

Table Rocks Curriculum

Dive into Vernal Pools!

Objective: Students will investigate the *vernal pool* ecosystem and its inhabitants. They will explore *adaptations*, lifecycles, and interrelationships of *vernal pool* species. Students will also investigate how environmental factors may affect *vernal pools* and their inhabitants.

Benchmarks Targeted: 1, 2, and 3 (Grades 3-8)

Oregon Standards:

Subject Area: Life Science

Common Curriculum Goals: Organisms: Understand the characteristics, structure, and functions of organisms.

Benchmark 1: Describe the basic needs of living things.

Benchmark 2: Group or classify organisms based on a variety of characteristics. Describe basic plant and animal structures and their functions.

Common Curriculum Goals: Diversity/Interdependence: Understand the relationships among living things and between living things and their environments.

Benchmark 1: Describe a habitat and the organisms that live there. Identify how some animals gather and store food, defend themselves, and find shelter.

Benchmark 2: Describe the relationship between characteristics of specific habitats and the organisms that live there. Describe how adaptations help a species survive.

Common Curriculum Goals: Heredity: Understand the transmission of traits in living things.

Benchmark 2: Describe the life cycle of an organism.

Subject Area: Scientific Inquiry

Common Curriculum Goals: Forming the Question/Hypothesis: Formulate and express scientific questions or hypotheses to be investigated.

Benchmark 1: Make observations. Based on these observations, ask questions or form hypotheses, which can be explored through simple investigations.

Benchmark 2: Make observations. Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations.

Benchmark 3: Based on observations and scientific concepts, ask questions or form hypotheses that can be explored through scientific investigation

Common Curriculum Goals: Designing the Investigation: Design safe and ethical scientific investigations to address questions or hypotheses.

Benchmark 1: Plan a simple investigation

Benchmark 2: Design a simple investigation to answer questions or test hypotheses.

Benchmark 3: Design a scientific investigation to answer questions or test hypotheses.

Common Curriculum Goals: Collecting and Presenting Data: Conduct procedures to collect, organize, and display scientific data.

Benchmark 1: Collect data from an investigation.

Benchmark 2: Collect, organize, and summarize data from investigations.

Subject Area: The Arts

Common Curriculum Goals: Create, present and perform: Apply ideas, techniques and processes in the arts.

Benchmark 1: Use experiences, imagination, essential elements and organizational principles to achieve a desired effect when creating, presenting and/or performing works of art.

Benchmark 2: Use experiences, imagination, observations, essential elements and organizational principles to achieve a desired effect when creating, presenting and/or performing works of art.

Benchmark 3: Select and combine essential elements and organizational principles to achieve a desired effect when creating, presenting and/or performing works of art.

Length of Lesson: 1-2 hours over several days

Materials:

- ✓ “Vernal Pool Activity Sheets” (provided)
- ✓ Pencils
- ✓ Various art supplies- clay, paper mâché, crayons, markers
- ✓ Coat hangers or sticks (to make mobiles)
- ✓ String

Key Vocabulary: *adaptation, cyst, crustacean, macro-invertebrates, metamorphosis, predator, vernal pool*

Background:

See Chapter Introduction

Procedure:

Preparation:

With the background information provided, discuss the *vernal pool* ecosystem with your students. Have students read the “Vernal pools and the Table Rocks” information sheet included in this activity. Use the provided “Vernal Pool Activity Sheets” to reinforce their understanding of this unique habitat.

Activity:

Discuss *adaptations* various animals (or even humans) have to ensure survival in their environment. Many *vernal pool* species undergo *metamorphosis* during their life cycle. You may find it helpful to explain the term *metamorphosis*. Each student will either choose or create an organism that would live in or around the *vernal pools*. Have students research the life cycle, food sources, *predators*, and *adaptations* associated with the organism. Have students fill out the “How could you live in a vernal pool?” activity sheet for guidance in addition to the “Animals of the Vernal Pools” sheet.

Grades 6-8: Explain to students they will present the species they researched/created to the “scientific community” (their classmates). They will pretend to be scientists who have just discovered a new *vernal pool* species. In order to do this, they must create a drawing, puppet, or model/sculpture of their *vernal pool* organism. Students should focus on *adaptations* (e.g., fairy shrimp eggs are enclosed in *cysts* that protect embryos; Pacific treefrogs only use the pools at the beginning of their life cycle), and present them in their art project.

Scientific Inquiry:

Discuss with students the possible effects of human activities on the **vernal pools** and the animals that depend on them. Talk with the students about the fragility of **vernal pool** habitat and how conditions in the pools (temperature, water chemistry and quality, available water) are easily altered by the construction of roads, ditches, trails, mining operations, and overgrazing. For example, oil and gasoline runoff from roads pollutes **vernal pool** habitat.

Grades 6-8: Obtain a sea monkey (brine shrimp, *Artemia salina*) kit for the classroom. Have students record daily or weekly observations of the sea monkey life cycle. After a few weeks of observation, have students hypothesize how various conditions - temperature, source of water, placement of tank - might affect the survival of the sea monkeys. Amplify the experiment by purchasing more than one kit. Have students brainstorm ways to change the conditions inside the sea monkey tank and make these changes. Maintain at least one kit as a “control” (no alterations) to compare the altered kits and to observe how changing the environment affects the sea monkeys. Discuss with students the relationship between the sea monkey experiment and how changing environmental factors could affect fairy shrimp.

* You can learn more about sea monkey kits at: <http://www.sea-monkeys.com>.

Extensions:

- Have students create a mobile to illustrate the life cycle of their **vernal pool** animal.
- Create puddles on the school playground by pouring water into depressions in the asphalt. While there may not be much in the way of life *in* the artificial pool, you can watch for life *around* it by sprinkling flour or cornstarch in the surrounding area and looking for animal tracks the next morning.
- Divide students into groups of five or six. Have each group create a play depicting a **vernal pool** food chain with each student acting the part of their chosen animal.

Discussion Questions:

If you were a vernal pool fairy shrimp, who would your closest relatives be?

Any of the primitive aquatic (mainly freshwater) crustaceans including: brine shrimp, tadpole shrimp, and water fleas. More distant relatives include other crustaceans such as lobster, crab, and barnacles.

What are some of the greatest threats to vernal pool fairy shrimp and their habitat?

Human activity is the greatest threat to the survival of the vernal pool habitat. The relatively flat meadow-like areas where vernal pools exist are frequently destroyed by urban/suburban development, agriculture, and soil compaction by off-highway vehicles and other vehicles. In addition, conditions in the pools (i.e. temperature, water chemistry and quality, availability of water) are potentially altered by the construction of roads, ditches, trails, mining operations, wetland draining, and overgrazing. However, there are some studies that have shown limited grazing may not be harmful. It may actually help to support the vernal pool environment by reducing the amount of thatch that can fill in the pools.

References:

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- “Educational Activities with Vernal pools.” The Vernal pool Association. 30 October 2007.
<<http://www.vernalpool.org>>.
- The Federal Register. 2006. US DI Fish and Wildlife Service. 29 Feb. 2008
<<http://www.thefederalregister.com/d.p/2002-09-24-02-23241-1>>.
- Table Rocks Environmental Education. 2007. US DI BLM. 16 October 2007
<<http://www.blm.gov/or/resources/recreation/tablerock/index.php>>.
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Vernal Pools and the Table Rocks

Habitat: The mounded prairie/*vernal pool* habitat is found on the top of the Table Rocks. It is called a mounded prairie because it is a grassy landscape characterized by small mounded hills. During the winter and early spring, rain and snowmelt collect and form pools of water in the depressions located between the mounds. They may look like puddles of water, but they actually form a special habitat known as a *vernal pool*.

Phases: The word *vernal* stems from the Latin word for spring. This is the time of year you are likely to see these seasonal pools of water. In order for a *vernal pool* to form, some type of *impermeable* surface is required. An *impermeable* surface is a surface that water cannot drip through such as pavement, cement, or in the case of the Table Rocks, andesite, a type of volcanic rock. *Vernal pools* cycle through three phases: wet, flowering, and dry.

The wet phase takes place during the wet season when rain and snow melt collect on top of the Table Rocks and form *vernal pools*. The progression of spring marks the flowering phase. The pools begin to dry up and flowers bloom. The dry phase occurs during the summer and fall when the pools no longer have enough moisture for plants to grow.

Adaptations: Due to the quick and changing nature of *vernal pools*, both plants and animals living in this challenging environment have *adapted* to help them survive. There are three basic secrets to the success of *vernal pool* organisms: get off to a fast start, mature quickly, and be capable of surviving prolonged periods without water and high temperatures.

Plants: Most *vernal pool* plant species complete their life cycle in the course of a single season. Some plants, including the downingia and popcorn-flower, have seeds that sprout and begin to grow while still underwater. By the time the pools are dry, most plants have bloomed and their seeds have fallen to the ground to wait for the return of the wet season. The seeds of *vernal pool* plants can lie dormant for years waiting for another wet season to begin the cycle again. The dwarf woolly meadowfoam, an endemic plant that grows nowhere else in the world but on the tops of both Table Rocks, has *adapted* to the harsh seasons of the Table Rocks by producing oily seeds that can withstand very hot temperatures. The seeds germinate in wet areas soon after the rains begin in the fall. The oily seeds float and during particularly wet years the seeds spread, enabling the plant to occupy areas a short distance from the mother plant. Dwarf woolly meadowfoam can bloom as early as March, often while its roots and leaves are still under water.

Animals: Many *vernal pool* species are *macro-invertebrates*. *Macro* refers to something that is visible with the naked eye while *invertebrate* describes an organism that lacks a backbone. *Vernal pool* animals also have *adaptations* allowing them to survive seasonal changes. *Vernal pool* fairy shrimp and tadpole shrimp produce *cysts*. A *cyst* is a fully developed embryo enclosed in a hard, sponge-like shell. Once released, *cysts* are *adapted* to survive through extreme temperature changes and dry conditions for extended periods. In one case, scientists found that fairy shrimp *cysts*, determined to be several thousand years old, under the right conditions hatched. When *vernal pools* fill in the early winter, within weeks fairy shrimp embryos hatch out of *cysts* and rapidly develop into adults. Because their habitat is becoming increasingly rare, *vernal pool* fairy shrimp are a federally threatened species. Both *vernal pools* and fairy shrimp are at risk of disappearing due to human activity such as development and agriculture that take over *vernal pool* habitats.

Name: _____

Vernal Pool Activity Sheet: The Lowdown

Read "Vernal pools and the Table Rocks," then complete this Activity Sheet.

Circle the best answer:

1. Vernal pools are seasonal pools of water.
True False
2. Vernal pools are fed by underground springs.
True False
3. An adaptation of many vernal pool species is to be able to survive prolonged dry periods.
True False
4. Vernal pools are only found on top of the Table Rocks.
True False

Fill in the blanks using the words below (not all words will be used):

tadpoles evaporates cysts impermeable coyote thistle
dwarf woolly meadowfoam macro-invertebrates spring fairy shrimp

5. Vernal pools dry up because the water_____.
6. Vernal is a Latin word meaning _____.
7. Fairy shrimp hatch from _____, which endure the hot summers and cold winters buried in the soil where vernal pools form in the wet season.
8. When it rains, the _____, or hardpan layer, acts like the bottom of a bathtub, holding the water in place.
9. The seeds of the _____ survive the hot, dry summers of Table Rocks because they contain oil that can withstand very high temperatures.
10. Fairy shrimp are _____, creatures that lack a backbone and that are large enough that they can be seen with the naked eye.

Vernal Pool Activity Sheet: The Cycles

As the seasons change, so do the conditions in and around a *vernal pool*. For the following examples, indicate if this event happens during the Wet phase, Flowering phase, or the Dry phase. Indicate the phases by placing a W, F, or D.

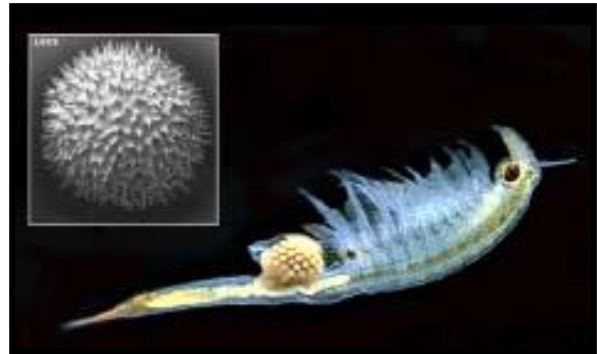
- _____ Soil is cracked and dry.
- _____ Water Starwort and other plants begin to sprout.
- _____ Vernal pools fill with water.
- _____ Flowers bloom and the vernal pools begin to dry up.
- _____ Seeds and cysts lay dormant, waiting for rain to begin a new cycle.
- _____ Migrating birds and other animals visit the pools for a macro-invertebrate snack.

Draw a line to connect each word with the correct description:

- | | |
|----------------------|--|
| metamorphosis | hard shell surrounding fairy shrimp embryo |
| adaptation | hunts for other animals to eat |
| cyst | drastic physical changes |
| copepod & water flea | lobsters, crab, shrimp, barnacles |
| crustacean | threatened species that live in vernal pools |
| fairy shrimp | survival trait of plants and animals |
| predator | macro-invertebrates |

Animals of the Vernal Pools

- Fairy Shrimp
- Aquatic Snail
- Flatworm
- Water Mite
- Clam Shrimp
- Copepod
- Seed Shrimp
- Tadpole Shrimp
- Water Flea
- Aquatic Beetle
- Dragonfly and Damselfly
- Mosquito
- Pacific treefrog
- Daphnia



Vernal pool fairy shrimp and cyst
<http://www.sacsplash.org>



Daphnia
<http://www.wikipedia.com>



Dragonfly
<http://www.wikipedia.com>



How could you live in a vernal pool?



Research an animal that lives in the vernal pool habitat and/or create your own imaginary vernal pool species using the following questions as a guide. Then get creative and make a model of the animal. Be sure to include the necessary adaptations needed for survival in a vernal pool habitat. Be prepared to share your creation with the class and explain how it would survive in a vernal pool habitat.

1. Who am I?
2. What is my prey (what do I eat)?
3. What is my predator (what eats me)?
4. Adaptations:
How do I survive the dry season, when there are no pools?

How do my eggs or offspring survive the dry season?

How do I move in or around the vernal pools? (what are my limbs like?)

What other adaptations help me or my offspring to survive?

5. Am I a crustacean?
6. Am I a macro-invertebrate?
7. Do I metamorphose?
8. What other animals am I related to?

Use the back of this sheet if necessary



ANSWER KEY

Vernal Pool Activity Sheet: The Lowdown

Circle the best answer:

1. Vernal pools are a temporary wetland.
True
2. Vernal pools are fed by underground springs.
False
3. An adaptation of many vernal pool species is to be able to survive prolonged dry periods.
True
4. Vernal pools are only found on top of the Table Rocks.
False

Fill in the blanks using the words below (not all words will be used):

tadpoles evaporates cysts impermeable coyote thistle
dwarf woolly meadowfoam macro-invertebrates spring fairy shrimp

5. Vernal pools dry up because the water evaporates.
6. Vernal is a Latin word meaning spring.
7. Fairy shrimp hatch from cysts, which endure the hot summers and cold winters buried in the mud at the bottom of the vernal pools.
8. When it rains, the impermeable surface, or hardpan layer, acts like the bottom of a bathtub, holding the water in place.
9. The seeds of the dwarf woolly meadowfoam survive the hot, dry summers of Table Rocks because they contain oil that can withstand very high temperatures.
10. Fairy shrimp are macro-invertebrates, creatures that lack a backbone and that can be seen with the naked eye.

ANSWER KEY

Vernal Pool Activity Sheet: The Cycles

As the seasons change, so do the conditions in and around a vernal pool. For the following examples, indicate if this event happens during the Wet phase (winter/early spring), Flowering phase (spring), or the Dry phase (summer/fall). Indicate the phases by placing a W, F, or D.

D The soil is cracked and dry.

F Starwort and other plants begin to sprout.

W Vernal pools fill with water.

F Flowers bloom and the vernal pools begin to dry up.

D Seeds and eggs lay dormant, waiting for rain to begin a new cycle.

F/W Migrating birds and other animals visit the pools for a macro-invertebrate snack.

Draw a line to connect each word with the correct description:

metamorphose	hard shell surrounding fairy shrimp embryo
adaptation	hunts for other animals to eat
cyst	drastic physical changes
copepod & water flea	lobsters, crab, shrimp, barnacles
crustacean	threatened species that live in vernal pools
fairy shrimp	survival trait of plants and animals
predator	macro-invertebrate