of creating students who have an educated, yet narrow view of their role in the world, David Sobel, in his book *Place-Based Education*, postulated that

place-based education produces dedicated global citizens who are ready to act.

> Place-based education is the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum. Emphasizing hands-on, real-world learning experiences, this approach to education increases academic achievement, helps students develop stronger ties to their community, enhances students' appreciation for the natural world, and creates a heightened commitment to serving as an active, contributing citizens. (2004, p. 7)

Assumptions

The following assumptions were made regarding the project:

1. The natural environment must be valued and conserved in order for humankind to survive.
2. Place-based curriculum is more relevant for children than traditional curriculum.
3. Young elementary children easily bond with the natural world.

Limitations and Delimitations

During the development of the project, a number of limitations and delimitations were noted. These limitations and delimitations are presented in the next section.

Limitations

The following limitations apply to the project:

1. This project's scope was limited by lack of local school district funding and support for fieldtrips lasting longer than one day.
2. Constraints of time and resources limited the size of the curriculum.

Delimitations

The following delimitation applied to the project:

1. The project addressed only one environmental resource in Southern California, The Santa Rosa Plateau Ecological Reserve. It did not reflect or include any of the other local areas possible for developing place-based curriculum.

Definition of Terms

The following terms are defined as they apply to the project.

1. A habitat is a natural home or environment of an animal, plant or other organism.

2. The variety of life in a particular habitat or ecosystem is called biodiversity.

3. A relationship is an interaction or connection between two living organisms.

4. Adaptations are physical changes or behaviors that help organisms or species become better suited to their environments.

5. An ecosystem is a biological community of interacting organisms and their physical environment.

6. Vernal pools are seasonal ponds that support fairy shrimp, wintering waterfowl, and wildflowers in the spring months.

7. Riparian areas are wetlands adjacent to rivers and streams.

8. A bunchgrass prairie is an area of native grasslands.

9. Southern oak woodlands are found in sheltered inland valleys and canyons below 5000 feet.

Organization of the Project

The project is divided into five chapters. Chapter One provides an introduction to the context of the problem, purpose of the project, significance of the project, limitations and delimitations and definitions of terms. Chapter Two consists of a review of relevant literature. Chapter Three documents the steps used in developing the project. Chapter Four presents the results and conclusions from the project. Chapter Five presents implications for education drawn from the development of the project. Appendices for the project consist of Appendix A, GENERAL INFORMATION AND MAPS; Appendix B, VERNAL HABITATS TEACHING MODULE; Appendix C, VERNAL POOL RESOURCES; Appendix D, ENVIRONMENTAL PRINCIPLES AND CONCEPTS; Appendix E, CALIFORNIA STANDARDS CORRELATIONS; Appendix F, AUTHORIZATION LETTERS. Finally, the project concludes with the References section.

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

Chapter Two consists of a discussion of the relevant literature. Specifically, the benefits and value of environmental education are discussed with reference to creating citizens who can intelligently and creatively problem-solve current environmental issues. Next, constructivism is considered as an instructional method that has particular relevance to the study of environmental science, and one that leads to enhanced student learning. Place-based education is discussed in depth, as this is the main tenet and foundation upon which this master's project is formulated. Lastly, academic achievement is reviewed as it applies to placed-based environmental education programs.

Environmental Education

Environmental education may have started out as nature study or outdoor and conservation education, but it has metamorphosed into what many educators consider a fundamental part of a comprehensive curriculum. Environmental education is considered by many world organizations to be a critical tool, not just to develop

environmental awareness in the public conscience, but to produce citizens who have the skills to make informed decisions regarding real issues of ecological sustainability (Westing, 1993, p. 5). In making his case for environmental education, Westing further elaborated that "one of the most formidable and ever more intractable challenges facing humans today is coexisting with the other living creatures on Earth" (p. 4).

The development of the knowledge and expertise to face this challenge, to change societal mores, and to fashion policies that lead humans to live in balance with the environment were the goals of environmental education as elaborated in the Tbilisi Declaration of 1977 (UNESCO-UNEP, 1978). Using these Tbilisi objectives as a guide to author the "Goals for Curriculum Development in Environmental Education," Hungerford envisioned that in the future hundreds of thousands of young learners would be receiving sound, research-based environmental education programs (in Simmons & Volk, 2002, p. 7).

Although there continue to be significant barriers to Hungerford's vision in the allocation of educational energy and resources, there has been an increasing interest in the practical applications of environmental education. Caduto

has written of his conviction that environmental education is particularly effective for connecting in a significant way with individuals from diverse cultures. In *Ecological Education*, he stated that environmental education combines "the wisdom of the story with the knowledge of science" in order to be meaningful to those from a variety of cultures and learning styles (1998, para. 20). He postulated that Gardner's list of multiple intelligences should include environmental intelligence, and that the world needed an ethic that placed an equal value on nature as it did on humankind.

Constructivism

The constructivist classroom presents the learner with opportunities to build on prior knowledge and understanding in order to construct new knowledge and understanding from genuine experience. Students are permitted to struggle with problems full of meaning because of their real-life immediacy. In solving these problems, students are encouraged to explore diverse possibilities, invent alternative solutions, collaborate with other students, try out hypotheses, revise their thinking, and finally present the best solution they can derive (Siegal, 2005, p. 344).

A careful reading of this description of a constructivist classroom demonstrates how well this teaching method correlates with the stated objectives of environmental education. Environmental education seeks to foster awareness of, and concern about, economic, social, political, and ecological interdependence, and aims to provide every person with the opportunities to acquire the knowledge, skills, and experience necessary to identify, investigate, and take action towards solving current and future environmental problems and issues (UNESCO-UNEP, 1978). These objectives and the constructivist method mesh almost seamlessly in their effective mingling of process and intent.

Lord (1999), in linking constructivism and environmental science, devised a study to measure and compare constructivist versus traditional teaching methods. He pointed out

> that lasting knowledge is not gained by a student who simply reads phrases in a text or hears words in a lecture. Instead, lasting knowledge occurs when the learner attempts to make sense of the new information by applying it to his or her already perceived notions about the topic. (para. 7)

To test his hypothesis, Lord devised a study in which two groups of college students received the same environmental science information by different methods. The experimental group was taught using a constructivist model, and the control group was taught using a traditional teacher-centered model. He found, at the end of his study, that the students taught by the constructivist method had a much deeper, more comprehensive understanding of the information as shown by their test scores. In addition, the majority of students in the experimental group found the class interesting and enjoyable, in contrast with the control group, who almost universally found the class very hard and overly exacting (1999). According to Lord's research results, his constructivist lesson design was shown to have culminated in his students' successful learning experiences.

Place-Based Education

The contention that place-based approaches to learning preserve academic and intellectual standards, heighten ties to community, and thus join respect for the natural world to a committed citizenry, is the central premise of this project. Writers have championed this same concept as one necessary for the continued survival of humans and other

living creatures in the earth's biosphere. David Orr remarked that "we should worry a good bit less about whether our progeny will be able to compete as a 'world-class workforce' and a great deal more about whether they will know how to live sustainably on the earth" (1994, p. 148). He further specified that "education that supports and nourishes a reverence for life would occur most often out-of-doors and in relation to the local community" (p. 148).

Although educational researchers have championed teaching that uses the resources, issues and values of the local community and utilizes communities as a unifying context for learning, this pedagogy has often been referred to by different, yet interchangeable, terms. Environment as an integrating concept, sustainability education, service learning, community-based learning, project-based learning, and place-based learning all are terms that refer to a clear and integral connection between learners and their school and community. However the teaching method has been described, there has been much interest in evaluating its results. The Place-based Education Evaluation Collaborative (PEEC) was formed in 2002 to assess members programs and organize research efforts aimed at discovering the

effectiveness of place-based models in achieving educational objectives (Powers, 2004, p. 17).

As research into place-based models of learning has increased during the past decade, the evidence of both benefits and challenges has grown exponentially. Researchers (Booth, 1998; Emmons, 1997; Palmberg & Kuru, 2000; Powers, 2004) have cited multiple benefits: the positive impact on student motivation toward learning, the contention that students who were engaged in real-world learning were more likely to retain information, and the goal of students practicing more environmentally responsible behaviors. These environmentally responsible behaviors should result in a citizenry that is competent and willing to take action.

Bogner (1998) studied the influence of short-term outdoor ecology education on children's environmental perspective and action. He empirically evaluated the goals of environmental and ecological education. After completing his study on an outdoor ecology program in a national park with sixth grade children, he deduced that

> People's daily lives are separated from nature in "normal" reality, and they need to be linked to it again. The certainty, therefore, that students could

> be provided with additional tools to make responsible environmental decisions by means of first-hand experience, participatory interaction, adequate preparation, and subsequent reinforcement is the most important conclusion of this study. (para. 42)

In attaining and retaining this competency to make responsible decisions, Palmberg and Kuru's study results mirrored Bogner's conclusions, and emphasized further that it was of vital importance to "address pupils' feelings of being capable of doing something important in order to save nature (in their own neighborhood)" (2000, p. 36).

Lindholdt, another researcher, focused on this same capacity of place-based education to foster environmental sensitivity leading to action. His study of college students reflected his ability to generate literary activism using bioregion and ecological identity.

> Activism calls for passion, and true passion cannot be garnered from a book. Passions adequate for activism begin in place. Where is your place? I ask my students. They answer by engaging in research that really matters, and they succeed as writers by attaching fast to a particular genius loci, the pervading spirit of a place (1999, para. 8).

In addition to the activism created by environmental place-based teaching methods, Lindholdt reported his observation that "particularly in entry-level classes, students urged to explore and develop connections to nature in their personal lives are more apt to thrive as scholars and postgraduate professionals" (1999, para. 20). Not only in college classes did this benefit of hold true. According to research results, these benefits have been also observed in elementary school children.

Academic Achievement

Powell and Wells' paper on the effectiveness of experiential teaching approaches in fifth grade science classrooms concluded "experientially based programs that directly engage the student in the learning process seem to promote learning" (2002, p. 37). Other researchers found similar results in school-age children when they addressed the question of achievement and learning. In particular, Powers (2004, p. 17) and Lord (1999, p. 23) found in separate studies that the type of teaching usually found in constructivist place-based programs led to a boost in student academic achievement. Booth found that service projects often motivate children to "go beyond the confines of a class demonstration and were the seeds of larger

environmental efforts at an institutional level" (1998, para. 34).

Some of the most convincing research comes from Lieberman and Hardy. In their California Student Assessment Project they reported that "evidence gathered from the study of over 60 schools, indicates that students learn more effectively within an environment-based context that within a traditional educational framework" (2000, p. 2).

This evidence of positive research results was not the only outcome of the studies. Researchers found that there were significant challenges to the successful functioning of the programs. During Powers' evaluation of four place-based education programs, she found that both internally and externally based constraints impacted the programs. One was "a lack of time to devote to curricular change in the midst of multiple curricular pressures" and another was the variable "level of attention given to helping teachers acquire curriculum planning skills" (2004, p. 23-24). Simmons, in her article, found that teachers used available educational resources unevenly and were concerned about their readiness and knowledge to effectively teach in a natural setting (1998). These researchers were convinced, however, that these few challenges could be overcome so

that the students and their teachers could enjoy learning in the out-of-doors and could reap the academic benefits of the programs.

CHAPTER THREE

DESIGN OF THE PROJECT

Introduction

Chapter Three documents the steps used in developing the project. Specifically, a local natural environment was researched and selected: the Santa Rosa Plateau Ecological Reserve. Resources pertaining to this area were reviewed, and vernal pools were selected as an intriguing subset for investigation. After research and collection of vernal pool data, the resulting materials were formulated into a curriculum that reflects the goals and objectives of this project.

Development

The development of this project consisted of the compilation of resources on the Santa Rosa Plateau Ecological Reserve, specifically those pertaining to the subject of vernal pools and riparian habitats. Resource material and information was obtained from printed, Internet, and interview sources (see Appendix A). Particular care was taken when using materials that had been specifically developed for other regions of the United States. In these cases, when included in this project, these materials were realigned in content to reflect the

environment and amphibian species now existent in Southern California and in the Santa Rosa Plateau area. The resulting curriculum, The Vernal Habitats Teaching Module, consists of pre-visit, visit, and post-visit lessons, and is included in its entirety in Appendix B.

Resources

Many local and Internet resources were used in the development of this curriculum. There is a listing of these resources in Appendix C, but two resources of particular merit deserve inclusion here. Rob Hicks, Park Interpreter with the Riverside County Regional Park and Open Space District at the Santa Rosa Plateau Ecological Reserve, was of exceptional assistance in providing support, advice, and guidance regarding the ecological details of this project. Another exceptional contributor to this project was the Wildlife Habitat Council. They had created a place-based curriculum based upon the study of vernal pools in the mid-Atlantic region of the United States. This curriculum was adapted and redesigned to reflect the particular needs of the Western region of the United States and the Santa Rosa Plateau Ecological Reserve.

Design

Vernal Habitats is a teaching module designed to inspire a sense of stewardship and respect for amphibians

and empower students to take action to conserve their local habitats. The module consists of hands-on inquiry, teamwork, and exploration of a local ecosystem. There are optional pre-visit and post-visit lessons that complement the main inquiry-based study of vernal pools and riparian streamside habitats.

The three pre-visit lessons are called Toads Together, Welcome Wildlife, and Hide n' Peep, the main field study visit lesson is entitled the Santa Rosa Plateau Vernal Pool and Riparian Study, and the module ends with three follow-up lessons called Cool Pools Need Protection, Toad Abode, and Salamander Crosswalk.

This project utilizes the Environmental Principles and Concepts proposed in the Education and the Environment Initiative, Assembly Bill 1548 (Pavley, Chapter 665, Statutes of 2003)(see Appendix D). All of the lessons in this habitat curriculum are aligned to these environmental principles and concepts, and to California academic content standards for life science (see Appendix E).

Population Served

This project was designed for third and fourth grade students in the state of California. The habitat study

created in this curriculum was closely aligned with the science curriculum for these grades.

Goals and Objectives

The goal of this project was to provide a place-based habitat curriculum that introduced children to the Santa Rosa Plateau Ecological Reserve, and increased their sense of stewardship for the earth and its precious resources. The objectives for student learning through the use of this habitat curriculum in the classroom during the pre-visit and post-visit lessons, and in the fieldtrip study visit to the Santa Rosa Plateau Ecological Reserve, are listed below.

Goal 1: Teach concepts about and interact closely with a local environment.

- Objective 1: Students will understand the concept of habitat as food, water, shelter, and space.
- Objective 2: Students will collect organisms from a riparian habitat, observe and describe one organism, and consider its relationship to amphibians and other species.

Objective 3: Students will generate investigable questions from habitat inquiry, as guided by the Santa Rosa Plateau Field Journal.

Goal 2: Develop stronger ties between the student and their community.

Objective 1: Students will create an amphibian habitat enhancement plan for their yard, schoolyard, or park.

Goal 3: Increase appreciation of the natural world.

Objective 1: Students will understand that frogs call to attract a mate, and that each species has a unique call which can be identified by other frogs as well as biologists.

Objective 2: Students learn practical projects to provide habitat for amphibians.

Goal 4: Provide opportunity for stewardship development and activities.

Objective 1: Students will develop ways to improve amphibian habitat in their community.

Objective 2: Students will create signs to raise awareness and encourage protection of the vernal pool they visited, and/or other vernal pools in the community.

Objective 3: Students will write about and solve a conflict based on a fictional situation involving amphibians and suburban development.

Summary

The design of this project was developed with the intent to bring students intimately closer to a local natural area in both practical knowledge and environmental appreciation. The design further reflected the desire of the author to incorporate Environmental Principles and Concepts into the development of a regional habitat curriculum.

CHAPTER FOUR

RESULTS AND CONCLUSIONS

Introduction

Included in Chapter Four is a presentation of the results of completing the project. Further, conclusions are proffered which lay the groundwork for the next chapter, Implications for Education.

Presentation of the Findings

During the conception, design, and production of this project, several findings were made that affected the final result. There were massive amounts of resources available for local California natural resource areas, whether in print, Internet, or in person. The materials and opportunities available vastly outweighed the time allocated to habitat study in California's elementary classrooms. With the nature of visitations to the Reserve limited by time and money to one day, this curriculum was reduced in scope from the planned multiple-habitat full unit of study to a one-habitat amphibian study. In addition, the Metropolitan Water District of Southern California funds school tours, and offers a limited lower elementary curriculum for the Santa Rosa Plateau Ecological

Reserve, which reduced the current need for an extensive habitat curriculum.

Discussion of the Findings

This modest curriculum reflects the current needs for habitat study at the Santa Rosa Plateau Ecological Reserve. It is projected, however, that the Metropolitan Water District may withdraw funds for local school district fieldtrips. If this occurs, new needs may require the additional development of oak woodland, bunchgrass prairie, coastal sage scrub, and chaparral habitat modules to add to this vernal pool and riparian habitat module. This additional effort would clearly be justified in helping students and their teachers understand local environmental issues, and the immediate need to preserve and conserve this unique natural resource.

Summary

In conclusion, this habitat curriculum developed for the Santa Rosa Plateau Ecological Reserve is an inquiry-based, hands-on teaching module that clearly involves children in activities that will broaden their connection with the environment around them, and reinforces and strengthens their responsibility to be involved citizens and skilled stewards of the environment. In accomplishing

these goals, the Vernal Habitats Teaching Module enables students to acquire required California academic content standards and education principles as stated in the Education and the Environment Initiative.

CHAPTER FIVE

IMPLICATIONS FOR EDUCATION

Implications

The conclusions extracted from the development of this habitat project follow.

1. There is a need for place-based curriculum in the current elementary school system in California.
2. There is little time and money for implementing an extensive place-based curriculum.
3. This module, Vernal Habitats, or others similar to it, can be utilized within the constraints of today's time-limited instructional cycle.
4. Place-based curriculum can be the starting point to successfully motivating students to learn required concepts across the curriculum.

Recommendations

The recommendations resulting from the development of this habitat project follow.

1. It is essential that many such educational modules be developed for communities and their adjacent undeveloped natural areas across the United States, so that children can learn to be

involved in, and with, their own local environment and resources.

2. Due to the increasing urbanization of California, local natural areas are disappearing at an accelerated rate. It is imperative that students be educated about, and given the tools and knowledge to protect and conserve these vanishing resources.

Summary

It is hoped that the continuing development of place-based educational materials, like this Vernal Habitats Module, will provide basic information and lessons to help teachers and their students better understand their roles in helping preserve natural ecosystems such as the Santa Rosa Plateau Ecological Reserve.

APPENDIX A

GENERAL INFORMATION AND MAPS

VERNAL POOLS OF THE SANTA ROSA PLATEAU

Vernal is derived from the Latin word for spring. A vernal pool is a spring pool - one that dries up in late spring or summer and therefore does not have water in it until winter rains recreate the pool. Vernal pools usually are found in areas where the winter means the rainy season, and summer means the dry season. Pools fill in winter from the rains, and evaporate in the dry heat of summer.

There are many types of vernal pools in California. The California Wetlands Information System has put together a map showing their distribution. A detailed map of the individual pools in each region along with very detailed descriptions of the type of vernal pools, their protection status, geology, etc., can be reached by clicking on each region (http://ceres.ca.gov/wetlands/geo_info/vernal_pools_map.html).

The vernal pools of the Santa Rosa Plateau are the only known examples of Southern Basalt Flow Vernal Pools. The basalt on the Santa Rosa Plateau is the key to the large number of vernal pools there. It weathers to clay that is especially effective at swelling and forming a tight seal when wet. Hence the earliest rains create a lining for each pool that retains subsequent water flows.

These pools usually, but not always, fill with water each winter, which then evaporates relatively slowly in late spring and summer. This feature makes them much more interesting than puddles that fill with water and then go dry! It allows a community of plants and animals to be adapted to that kind of pool, and thus to put on a regular show each year.

A general description of what happens every winter and spring is as follows. After a pool forms, fairy shrimp hatch from eggs that have survived complete desiccation through the heat of summer. In only 2-7 weeks, they live their complete life cycle, and the population is back to only eggs.

As the pool dries up, plants begin to grow, often when plants in the surrounding landscape are near the end of their life cycle. Thus plants in the former vernal pool often reach peak bloom long after blooms are gone from the surrounding landscape. When the pool dries up completely, the plants complete their life cycle, with their seeds awaiting the rejuvenation of the pool.

If the vernal pool is significantly deeper in its center than near its edges, the life cycles of the plants will begin first at the edges, following the edge of the

pool as it recedes. Thus concentric rings of flowers bloom successively, starting at the largest attained perimeter of the pool and subsequently shrinking toward the center. Often there is a succession of plants at a given spot, which creates concentric rings of flowers visible at optimum times. These are among the most breathtaking of pools. Unfortunately, none of the pools at the Santa Rosa Plateau have enough depth variation to create concentric rings of flowers. At best, near the end of the lifetime of the pool, grasses and tarweeds create a few large rings of muted color variations at the edge of the pool.

Only 14 vernal pools survive in Riverside County; 13 of them are protected on the Santa Rosa Plateau. Around 2,000 vernal pools still exist in the coastal mesas of San Diego County, but they are underlain by hardpan (caliche), which prevents drainage of seasonal rainfall. However, many of them also support fairy shrimp and the ring of flowers.

Of the 13 pools at the Santa Rosa Plateau, 8 are on Mesa de Burro, 4 on Mesa de Colorado and 1 on Mesa de la Punte. The largest Mesa de Colorado pool is either 25 acres (from San Diego Union-Tribune article, May 9, 1996) or over 30 acres (from California Wild Lands), or 10 acres (Vernal Pools in Western Riverside County) and is one of the

largest in the state.

In 1995, a permanent boardwalk and bench, made out of recycled plastic, was installed at the largest Mesa de Colorado pool, allowing visitors to see the pool's activity close-up. At the center of the pool, the boardwalk encircles about a 6' diameter area of the pool.

(This article is reprinted here with authorization from Tom Chester. See Appendix F).

THE SANTA ROSA PLATEAU'S HISTORY

The Santa Rosa Plateau, with an average elevation of 2,000 feet, is located at the southern end of the Santa Ana Mountains in southwestern Riverside County, California. Ancient oak woodlands, rare bunchgrass prairie, and aromatic coastal sage scrub are a few of the plant communities that reside on this land located less than 20 miles from the Pacific Ocean.

The Plateau's mild climate made the area an ideal habitat for people, beginning thousands of years ago with the arrival of Native Americans. Ancestors of local American Indians, known today as the Luiseño, harvested and hunted the oaks and mule deer that are still found on the land today. This hunting and gathering way of life came to an end on the Plateau in the 1820s with the secularization of mission lands.

The Santa Rosa Plateau became Rancho Santa Rosa under a 47,000 acre 1846 Mexican land grant to cattle rancher Juan Moreno. In 1855, Senor Moreno sold his ranch to land-grantee neighbor Augustin Machado (owner of the Rancho La Laguna, today the Lake Elsinore area) for 1000 American dollars. The Moreno and Machado adobes stand as the oldest structures in Riverside County.

The ranch passed from owner to owner until 1904, when the Vails, a ranching family from Arizona, purchased the Santa Rosa, plus much of what was to become Murrieta and Temecula. They continued to operate their large cattle ranch for the next 60 years. Fortunately, for the sensitive habitats on the Plateau, the Vails were wise stewards of their property. They kept the number of head per acre to a sustainable amount, and only grazed during the wet months, moving the cattle down to valley feed lots when the dry summer season arrived. The grazing practices of the Vail Ranch management may be the reason the Plateau is considered by many to be the finest remaining example of a once widely-scattered California bunchgrass prairie system.

In 1964, the Vails sold the ranch to the Kaiser Steel Company, which master-planned "Rancho California" - the communities that today comprise the cities of Temecula and Murrieta. In the first two decades of that era, grazing leases allowed cattle operators to continue to use the Plateau. Overgrazing and year-round use caused habitat deterioration during that 20 year period, including the formation of deep erosion channels along the Plateau's main creeks.

In 1984, The Nature Conservancy of California, recognizing the intense concentration of unique and rare species supported on the Plateau lands, purchased 3,100 acres in two parcels from the owner, KACOR (a subsidiary of Kaiser Steel). The intervening lands were targeted for later conservation purchase.

In the late 1980s, however, Ranpac Inc. of Temecula purchased 4,000 acres comprising most of the intervening lands and prepared a specific plan for approximately 4,000 homes. A citizens' group, called Preserve Our Plateau, formed to try and protect the property from development. Purchase money was sought to buy the land back from Ranpac, who was agreeable to a sale. Awareness and moral support was widespread, but funds were scarce; county, state and national agencies were unable to secure enough for a purchase.

Seeking extensive and significant off-site mitigation opportunities for a new, large storage reservoir planned in the region, Metropolitan Water District of Southern California (MWD) approached the organization with an offer to provide $15.4 million towards a purchase in exchange for mitigation credits for their future Eastside Reservoir Project. The County of Riverside nearly matched that

funding with $15 million; the State of California's Wildlife Conservation Board provided $5 million from Proposition 117 (Mountain Lion Initiative) funds. The Nature Conservancy handled negotiations and provided closing costs. Each entity purchased its own property, but the entire site, known collectively as the Santa Rosa Plateau Ecological Reserve, is managed as one biological unit.

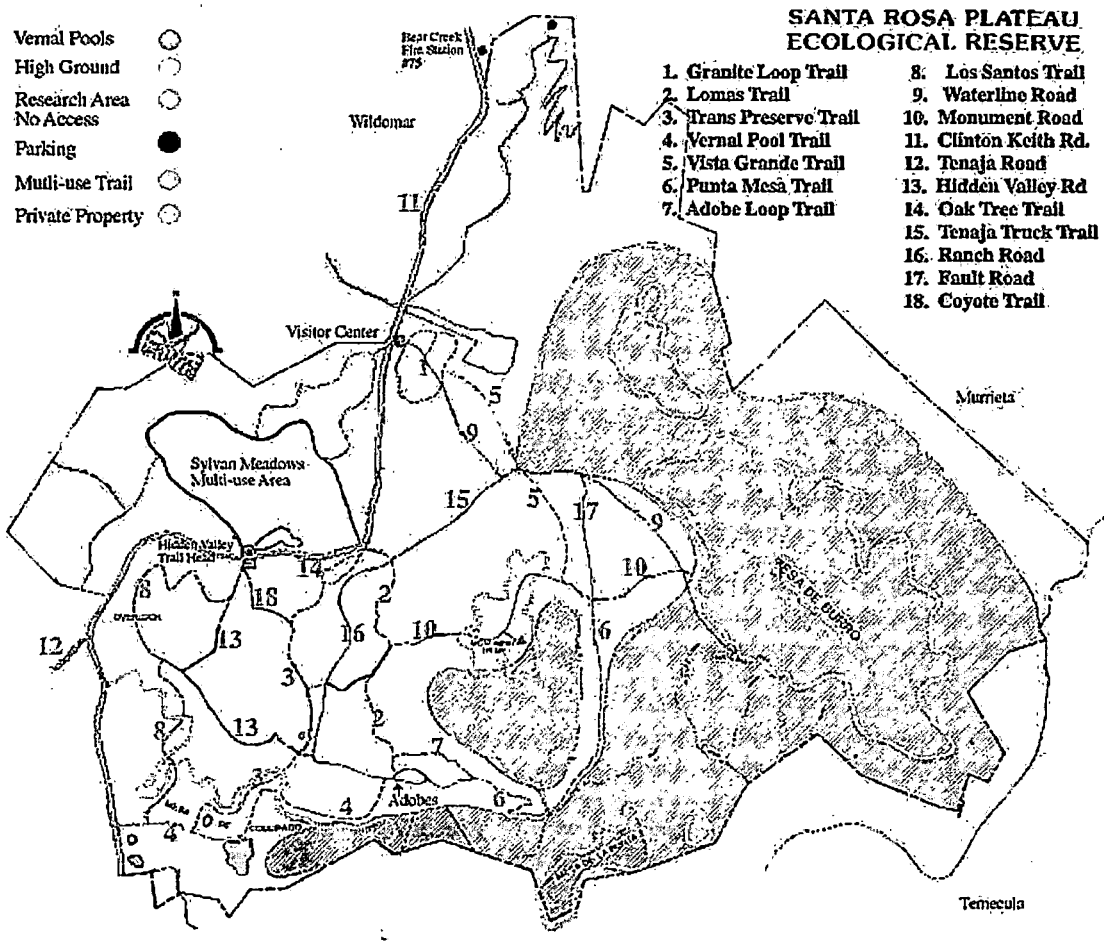
The four landowners (the state, county, MWD, and The Nature Conservancy), and the U.S. Fish and Wildlife Service (which owns no land on the Plateau, but has an interest in its rare and endangered species) signed a cooperative management agreement and today meet monthly to oversee management of the Reserve. The Nature Conservancy conducts biological resource management, including a prescribed fire program and habitat restoration. Riverside County Regional Park and Open-Space District conducts visitor management resources, including a Visitor Center and 40-mile trail system. Metropolitan Water District of Southern California provides an education grant, which allows over 5,000 local grade school children to visit and become inspired by one of their communities' most outstanding resources.

Additional purchases have now expanded the Plateau's protected size to nearly 8,500 acres. Annually, more than 40,000 day-use visitors travel to the Reserve for hiking, nature study, photography, etc. Visitors may also use some trails for horseback riding and mountain biking.

Of the more than 120 sensitive species of plants and animals in the Inland Empire, 59 of them can be found on the Santa Rosa Plateau. Red-legged frogs, California newts, and southwestern pond turtles survive in bedrock-lined pools of the stream system, much of which is under restoration. Native wildflowers, some nationally endangered, draw thousands of spring visitors. Vernal pools, the seasonal, shallow ponds that collect on rare volcanic soils, support endemic fairy shrimp and wintering waterfowl. Engelmann oaks, a vanishing, semi-deciduous species with blue-gray leaves and contorted branches, are found in abundance among the rolling grasslands. Badgers, horned lizards, mountain lions, bobcats, gray fox and deer are found on the Plateau, as are more than 180 species of birds.

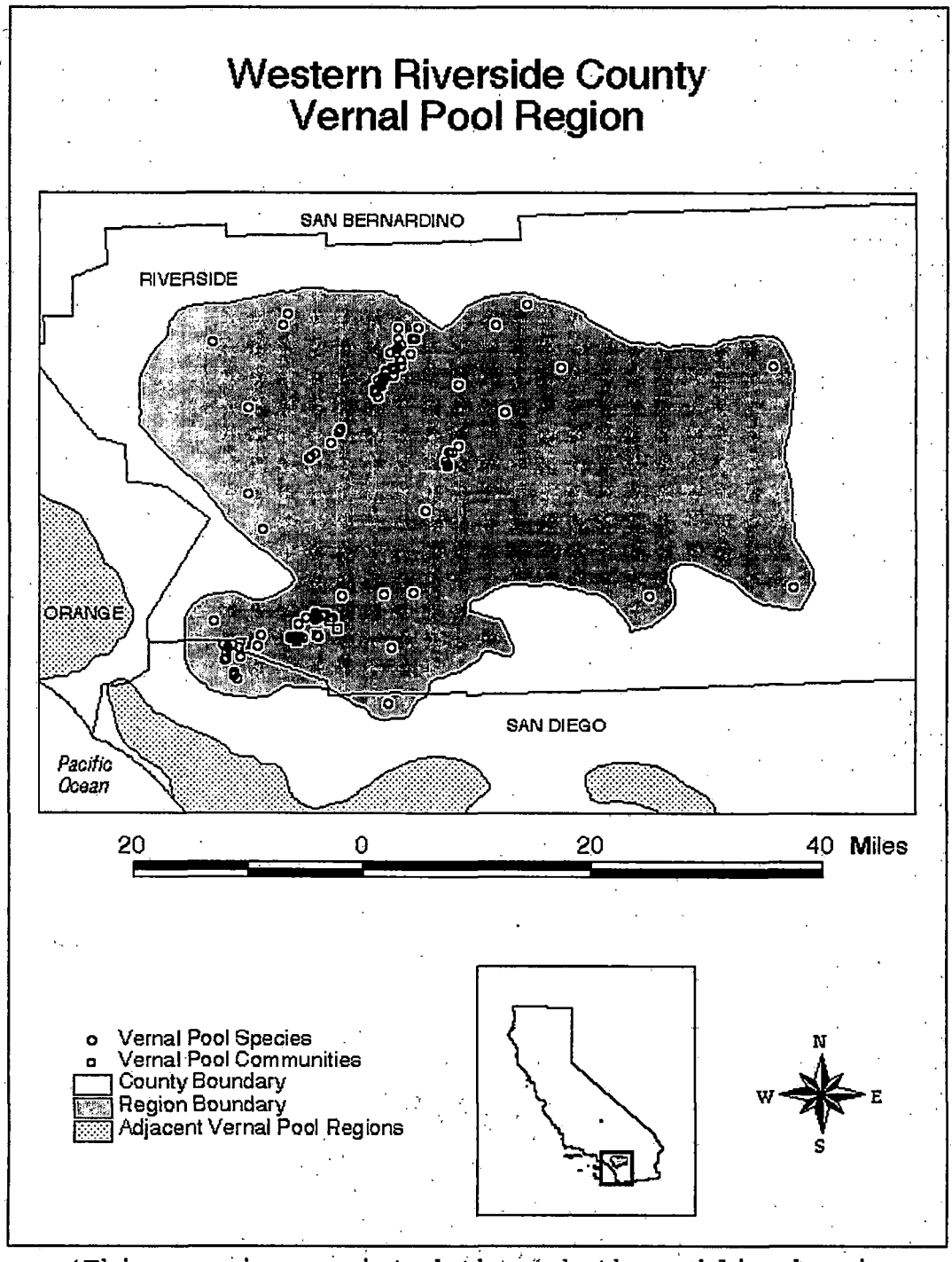
(This article is reprinted here with authorization from Rob Hicks at the Santa Rosa Plateau Ecological Reserve. See Appendix F).

MAP OF THE SANTA ROSA PLATEAU ECOLOGICAL RESERVE



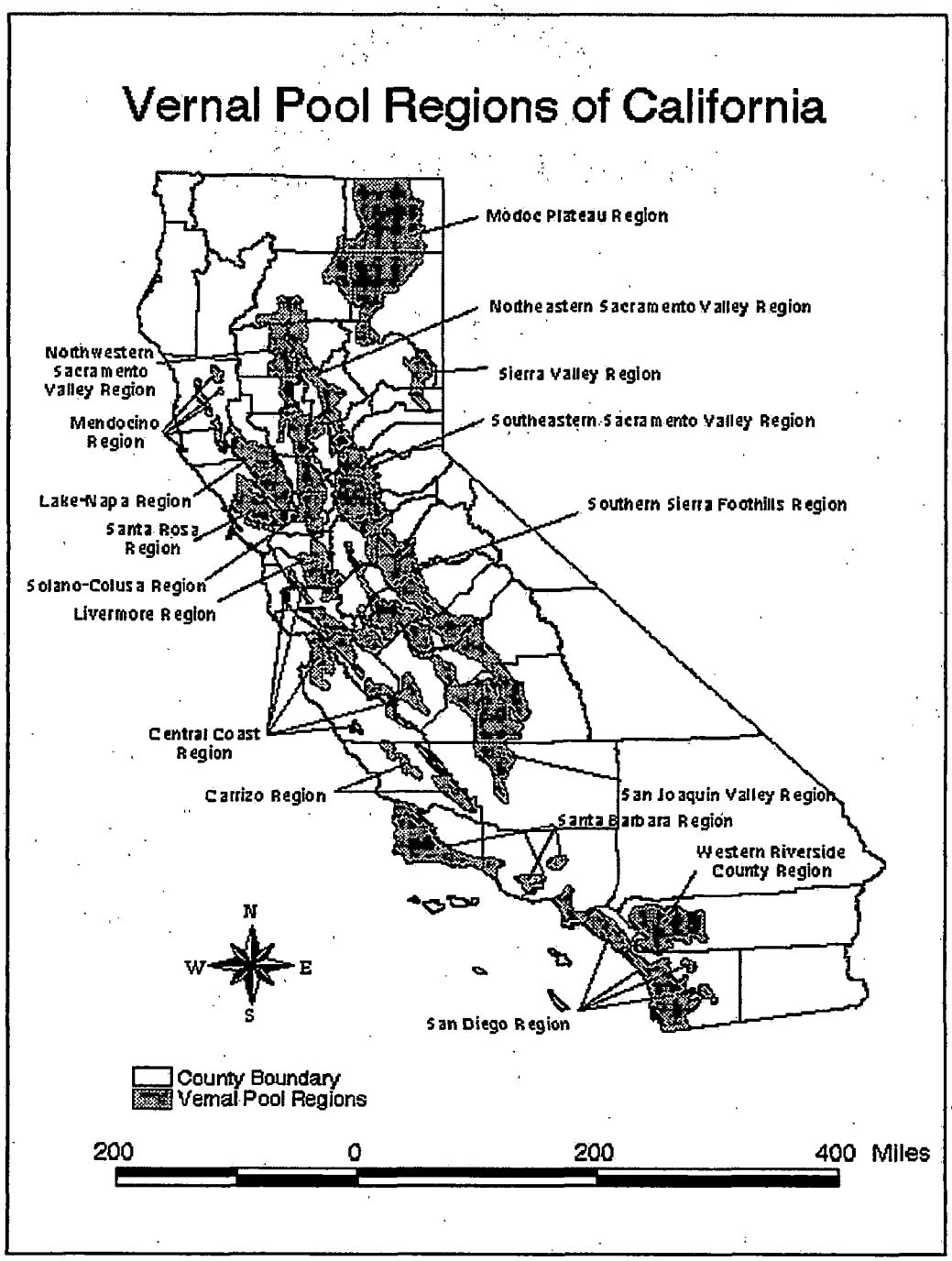
(This map is reprinted by the authorization of Rob Hicks at the Santa Rosa Plateau Ecological Reserve. See Appendix F).

MAP OF WESTERN RIVERSIDE COUNTY VERNAL POOLS



(This map is reprinted through the public domain authorization of the State of California, Department of Fish and Game, http://www.dfg.ca.gov/whdab/wetlands/vp_asses_rept/figures.htm.).

MAP OF CALIFORNIA VERNAL POOLS



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APPENDIX B

VERNAL HABITATS TEACHING MODULE

VERNAL HABITATS TEACHING MODULE

Summary

Vernal Habitats is a teaching module adapted from Wildlife Habitat Council's Hoptoad Habitats. It was designed to inspire a sense of stewardship and respect for amphibians and empower students to take action to conserve their local habitats. The module consists of hands-on inquiry, teamwork, and exploration of local ecosystems. There are optional pre-visit and post-visit lessons that complement the main inquiry-based study of a vernal pool and riparian habitat. The Wildlife Habitat Council is gratefully acknowledged for its immense contribution to this local Southern California regional curriculum.

Objective

Students will explore the concepts of habitat, amphibian life cycle, and the connection between habitat and amphibians. During optional pre-visit lessons, students will brainstorm in teams to determine habitat needs and develop an amphibian habitat plan for their own yards. Students will also complete their field guide by accurately coloring the species in preparation for the study visit. They will then develop observation skills though a field study visit to a vernal pool and streamside riparian

habitat, where they will use inquiry and teamwork. Following the visit, students will investigate questions generated during the visit, reproduce the habitat through a mural, and create signs to encourage awareness and conservation of the vernal pools in their community.

Lessons

The lessons are designed for students from third to fourth grade in the subjects of science, language, and art. The skills the students will practice are observation, research, inquiry, communication, animal and plant identification, habitat design, organization, creative thinking, and teambuilding. The materials needed for the lessons are the Santa Rosa Plateau Vernal Pools Field Journal, field guides, and art supplies. The module consists of three optional pre-visit lessons called Toads Together, Welcome Wildlife, and Hide n' Peep, a field study visit lesson entitled the Santa Rosa Plateau Vernal Pool and Riparian Study, and three optional follow-up lessons called Cool Pools Need Protection, Toad Abode, and Salamander Crosswalk.

PRE-VISIT LESSON 1 - VERNAL HABITATS: TOADS TOGETHER

Summary: This activity introduces the concept of habitat and the basic needs of all wildlife. Students will brainstorm in teams to determine these needs for a common amphibian in California, the Western Spadefoot Toad. This knowledge will prepare students for *Welcome Wildlife*, and the *Santa Rosa Plateau Vernal Pool* field study visit.

Objective: Students will understand the concept of habitat as food, water, shelter, and space, with an emphasis on the Western Spadefoot Toad. They will use this understanding to develop ways to improve amphibian habitat in their community.

Grades: 3-4

Subject: Science, language

Skills: teamwork, communication, habitat design

Materials: pencil, paper

Activity

1. To get a basic understanding of what a toad needs to live, we can look at what comprises a habitat. Students may work in groups; each student will number off by four (or a suitable number for the class), and all of the same numbers form a group. This will encourage interaction with other students and build teamwork skills.

2. Each team will make four columns on a sheet of paper, one for food, water, shelter, and space. In the group, one student should take notes, and another be prepared to write them on the board. Then the teams will brainstorm the possibilities to each of these habitat requirements for the toad. Encourage them to think like a toad, from a toad's perspective. Answers to one of the questions can also help answer another. For

instance, if you think you know what a toad eats, this may help you decide where it lives and finds shelter.

3. The following questions may help students think about these needs, and paint a picture of the toad's habitat. The focus questions may be given by the teacher as needed, or written on the board to stimulate thought.

   What does a toad eat?
   How does it get its food?
   Where does it find shelter in the summer?
   Where does it find shelter in the winter?
   Where does it find water?
   What does it need water for?
   How much space does a toad need?
   What about the tadpoles?
   What can we do to help make a home for toads?

4. Once the students have had ample time to brainstorm, a representative chosen by the students from each group will write their answers on the board under the appropriate category. The group can then discuss their answers, why they considered it, and if there are any questions or issues with their choices. Leave the answers on the board for the next activity.

5. Let students discuss ways each of these needs can be met in the student's backyard, the school grounds, or a nearby park. Some ideas to discuss may include,

   Not mowing along the edge of woods (food and shelter)
   Creating or protecting shallow pools of water (tadpoles)
   Planting flowers and grasses that attract insects (food and shelter)
   Building a pond
   Building a Toad House (See enrichment activity)
   Putting up toad lights (food)

6. Another local amphibian species can be used for this activity instead of the Western Spadefoot Toad, such as the California Newt. The Western Spadefoot Toad was chosen since it is common to the Santa Rosa Plateau area and other local vernal pools.

PRE-VISIT LESSON 2 - VERNAL HABITATS: WELCOME WILDLIFE

Summary:	This activity builds on a basic understanding of habitat by asking students to develop a habitat design for their own yards. This knowledge will prepare students for the *Santa Rosa Plateau Vernal Pool* field study visit.
Objective:	Students will create a habitat enhancement plan for their yard, schoolyard, or park for an amphibian species such as the California Toad or the American Bullfrog.
Grades:	3-4
Subject:	Science, language, art
Skills:	communication, creative thinking, habitat design, art
Materials:	graph paper, pencils, frog/toad stickers, colored pencils or crayons

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Activity

1. Now that students have an understanding of what comprises a habitat, and specifically what makes a toad's habitat, they will be asked to problem solve and apply the principles to their own yards, the school grounds, or a nearby park.

2. On graph paper, sketch a diagram of your yard (or other location) as if you were in an airplane looking down. Draw your house, driveway, trees, and shrubs, everything that is in your yard right now.

3. Look at your yard design. Do you have shelter for wildlife as it is now? What about food sources? Water? Remember that different animals eat different foods, so the lawn may be food for rabbits, but not for butterflies. If you do have food for the rabbit, do you have shelter? If not, how can you provide that?

Add drawings in ways to meet the habitat needs of many types of wildlife, or a particular or favorite species. The toad house, mini-pools, and natural areas that are not mowed are projects students should remember and possibly include in their plans.

4. Share the habitats, have students explain what was in their yard/area, and why they added things, what they hope to attract. Have other students offer suggestions to further improve the chances. Give each student who shares their design a wildlife sticker on their work, preferably a frog or toad.

PRE-VISIT LESSON 3 - VERNAL HABITATS: HIDE N' PEEP

Summary:	This game demonstrates through participation that frogs call to potential mates with a voice unique to each species. Students will gain an appreciation and understanding of the amphibians they hear each spring and summer.
Objective:	Students will understand that frogs call to attract a mate, and that each species has a unique call which can be identified by other frogs as well as biologists.
Grades:	3-4
Subject:	Science, language
Skills:	communication
Materials:	game cards, gummy worms (or other similar prize for the winning frogs), suitable location for hide-and-seek (preferably outside near water), frog calls (optional), Internet access (optional)

Activity

Background

Frogs and toads are often heard before they are seen. Their musical voices fill the evening air spring through summer. One of the earliest heralds of spring is not the robin, but a robust chorus of Pacific Treefrog in March. As the spring progresses, the night air is filled with the calls of the California Red-legged Frog, and then the musical trill of the California Toad. The low rumbles of the American Bullfrog, and the musical trill of the Arroyo Toad mark summer. Since each species has its own distinctive call, you can tell what frogs are nearby without ever seeing them.

Why do all these frogs sing anyway? Their calls are to attract a mate of the opposite sex. By announcing their

presence, male frogs tell nearby females "Here I am!" Females can then find a male they think is suitable, and breed. Since the eggs need to be in or near water, most calling occurs here as well.

The Game

1. Set up the atmosphere by asking the students to sit in a circle, close their eyes, and use their imagination to visit Peeping Pond. It is an early summer night; is it warm or cool? Let students answer each question. Is it pitch dark, or is there a full moon tonight? Do you hear anything? What does it sound like? Do you feel anything? Perhaps you feel a breeze, water in your shoes, grass tickling your legs?

2. Now announce that students will play frogs of different species that live at Peeping Pond. For a class of 20, there should be four duplicates of each call (cards follow on the next page). Ask the students why do frogs call? Explain that calls are used to locate other frogs of the same species for breeding. For instance, bullfrogs are calling to attract female bullfrogs, and treefrogs are calling for other treefrogs. Then tell them that each student will play a special type of frog, and they must make the sound as described on their card. Ask the entire class to make their call at the same time for practice. Peeping Pond is getting pretty loud!

3. Now instruct the class that they will play a game of hide n' seek around the marked area (give guidelines as to the area), but they are to find other frogs of the same species based on their calls alone. Everyone must make their frog calls, and the frogs that find all of their species first are the winners. For instance, all the treefrogs must find each other based on the krek-ek call, all the bullfrogs based on the jug-o-rum, etc. Whichever team joins up first wins control of the entire Peeping Pond. Gummy worms are especially appropriate prizes. Have students spread out first before calling, and then count down to sunset. Once the sun sets, let the calling begin!

4. For actual frog calls, there are a number of recordings that can be purchased through a large bookstore or nature store. These can be played while students close their eyes, or during the calling game. Students and teachers can also visit CaliforniaHerps.com for information and online frog vocals.

   http://www.californiaherps.com/frogs/frogs.html

GAME CARDS

Jug-o-rum (American Bullfrog)	Peep-peep-peep (California Toad)
Uh-uh-uh-uh-uh (California Red-legged Frog)	Krek-ek (Pacific Treefrog)
Fast musical trill (Arroyo Toad)	

STUDY VISIT - VERNAL HABITATS: SANTA ROSA PLATEAU

Summary: Students will visit an actual vernal pool to study the organisms that reside there and their interrelationships, including amphibians, insects, plants, etc. Students will use their personal Santa Rosa Plateau Vernal Pool and Riparian Field Journals to record observations about the pool, describe their collection and examination of organisms from a nearby riparian area, generate questions, and create a food web for the pool. (If a vernal pool absolutely cannot be found, other wetlands or the edges of ponds can be used when there is shallow, open water present).

Objective: Students will collect organisms from the riparian habitat using nets and other tools, observe and describe one organism, and consider its relationship to amphibians and other species that utilize the habitat. Students will also generate investigable questions from inquiry, as guided by the field journal.

Grades: 3-4

Subject: Science, language, art

Skills: observation, communication, inquiry, teamwork, art

Materials: Santa Rosa Plateau Vernal Pool and Riparian Field Journals, clipboards (pieces of cardboard), pencils or pens, dip nets, small sieves, transparent cups, paint brushes, white tubs (dish pans work well).

Preparation

The pre-visit lessons developed for Vernal Habitats may be used for preparation, or at a minimum, a basic knowledge of habitats and amphibians must be given. The teacher will

need to duplicate the Santa Rosa Plateau Vernal Pool and Riparian Field Journal for each student. The pages can be copied onto both sides of the paper, folded and stapled. Students should then color the field journal pages accurately by using resource materials such as nature field guides. This will familiarize students with the field markings of these species, which they may or may not see during the visit.

A vernal pool needs to be located prior to the visit in late winter, or the spring prior. If a trip to the Santa Rosa Plateau Ecological Reserve cannot be arranged, students and teachers may search nearby locations for these pools, and local natural resource organizations can be contacted for assistance. Since the pools are temporary in nature, timing is important if you cannot find a knowledgeable resource person. If there is not a vernal pool nearby, a small pond or wetland area with open water can also be used.

One regional Internet resource is California Vernal Pools at http://www.vernalpools.org/

Background

Vernal pools are temporary pools of water found each spring caused by snow melting and high rains (vernal is Latin for spring). They are temporary, lasting only several weeks to several months in the spring before drying up in summer. They are important habitat for amphibians, especially many salamanders and frogs. Some amphibians such as the California Tiger Salamander and the Western Spadefoot Toad are called "obligate" vernal pool species, meaning that they require vernal pools for breeding and cannot exist without them. Other amphibians are considered "facultative" species, meaning they often use vernal pools but can use other bodies of water as well.

Because vernal pools dry up in the summer, fish, a major predator of amphibian eggs and young, do not survive. The pools stay wet just long enough for the amphibians to hatch and mature. Unfortunately, many people view these amphibian nurseries as waste places or just huge puddles, and drain or pollute them. Other wildlife besides amphibians depend on them as well, including fairy shrimp, aquatic beetles, snakes, birds, trees, and plants.

The Santa Rosa Plateau vernal pools contain species of fairy shrimp that are found only every few years. Among the most vulnerable of these are the federally threatened vernal pool fairy shrimp, and the riverside fairy shrimp (indexed on the federal endangered list). Plants such as Orcutt's brodiaea (listed rare by the California Native Plant Society), thread-leaved brodiaea (both state-endangered and federally threatened), and San Diego button celery (both state and federal endangered species and designated rare by the California Native Plant Society), are present in Santa Rosa Plateau's vernal pool habitats. Because of the endangered listing of these species, students cannot physically interact with the pools. The student's hands-on sampling will take place at a nearby riparian streamside habitat.

Now that the students are prepared with a background and appreciation for amphibians, field study will enhance their learning and show them a real-world example of this habitat. Review the concepts of habitat, amphibians, and the issues facing them. Students will examine the wildlife in the pools and streams, as well as the soils nearby, and record their findings in the Field Journal.

The teacher or activity leaders should visit the vernal pool and the riparian streamside habitat ahead of time to locate areas that may be too sensitive for disturbance. Stations for each work group can be flagged with red survey tape, and other areas marked off to avoid disturbance or dangerous spots. One assistant adult leader per team of students is recommended to assist the students, and ensure the safety of both the students and the habitat. A location nearby should also be marked off for the soil survey.

Activity

1. Divide the students into work teams of 4-5, with an adult assistant leader. To add to the fun and sense of teamwork, have each group choose an amphibian-related name, such as the Tadpoles, Bullfrogs, Newts, etc. If students have work teams from earlier activities, these may be maintained.

2. While walking to the vernal pool, stop at the pre-marked location near the trail for the soil stop. Explain that here is where the salamanders reside,

under the soil, logs, and rocks. Ask students to grab a fistful of soil and feel its texture. What does it feel like? Is it dry or wet? Is it hard or soft? Is it gritty or smooth? Place the soil in the sieve and examine the contents. Is it only dirt? What else is in it? Do you see leaves, bark, or insects? If you don't know, sketch what you find. Would a salamander prefer this soil, or a lawn to dig through? (On the way back from the field trip, stop at the school lawn or an open field for another quick soil stop to compare and contrast the vernal pool area soils.

3. Once the class arrives at the vernal pool or pond, review ground rules (no running, stay in work stations, do not enter the water, etc.). Explain that these rules are required in order to be effective wildlife detectives and to protect the amphibians. Review with the students the endangered species that live in the pool. Ask each team what they expect to observe in the vernal pool. Discuss the habitat in detail with reference to protecting the area for amphibians and other sensitive species. Then the teams should collect their materials and hike to their respective stations along the riparian streamside habitat. Santa Rosa Plateau Vernal Pool and Riparian Field Journals may be left at the gathering location near the stream.

Phase I: Critter Collection

4. At the stations, the teams should take turns using the large dip nets to collect organisms in the stream for about 20 minutes. Remind them to sweep up the bottom and carefully sift through mud and leaves, where the majority of the organisms reside. Once students begin to look through the muck, they should transfer organisms with the cup or paintbrush to the tub of water, with as little much dirt as possible which will cloud the water and hide their findings. Teams may wish to have two tubs for transfer so that one remains clear and free of muck. Leaders should make certain that all muck is promptly returned to the water since organisms are likely still hiding within. Organisms that may be found include tadpoles, insect larvae, beetles, snails, etc.

Phase II: Critter Identification

5. At the end of the collection period, all teams should bring their white tubs with organisms back to the gathering spot for examination. Identification is not as important as the discovery of the biodiversity that lives within such a shallow, small area. Each team will choose one mystery organism, and follow the Field Journal to record pertinent information. Leaders should help students observe their tiny finds, looking at number of legs, appendages, color, etc. The California Vernal Pool website mentioned previously can provide information for general identification. Once again, identification is not as important as developing careful observation skills and recording information.

6. At the end of the Critter Identification, teams should share their findings. Discuss the mystery organisms' relationships to one another; discuss the relationships between these organisms and the amphibians, both in the larval and adult stages. Any questions about the organisms or their behavior can also be discussed. If tadpoles, eggs, or salamander larvae are found, extra attention should be spent on observation, including sketching by all teams. Eggs should never be removed however. Once finished, all organisms should be gently released back into the stream.

7. Students should now meet again at the gathering place. Have them write the names of all the organisms the entire class found randomly on a clean sheet of paper. Be certain that they don't forget plants and algae. Amphibians they found (any life stage) should be drawn near the center, since that is the focus of study. If students did not find any amphibians, have them draw a tadpole and a frog in the middle. Other nonliving items found in the pond should also be written in, such as leaves, mud, logs, bark, etc. Let the students connect the organisms that might depend on them for food, shelter, etc.

8. Once complete, ask students what their work looks like. Some students may say a web. Explain the web of life concept that all organisms depend upon one

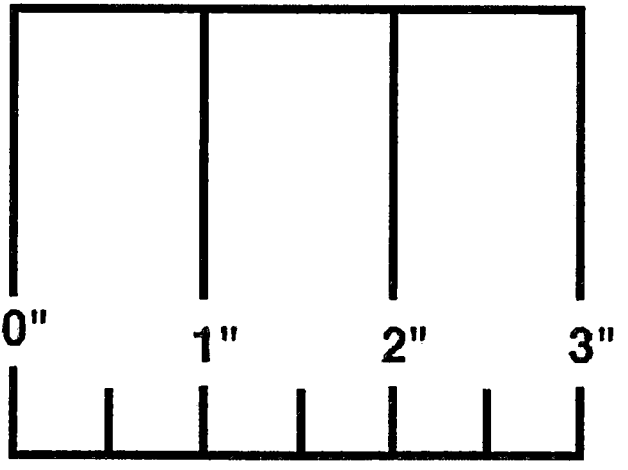
another, either directly or indirectly, and are woven together like a spider web. As an example, take one of the strands, such as the tadpole and algae, and explain how the absence of algae or other small plants would affect a tadpole. Or use the example of a fly larvae and a frog. Let students pick out strands of the web, and discuss. Then also mention, or let the students uncover, the dependence of living things on nonliving things, such as the water and dead leaves.

9. Lastly, or during the web creation, students should be given time to generate questions about the vernal pool and the streamside habitat, and their inhabitants in the "I wonder…" section of the Field Journal. Investigable questions can be topics for the students to conduct follow-up research, particularly if there are several issues that many of the students are curious about.

10. Continue with the post-lessons, follow-up activities, and resource information at your school site to add more value to this study module.

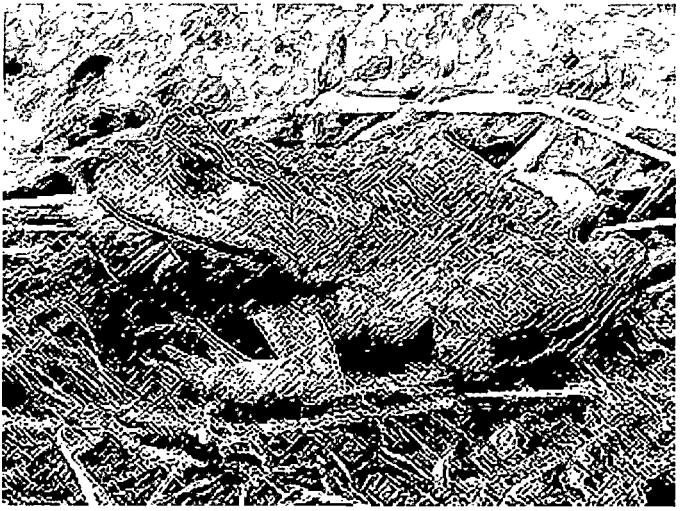
11. The Santa Rosa Plateau Vernal Pool and Riparian Field Guide is found on the following pages for duplication.

My Notes:



Santa Rosa Plateau Vernal Pool and Riparian Field Journal

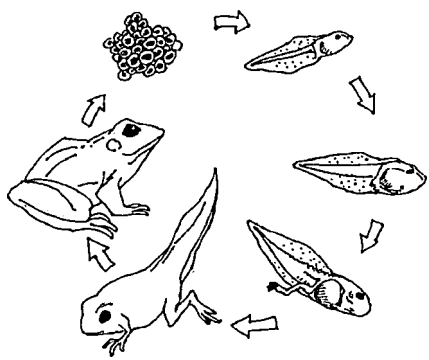
To be used in preparation for and during an ecology study visit to a vernal pool and riparian habitat.



Scientist's Name

What do we know about amphibians?

Frogs, toads, and salamanders are all examples of amphibians. The eggs of most go through an aquatic stage before they transform, or metamorphose, into adults. Because of this tadpole-like stage, amphibians must depend on water being available. Let's look at the American Toad, a common amphibian in most areas.



They first begin life as an egg, either in the water or a very damp place. Fish and other predators eat the eggs, so the parent often deposits hundreds to thousands of eggs at one time in a mass. The mass looks like jelly! Inside each egg, a tiny tadpole quickly develops.

A very special thanks to ASSET, Inc. (Allegheny Schools Science Education and Technology, Inc.), Classroom Clipart for photos and illustrations, and the Three Rivers Habitat Partnership (a WHC regional project) for journal development.

Investigations

Share your "I wonder" questions with your classmates. Did anyone else ask the same question as you? Are there any you would like to investigate further?

List some ways to further investigate your questions...

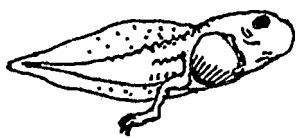
Many amphibians lay their eggs in shallow water that dries up in only a few months. Since fish cannot survive without year-round water, more eggs can hatch into tadpoles. But the young must grow quickly before the water dries up.

Vernal pools are a good example of such "puddles," and are found in nature in spring (vernal means spring in Latin). Vernal pools appear after the snow melts and spring rains fill depressions in the earth. Then amphibians such as frogs and toads and salamanders rush to lay their eggs. By summer, most vernal pools dry up, preventing fish predators from surviving.

Some amphibians can breed successfully only in vernal pools, like the California Tiger Salamander and the Western Spadefoot Toad. They are called obligate vernal pool species. If there were no more vernal pools on earth, these species would become extinct. Other amphibians often use vernal pools, but do not depend upon them since they can also breed in ponds and

other areas. The California Toad is an example of these types of species. Since they do not require vernal pools, they are called facultative vernal pool species.

The tadpole develops from the egg.



Soon the tadpole gets tiny legs, and the tail slowly disappears.

Less than a month later, a toadlet hops from the water. It is small enough to fit on the tip of your finger! It must hide from predators and yet hunt for food. Not many will survive long enough to mature into a large toad. But those that do will return to the vernal pools to breed and begin the cycle all over again.

Now that you have had time to meet some of the cool critters and plants that live in vernal pools and riparian streams, take a few minutes to reflect on the habitats. Scientists always have questions. They ponder problems or things they do not understand, and then try to investigate to understand the world better. What do you wonder about?

I wonder about...

I wonder about...

I wonder about...

Now share your observations with the other teams. Were there any amphibians? If so, write their names below. What stag are they in?

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Could any of the organisms serve as food for amphibians? If so, which life stage, aquatic or adult? Why?

A Map of your Habitat Study Area

Draw a map from above of your study habitat, as if you were a bird looking down. Draw any features such as trees, logs in the water, plants, etc. Then mark an X at your assigned study area.

A habitat is a scientific word for a place that provides all the needs of a living creature or organism. All organisms need certain things to live. Can you think of a list of things you need in order to survive? Write it below. Then compare your list with your classmates. Can you find several things that everyone needs in order to survive? Circle them.

When you visit the Habitat Study Area, you will look for amphibians and the organisms that live alongside them. What do you think a frog needs to survive?

What do you think a tadpole needs to survive?

Are they the same, or different? Why?

The next pages are your own personal field guide to common amphibians. Use a real field guide to color in the pictures as accurately as you can. Notice the subtle differences in color, shape, and markings to help you identify them in the wild.

An asterisk (*) indicates an obligate vernal pool species. Remember, if they are obligate, that species will only be found to breed in a vernal pool. The others will commonly use vernal pools as well as other habitats.

Have fun jumping through the world of vernal pools! They are much more than just oversized puddles.

Now watch your organism. Describe what it is doing. Is it swimming, lying on the bottom, the top of the water? How is it swimming (in circles, short bursts, not at all)? Is it hiding from other critters? Is it alive? Would it act like this in the vernal pool?

Behavior:

Using your field guides and charts, can you identify what this organism is? If not, can you investigate this later?

Description or drawing of a "Mystery" organism

Your job as a scientist is to record everything you can about this critter. Write and/or draw an entry so descriptive that another person would be able to identify it. Does it have legs? How many? Eyes? Wings? What do they look like? How big or small is it? What color? Does it have a tail?

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Where in the pool did you find it? Did you find it on the edge, on top of the water, along the grass, in the muck, in leaves, in the middle of the water, or in clear water?

My Field Guide:
Common Amphibians in Southwestern Study Habitats

California Toad
(Bufo boreas halophilus)

Pacific Treefrog
(Pseudacris regilla)

My Field Guide:
Common Amphibians in Southwestern Study Habitats

American Bullfrog
(Rana catesbeiana)

Western Spadefoot Toad (*)
(Spea hammondii)

Phase II: Critter Identification

At the end of the collection time, return to the group area with your team to further discuss your findings. Choose one organism that you found to study. You will record what the organism looks like through notes, drawings, behavior, where it was found in the stream, and its name if you can identify it with the help of other resources. Think about how this organism is important to the amphibians and other animals that live in or visit the stream.

Team Name: _____

Date: _____

Weather Conditions:

Sunny	Cloudy
Warm	Cool
Rainy	Windy

Notes and Drawings

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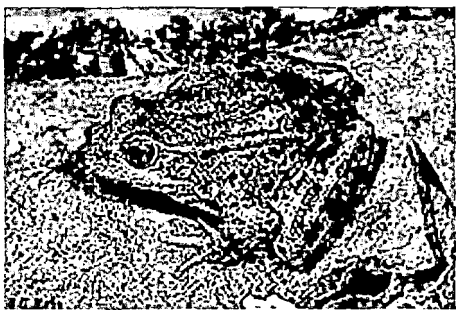
My Field Guide:
Common Amphibians in Southwestern Study Habitats

California Newt
(Taricha torosa)

California Red-legged Frog
(Rana draytonii)



Vernal Pool Visit: Spring

It is spring now, the rains are falling, snow is melting, and vernal pools come to life. Let us visit the vernal pool to discover what types of animals and plants are living there. The pool is like a neighborhood full of different critters, all of which make up a community. Vernal pools are especially important for amphibians, since they are nurseries for many species such as salamanders.

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Phase 1: Critter Collection: Amphibians and their Neighbors

Choose a team name that is somehow amphibian related, such as the Newts, Tadpoles, or Bullfrogs. You will visit a station as directed by your instructor to collect organisms that live within the stream.

Dip your net into different areas in the stream, such as the top, the middle and the mucky bottom to collect organisms such as insects, tadpoles, salamander larvae, snails,

or other critters. Try to remember where you found the different organisms. Sift through the mud and leaves to look for organisms. Your observation skills are very important in this step.

When you find an organism, gently transfer it to a cup with water, using the paintbrush if needed. All critters can be placed into the large white pans for later study. Be careful not to get mud into the white pan, which will cloud the water and hide your findings. Take turns with the large nets, and remember to always return any muck back to the pool since many organisms may be hiding within it.

Do not step into the water, or run, for your own safety and the safety of the habitat and its creatures. Step lightly!

POST-VISIT LESSON 1 - VERNAL HABITATS: COOL POOLS NEED PROTECTION

Summary:	This activity encourages students to take action to conserve valuable amphibian habitat, such as vernal pools, through creative expression and local action.
Objective:	Students will create signs to raise awareness and encourage protection of the vernal pool they visited, and/or other vernal pools in the community.
Grades:	3-4
Subject:	art, language
Skills:	art, communication, design, woodworking
Materials:	plywood, paper, laminator, paints or permanent markers, screws or nails, disposable cameras (optional)

Overview

Now that students appreciate the importance and uniqueness of vernal pools, they may wish to protect them and share what they have learned. In this activity, students will create signs geared towards protecting vernal pool habitats. They may be placed at vernal pools or other important amphibian breeding grounds throughout the area. The district's wood shop or Parent Teacher Association could be consulted for assistance with the materials and creation of the signs.

Activity

1. Students could choose what method they wish to make their sign to allow for personal expression, as well as use their own talents. For instance, most children may wish to draw and color on paper, which the teacher will then heavily laminate, and can be glued or nailed to the wooden sign. Other students may prefer to wood burn at home or in class (if resources allow), or

paint on the wooden sign itself. Since the signs should actually be placed near the pools, they should be as durable as possible. Once the artwork is complete, the sign will be secured to a post.

2. Ideas for the wording include, but are not limited to these suggestions.

   "Salamander Breeding Pond: Please Use Caution"
   "Vernal Pool Habitat: Please Do Not Litter"
   "Protect Our Vernal Pools"
   "Home for Frogs, Toads, and Salamanders: Tread Lightly"

3. Students can decide where they want their sign to be posted as they are working on them, and should even search for other vernal pools in their neighborhood. If they cannot find any, other students may have suggestions.

4. Students should be asked to report back on where they posted their sign. They could take turns using a disposable camera to record their sites, which would then be posted on a board.

POST-VISIT LESSON 2 - VERNAL HABITATS: TOAD ABODE

Summary: Toad Abodes, or toad houses, and other habitat projects are simple, fun ways to learn about habitat and encourage personal action. A toad house provides shelter for the toad, and is a good example of reusing products instead of throwing them away. They will hide in the shelter of dense grasses, or flowers, under rocks, in retaining walls, and even under terracotta pots. Students can choose from the following three projects to enhance amphibian habitat in their own yards or schoolyard.

Objective: Students learn practical projects to provide habitat for amphibians through the reuse of disposable items.

Grades: 3-4

Subject: science, art

Skills: art

Materials: old, broken terracotta pots, outdoor paints, disposable pie pans, rocks or pebbles

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Activities

1. Toad House

Most people have a broken terracotta pot lying around. Instead of tossing it in the trash, turn it upside down in a secluded portion of the yard or garden. A small crack can serve as the door. If there is no "door," prop the pot up slightly with a rock so the toad can access the interior. Toads particularly like the house if it is lined with sand, which they will dig into. Have students bring in broken pots, or collect them from other teachers and neighbors. Then have students decorate their toad houses with paints, stickers, or whatever they choose. Toads, dragonflies,

and other related themes may be painted on them. The houses can then be taken home, and/or placed in the schoolyard habitat. Make sure a saucer of water is placed close to the Toad Abode unless there is standing or running water near the area. Instructions for a toad house are also online.

www.nwf.org/backyardwildlifehabitat/toadabode.cfm

2. Rock Piles

Build a low pile of rocks, with a shady, cool space in the middle. Toads will hide from the sun in here, and wait for passing insects at night. This is a nice accent in a native flowerbed or vegetable garden. The toads will eat your slugs and insects that damage the plants.

3. Mini-ponds

Another reuse idea is to use the disposable pie pans and planting pot saucers as miniature "pools." These can be placed in a shallow depression in the flowerbed, garden, or corner of a yard to serve as a water source for toads and other wildlife. Line the pool with either pebbles or sand. Toads will visit for a nice soak, and even songbirds will stop by for a drink and a bath.

POST-VISIT LESSON 3 - VERNAL HABITATS: SALAMANDER CROSSWALKS

Summary: This activity is designed to stimulate thought about what students have learned regarding amphibians and their habitats over the course of the module, and provides a medium to link self with society. In the process of encouraging problem-solving and creative writing, the teacher may also use the resulting story to probe the students' understanding and content knowledge regarding amphibian habitats.

Objective: Students will write a creative essay to solve a conflict based on a fictional situation involving amphibians and suburban development. The essay will encourage creative problem solving and draw on students' knowledge of amphibians.

Grades: 3-4

Subject: language

Skills: writing, communication, problem-solving, public speaking

Materials: pencil, paper

Activity

In Salamander Sidewalks, students will be asked to determine the "why" in a situation, solve a problem (or multiple problems if they choose), and defend their prediction through facts and terms learned. A minimum of facts is to be provided, and the teacher should encourage and expect many varied "answers." Ample time should be provided to allow the students to carefully consider the situation and recall what they have learned.

Step 1. The Situation:

The citizens of Watersville have asked you, an amphibian habitat expert, to visit their town to solve a problem. A massive migration of salamanders is occurring across a busy local highway. The first rainy spring night this year, thousands of small, red salamanders tried to cross the new highway. The highway was built last fall through the middle of Big Oak Woods to access a shopping mall. There were a number of wetlands that had to be destroyed to build the road, but others were protected when possible. Some local residents are upset about running over so many of these creatures at one time, while others find it plain disgusting. Either way, the sheriff is depending upon you to do something.

Step 2. Your Suggestion:

Based on your knowledge of amphibians and their habitats, your task is to write a story explaining what may be occurring at Big Oak Woods, and offer possible solutions to save these red salamanders. There are no right or wrong answers, but what you have learned so far about amphibians and their habitats will help you determine what is occurring and why. Finding a solution, however, will require creative problem solving, as well as an understanding of the salamander's behavior. The local paper would like to publish a story about what you think is occurring and the solution. Your task is to write a story that explains what these creatures are, why they are crossing in massive numbers in spring, where they came from and where they are going, and a potential solution to prevent this road kill. Discuss your solution, explaining why it might work as well as potential problems. Some of the citizens want to protect the salamanders, while others don't care. Remember, the citizens do not know anything about salamanders, and are asking you to help.

Step 3. (Optional) Public Forum

The teacher may wish to have all students read their essays, and then allow students to ask questions about their suggestions. Or the teacher may wish to choose three stories that are very different, and have the students read them to the class for discussion and comparison.

Teacher Notes

The salamanders are crossing the highway to breed. The students can infer this since the season is spring, and the condition during the event is a rainy, spring night. Since the highway is new, this problem had not existed before, and the students may indicate this as a link between society and environmental conflicts. Students may explain the relationship between salamanders and vernal pools, their secretive nature, and the timing of the migration. At minimum, the students should connect the migration with breeding, and the potential habitat on the other side.

Although it is given that wetlands were destroyed, we do not know if there are any vernal pools on the other side of the road. Students may infer that there are, and may suggest studies to find them, an excellent link demonstrating actions to be taken to better access the problem. The vernal pools may have been drained or damaged during construction or either the road or the mall. In addition, if the pools are near the road, pollutants from the highway may degrade the water quality and impact the organisms. Students may suggest that the pools be protected. At minimum, students should mention that vernal pools were at least historically present, which is triggering the migration across a road that was previously not there.

Solutions to this problem may range widely. Potential possibilities include an underground salamander crossing (actually implemented, see the website below), crossing signs, closing the road on migration nights, volunteers moving the salamanders in buckets or by hand, or altering the highway. Remember, there are no wrong or right answers, but the students should provide some rational and discussion of positive and negative aspects of their solution. Students should also discuss the protection of vernal pools and the benefits of amphibians to help persuade the public to find a mutually beneficial solution.

If you are interested in a real life example of a salamander solution, review the website below.

http://www.fhwa.dot.gov/environment/wildlifecrossings/salamand.htm

APPENDIX C

VERNAL POOL RESOURCES

RESOURCES AND TOOLS

Vernal Pools

Santa Rosa Plateau Ecological Reserve
39400 Clinton Keith Road
Murrieta, CA 92562
(951) 677-6951
http://www.santarosaplateau.org/home.html

Understanding the Plants and Animals of the Western Riverside County Multiple Species Habitat Conservation Plan
http://ecoregion.ucr.edu

California Vernal Pools
http://www.vernalpools.org/

Environmental Protection Agency
http://www.epa.gov/owow/wetlands/types/vernal.html

Frogs and Amphibians

CaliforniaHerps.com
http://www.californiaherps.com/frogs/frogs.html

AmphibiaWeb
http://amphibiaweb.org/

Center for Global Environmental Education
A Thousand Friends of Frogs
http://cgee.hamline.edu/frogs/

Frog Watch USA
http://www.nwf.org/frogwatchUSA/

Partners in Amphibian and Reptile Conservation (PARC)
http://www.parcplace.org/education.html

Habitats

Wildlife Habitat Council
http://www.wildlifehc.org

National Wildlife Federation
http://www.nwf.org/habitats

Wild Ones
http://www.for-wild.org/

APPENDIX D

ENVIRONMENTAL PRINCIPLES AND CONCEPTS

Education and the Environment Initiative
Assembly Bill 1548 (Pavley, Chapter 665,
Statutes of 2003)

ENVIRONMENTAL PRINCIPLES AND CONCEPTS

The environmental principles examine the interactions and interdependence of human societies and natural systems. The nature of these interactions is summarized in the environmental principles and concepts that are presented below.

Principle I
The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services. As a basis for understanding this principle:

Concept a. Students need to know that the goods produced by natural systems are essential to human life and to the functioning of our economies and cultures.

Concept b. Students need to know that the ecosystem services provided by natural systems are essential to human life and to the functioning of our economies and cultures.

Concept c. Students need to know that the quality, quantity and reliability of the goods and ecosystem services provided by natural systems are directly affected by the health of those systems.

Principle II
The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies. As a basis for understanding this principle:

Concept a. Students need to know that the direct and indirect changes to natural systems due to growth of human populations and their consumption rates influence geographic extent, composition, biological diversity, and viability of natural systems.
Concept b. Students need to know that methods used to

extract, harvest, transport and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems.

Concept c. Students need to know that the expansion and operation of human communities influences the geographic extent, composition, biological diversity, and viability of natural systems.

Concept d. Students need to know that the legal, economic and political systems that govern the use and management of natural systems directly influence the geographic extent, composition, biological diversity, and viability of natural systems.

Principle III
Natural systems proceed through cycles that humans depend upon, benefit from and can alter. As a basis for understanding this principle:

Concept a. Students need to know that natural systems proceed through cycles and processes that are required for their functioning.

Concept b. Students need to know that human practices depend upon and benefit from the cycles and processes that operate within natural systems.

Concept c. Students need to know that human practices can alter the cycles and processes that operate within natural systems.

Principle IV
The exchange of matter between natural systems and human societies affects the long-term functioning of both. As a basis for understanding this principle:

Concept a. Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting byproducts.

Concept b. Students need to know that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect.

Concept c. Students need to know that the capacity of natural systems to adjust to human-caused alterations depends on the nature of the system as well as the scope, scale, and duration of the activity and the nature of its byproducts.

Principle V
Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes. As a basis for understanding this principle:

Concept a. Students need to know the spectrum of what is considered in making decisions about resources and natural systems and how those factors influence decisions.

Concept b. Students need to know the process of making decisions about resources and natural systems, and how the assessment of social, economic, political, and environmental factors has changed over time.

APPENDIX E

CALIFORNIA STANDARDS CORRELATIONS

CALIFORNIA STANDARDS CORRELATIONS TO ENVIRONMENTAL PRINCIPLES AND CONCEPTS FOR 3RD GRADE

The 3rd grade life science standards correlations listed here correspond to and reference all of the lessons included in this module.

Life Sciences 3. Adaptations in physical structure or behavior may improve an organism's chance for survival. As a basis for understanding this concept:		
a. Students know plants and animals have structures that serve different functions in growth, survival, and reproduction.	I a b; III a c	• Plants and animals have different structures that allow them to grow, survive, and reproduce or to use the goods produced within the ecosystem to meet their needs. These functions play important roles in the production of some of the goods and services essential to human life and integral to our economies and cultures. • Organisms have adaptations to help them survive in a given environment. If an environment changes either through human activity or natural occurrences, organisms may or may not have the adaptations that would enable them to survive. Organisms cannot simply adapt when environments change. • Growth, survival and reproduction of plants and animals are cycles and processes necessary for the functioning of natural systems. • These processes can be influenced by human activities.
b. Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.	I a b c; II a b c d	• Different environments produce different quantities and qualities of goods and ecosystem services, depending in part on the plants and animals that live there. The quality, quantity, and reliability of resources within a natural system are assured only when this composition of plants and animals is maintained. • Different kinds of organisms are adapted for living in different environments. If an environment changes either through human activity or natural occurrences, some of the organisms that live there may not survive. • The growth of human populations, expansion of human communities, natural resource production and consumption patterns, and laws and policies governing use of natural systems influence the geographic extent, composition, biological diversity, and viability of those systems.
c. Students know living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms, and some are beneficial.	I a b c; II a b c d; III a c; IV a b c ; V a	• Natural systems produce goods and ecosystem services essential to human life. As environments change, whether by human activity or natural occurrences such as succession, the goods and ecosystem services those environments provide also change. • The growth of human populations, expansion of human communities, natural resource production and consumption patterns, and laws and policies governing use of natural systems influence the geographic extent, composition, biological diversity, and viability of those systems. • The health of natural systems depends on maintaining the natural cycles and system processes that operate within them. Human activities change the patterns of flow and natural cycles. • The quantity of resources used, the energy consumed, and the byproducts of human activities can affect the way natural systems function. Byproducts of human activities are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect. The capacity of natural systems to adjust to change varies with the nature of the system and the nature and scope of the alterations.

d. Students know when the environment changes, some plants and animals survive and reproduce; others die or move to new locations.	I a b c; II a b c d; III a c; IV a b c; V a	• Natural systems in any environment produce goods and services essential to human life. As environments change, whether by natural phenomenon such as succession or human-generated occurrence, the goods and services those environments produce also change. • The growth of human populations, expansion of human communities, natural resource production and consumption patterns, and laws and policies governing use of natural systems influence the geographic extent, composition, biological diversity, and viability of those systems. • Organisms that already have adaptations may survive in a given environment. If an environment changes, organisms may or may not have the adaptations that would enable it to survive. • The health of natural systems depends on maintaining natural cycles and system processes. Human activities change the patterns of flow and natural cycles. • The quantity of resources used, the energy consumed, and the byproducts of human activities impact the way natural systems function. Byproducts of human activities are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect. The capacity of natural systems to adjust to change varies with the nature of the system and the nature and scope of the alterations.
e. Students know that some kinds of organisms that once lived on Earth have completely disappeared.	I c; II a b c d; III a c; IV a c; V a b	• Extinction of species changes the quality, quantity and reliability of goods and services produced by natural systems. • The growth of human populations, expansion of human communities, and the natural resource production practices and consumption of humans cause changes in natural systems, including extinction of species. Laws, regulations, and policies governing the management of threatened and endangered species can prevent or delay extinction of species. • Natural systems proceed through cycles and processes that are required for their functioning. Extinction can occur in response to human activity or natural cataclysms. • Human activities such as energy consumption, use of goods, and generation of byproducts as a result of human activity can result in the extinction of species. • The ability of natural systems to adjust to change varies with the nature and scope of the alterations. In some cases, organisms that once lived on Earth have disappeared completely. Humans can adjust their practices to prevent extinction of species.

CALIFORNIA STANDARDS CORRELATIONS TO ENVIRONMENTAL PRINCIPLES AND CONCEPTS FOR 4th GRADE

The 4th grade life science standards correlations listed here correspond to and reference all of the lessons included in this module.

Life Sciences 2. All organisms need energy and matter to live and grow. As a basis for understanding this concept:		
a. Students know plants are the primary source of matter and energy entering most food chains.	I a b c; III a b c; IV a b c	• Plants are among the goods produced by natural systems upon which humans and other animals rely for food. Plants provide an ecosystem service by converting sunlight into a form that is usable by humans and other animals. • The health of natural systems affects the quality, quantity, and reliability of food chains. • Food chains and webs are among the natural cycles and processes essential to the function of natural systems. • The quantity and toxicity of waste and other byproducts introduced by humans into natural systems can be taken up by plant roots and thus enter food chains. The byproducts of human activity are not readily prevented from entering natural systems and may be detrimental to plant life. • In some cases, plants also play a role in the detoxification of waste and the cycling of nutrients —ecosystem services upon which humans depend.
b. Students know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.	I a b c; II a b c d; III a b c; IV a b c	• Producers (plants) are among the goods produced by natural systems upon which humans and other animals rely for food. Plants provide the service of converting sunlight into a form of energy (food) that is usable by humans and other animals. The health of natural systems affects the quality, quantity, and reliability of producers and consumers and the food chains and webs that connect them. • Food chains and webs are among the cycles and system processes required for natural systems to function. Many factors, including the human use of resources, can affect the competition for resources among other producers and consumers, altering the natural flow of energy and matter in natural systems. The byproducts produced by human activities can enter food chains and affect natural systems. • The capacity of natural systems to adjust to human alterations in food chains and webs varies with the nature of the system and the nature and scope of the alterations.
c. Students know decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.	I a b c; II a b c; III a b c; IV a b c	• Decaying plants and animals contain matter (nutrients) that can be counted among the goods produced by natural systems upon which humans and other animals rely for food. Decomposers provide ecosystem services by returning nutrients to the soil for further uptake by plants and enhancement of soil quality. • Decomposers play an essential role in the cycles and processes that comprise the food chains and webs required for natural systems to function. • Human practices can alter the flow of matter and energy in natural systems. • The byproducts produced by human activities can enter food chains and affect the natural systems. • The capacity of natural systems to adjust to human alterations in food chains and webs varies with the nature of the system and the scope of the alterations.

3. Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept:		
a. Students know ecosystems can be characterized by their living and nonliving components.	I a	• The living and nonliving components of an ecosystem and their interactions produce goods essential to human life and integral to our economies and cultures.
b. Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.	I c; II a b c d; III a c; IV a c	• The health of an ecosystem affects the ability of plants and animals to survive in any particular environment and therefore influences the quality, quantity, and reliability of the goods and ecosystem services that natural systems produce. • The cycling of energy and matter within natural systems affects the survival of plants and animals in any particular environment. Human activities can change the patterns of flow and natural cycles and make it more difficult for some kinds of plants and animals to survive. • The quantity and qualities of the matter, energy, and waste that flow between natural and human systems differ with the practices employed in various human activities. Human activities can make it more difficult for some kinds of plants and animals to survive. • The capacity of natural systems to adjust to human alterations varies with the nature and scope of the alterations. These alterations can make it more difficult for plants and animals in a particular environment to survive.
c. Students know many plants depend on animals for pollination and seed dispersal, and animals depend on plants for food and shelter.	I a b c; II a b c d; III a c; IV a c	• Maintaining the interdependence of plants and animals is a vital component in the cycling of energy and matter within and between natural and human systems. Human activities can change the patterns of flow and natural cycles and make it more difficult for plants and animals to interact, survive, and reproduce. • The quantity and qualities of the matter, energy, and waste that flow within natural systems differ with the practices employed in various human activities. Human activities can make it more difficult for some kinds of plants and animals to interact, survive, and reproduce.
d. Students know that most microorganisms do not cause disease and that many are beneficial.	I a b c	• Microorganisms provide essential services within a natural system. • The ability of microorganisms to function effectively is directly affected by the health of the natural system.

APPENDIX F

AUTHORIZATION LETTERS

1802 Acacia Lane
Fallbrook, CA 92028
tom@tchester.org

February 19, 2006

Lin Matthews
P.O. Box 906
Idyllwild, CA 92549

Dear Lin:

You have my permission to reproduce my web article on the *Vernal Pools of the Santa Rosa Plateau, published on the web at this URL:*

http://tchester.org/srp/vp/index.html

in your master's project, *An Elementary Habitat Curriculum For The Santa Rosa Plateau Ecological Reserve.*

Sincerely,

Tom Chester

January 28, 2006

To Whom It May Concern,

One of the missions of the Santa Rosa Plateau Ecological Reserve is to share the Plateau's natural and cultural history through on-site and off-site programming. It is for this reason that we grant full permission to Lin Matthews to utilize any printed or internet-accessed materials related to the Reserve.

"An Elementary Habitat Curriculum for the Santa Rosa Plateau Ecological Reserve" will serve as an important tool in the sharing of the Plateau's resources and their conservation.

Sincerely,

Robert Hicks
Park Interpreter
Santa Rosa Plateau
Ecological Reserve

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