Table Rocks Curriculum

Vernal Pool Investigators

Objective: Students will explore the physical factors that create ***vernal pools*** and the annual cycle of the ***vernal pool*** ecosystem by completing activities that involve measuring and displaying data. Students will also investigate the organisms that depend on the ***vernal pool*** ecosystem.

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

Subject Area: Life Science

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

Benchmark 1: Describe a habitat and the organisms that live there.

Benchmark 2: Describe the relationship between characteristics of specific habitats and the organisms that live there.

Benchmark 3: Identify and describe the factors that influence or change the balance of populations in the environment.

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 investigation.

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 answered or tested through scientific investigations.

Subject Area: Scientific Inquiry

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.

Benchmark 3: Collect, organize, and display sufficient data to support analysis.

Subject Area: Scientific Inquiry

Common Curriculum Goals: Analyzing and Interpreting Results: Analyze scientific information to develop and present conclusions.

Benchmark 1: Use the data collected from an investigation to explain the results.

Benchmark 2: Summarize, analyze, and interpret data from investigations.

Benchmark 3: Summarize and analyze data including possible sources of error. Explain results and offer reasonable and accurate interpretations and implications.

Subject Area: Mathematics

Common Curriculum Goals: Statistics and Probability: Select and use appropriate statistical methods to analyze data.

Oregon Grade-Level Foundations: Collect and Display Data (grades 1-8)

Common Curriculum Goals: Measurement: Apply appropriate techniques, tools, and formulas to determine measurements.

Oregon Grade-Level Foundations: Units and Tools (grades 1-8)

Oregon Grade-Level Foundations: Direct and Indirect Measurements (grades 1-8)

Length of Lesson: 1-2 hours over several days

Materials:

- ✓ "Three Phases of a Vernal Pool" Activity Sheet (provided)
- ✓ Plastic sheeting or large garbage bag
- ✓ 1-2 water bottles/containers for each child (have students bring them from home)
- ✓ Measuring tape
- ✓ "Vernal Pool Data Sheet" (provided)
- ✓ "Vernal Pools Macros" activity sheet and "Flower Pie" activity sheet (provided)
- ✓ Colored pencils or crayons
- ✓ Thermometer

Key Vocabulary: *cyst*, ***evaporation***, ***impermeable***, ***macro-invertebrate***, ***vernal pool***

Background Information:

See Chapter Introduction.

Procedure:

Preparation:

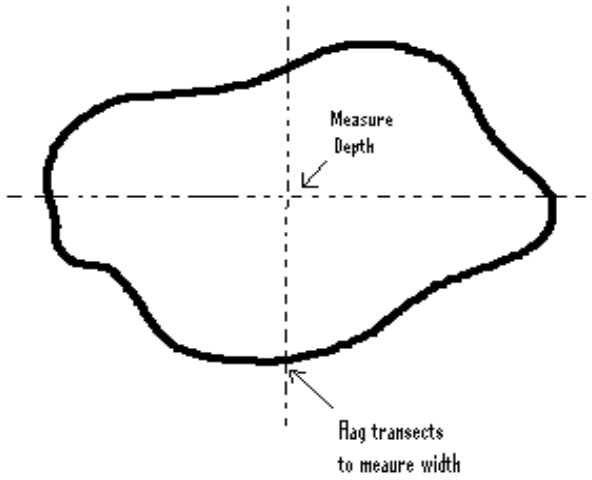
Have students bring containers from home they can fill with water and use for this activity. With the background information provided, discuss the ***vernal pool*** ecosystem with your students. Include the concepts of precipitation and ***evaporation*** in your discussion. Give students the "Three Phases of a Vernal Pool" activity sheet to look over and color.

Activity:

In the school yard find a depression at least a few inches deep and a few feet across. Have the students discuss what size the pool should be. Place the plastic sheet over the depression. Explain to students that this is the ***impermeable*** layer, or "hard pan" surface, of the ***vernal pool***. Discuss the annual cycle of the ***vernal pools***, beginning with the dry season. Explain to students that in the summer and early fall, when it is hot and there is little precipitation, the ***vernal pools*** are completely dried up. During the dry season depressions are filled with dry grasses, flower seeds, and the ***cysts*** of ***macro-invertebrates*** that inhabit the pools during the wet season. What happens in the winter and spring? The weather changes and rain fills the ***vernal pools*** with water. Have each student step up to the edge of the ***vernal pool*** and create "rain" by emptying their container of water into the depression. Once the depression has been filled, mark one or more transects (shown by the dotted lines in Figure 1) where students will measure the width of the ***vernal pool***. Have students survey the pool at least once a day from the same spot and record the width and depth of the pool along each transect.

Scientific Inquiry:
Grades 3-8: Have students write down a hypothesis stating how long they think it will take for the pool to ***evaporate***, according to the size of the pool and the weather. Survey the pool at least once a day from the same spot and record the day, time, cloud cover, water and air temperature, width and depth of pool (along transects), and any other notes on the data sheet provided.

Figure. 1



Activity 2:
Grades 4-8: As the pool begins to dry, talk about the flower phase of ***vernal pools***. You can explain the importance of moisture to the flowers that grow in and around the ***vernal pools***. Introduce the students to four common ***vernal pool*** flowers using the "Flower Pie" activity sheet. On the activity sheets, have students look at the distribution of flowers in the ***vernal pools***. What patterns do they observe? How are flowers distributed in and around the pools? Different moisture levels are responsible for the different patterns; some flowers require more water, some less.

Grades 4-8: While the pool is still filled with water, talk about the animals that live in ***vernal pools*** during the winter and spring (the wet phase). Discuss the life-cycle of the aquatic ***macro-invertebrates*** that inhabit the ***vernal pools*** (see Chapter Introduction). Use the "Vernal Pools Macros" activity sheet provided to introduce the students to four ***vernal pool*** animals of the Table Rocks.

Grades 6-8: Discuss why there are fewer large predatory invertebrates, such as tadpoles, and more tiny invertebrates that consume plant matter in this environment. This is due to lack of prey; ***vernal pool*** inhabitants are generally very small. In addition, their populations are not large enough to support many large predators.

Follow-up:
Grades 6-8: Once the pool dries up, compare student hypotheses with the actual ***evaporation*** time of the pool. Address what may have influenced this process. Did it rain after the pool had been filled by students? Was it hot and sunny or was it cloudy when the pool was still filled with water? Were there any holes in the ***impermeable*** layer (plastic sheet)? What difference would it have made if there were holes?

Adaptations:

Grades 1-3: Use the bar graph included with the "Vernal Pool Macros" and "Flower Pie" activity sheets (omit the pie chart and necessary fractions) to introduce students to the concepts of displaying data and graphing.

Grades 4-8: Make a mock ***vernal pool***; talk with the janitor/groundskeeper of the school and find a spot in the school yard where the students can build a "real" ***vernal pool***. This activity should be started in late winter or early spring to allow enough time for flower seeds to germinate. Lay the plastic sheeting down in the chosen spot, cover the plastic with a thin layer (3-5") of soil and scatter native flower seeds in the soil. If possible scatter seeds of flowers that would actually be found in a ***vernal pool***. Fill the depression with water and continue with the directions from the previous activity for observing the pool.

Grades 6-8: Separate the class into four to six groups. Have each group create their own ***vernal pool***. Each group will have to decide what size their pool will be and then they will measure their pool along designated transects, as shown in Figure 1, and mark where those measurements were taken. Then measure the depth of the pool in the center. Record the transect width, pool depth, and any other data for all of the ***vernal pools*** on the board for the entire class to see. Have each group hypothesize which pool will dry up first and which will last the longest. Continue the activity as described above, finishing with a discussion of the factors that caused certain pools to ***evaporate*** sooner than others. Have students do a short write-up explaining the factors they thought caused the pools to dry up in the order they did. Have students create a bar graph (or use the included bar graph activity sheet) for the flowers and macros on the two "pool" activity sheets. Discuss the differences between pie charts and bar graphs and which type of data is best displayed by each (pie charts are more appropriate for displaying percentages, while bar charts are good for comparing whole numbers).

Extensions:

Sign up your class for a Table Rocks field trip in early April so they will be sure to see the ***vernal pools*** with water in them.

Grades 4-8: Using the same amount of water, have students fill an ***impermeable*** black surface (black trash bag), an ***impermeable*** white surface (white trash bag), and another permeable surface using a trash bag with holes in it (or one black and one white trash bag with holes). Have students hypothesize which surface will dry up the fastest. Using critical thinking skills, discuss why the water ***evaporated*** from one pool before the others. Students should be able to observe that the water disappears more quickly from a permeable surface. They should also observe that water ***evaporates*** more quickly from the darker ***impermeable*** surface. Discuss how ***vernal pools*** could not exist on a permeable surface. Discuss why dark surfaces tend to cause water to ***evaporate*** faster (they absorb more heat) than lighter surfaces.

Grades 6-8: Have each student or pair of students conduct research and give a short presentation on the current threats to ***vernal pool*** habitats. (Why is this environment at risk of disappearing? Do the BLM or The Nature Conservancy, the two land managers of Table Rocks, work to protect vernal pools? Why?)

Discussion Questions:

Does the depth of the pool make a difference in how long it takes for the pool to *evaporate*? What other environmental factors influence how fast a *vernal pool* will *evaporate*?
A deeper pool with a smaller surface area will dry up much slower than a shallow pool with a larger surface area. Weather and temperature are also huge influences on how fast a ***vernal pool*** *will dry. If there is no rain and it is hot and sunny, the pools will* ***evaporate*** *quickly. If it is cool and cloudy, they will dry more slowly. If it rains, the pools will refill with water. The* ***impermeable*** *surface under the pools may also influence how fast the pool dries. If the surface is truly* ***impermeable****, the water will stay in the pool longer. If the rocks are a little bit porous, water may seep through the* ***impermeable*** *layer and the pool will* ***evaporate*** *faster.*

Why is it important to use markers and measure the pool in the same place every time?
If the pool is measured in one place one day and a different place the next day, it will be difficult to determine if the measurements truly show a difference in how much water is in the pool between the two days.

What do you think will happen to the *cysts* and seeds of the animals and plants in the *vernal pools* if the following spring is very dry and the pools do not fill with water?
The plants and animals that live in the ***vernal pools*** *have adapted to produce seeds and* ***cysts*** *that are able to withstand hot, dry conditions for many years. The seeds and* ***cysts*** *will hatch and grow when enough water has returned to the pools to create a suitable growing environment.* ***Cysts*** *can survive for decades in the soil before they eventually hatch.*

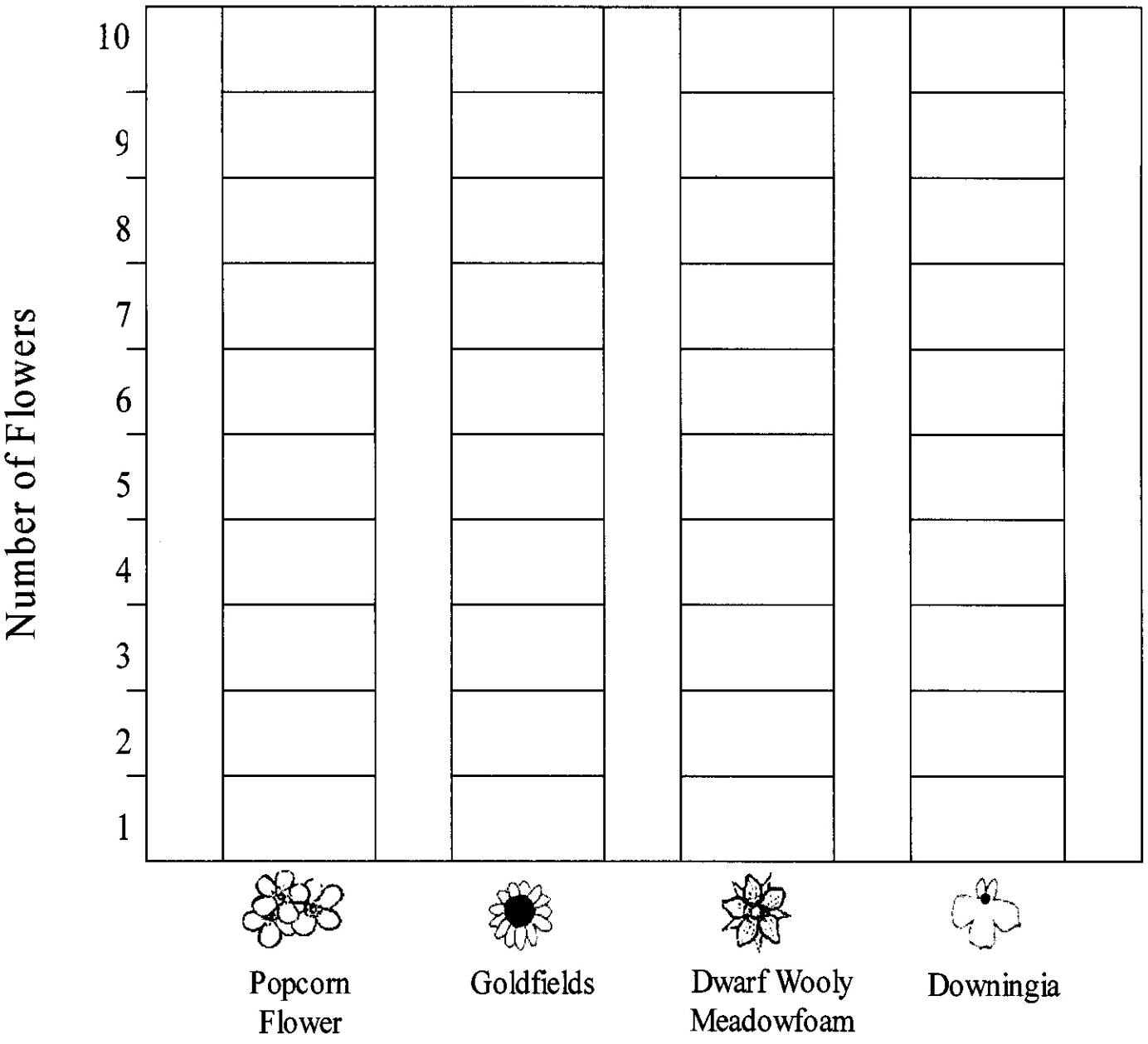
References:

Butler, Eva, Greg Suba, and Carol Witham. "Life in Our Watershed: Investigating Vernal Pools." Sacramento Splash. 11 February 2008 <www.sacsplash.org>.

Table Rocks Environmental Education. 2007 USDI BLM. 16 October 2007 <http://www.blm.gov/or/resources/recreation/tablerock/index.php>.

NAME:_____

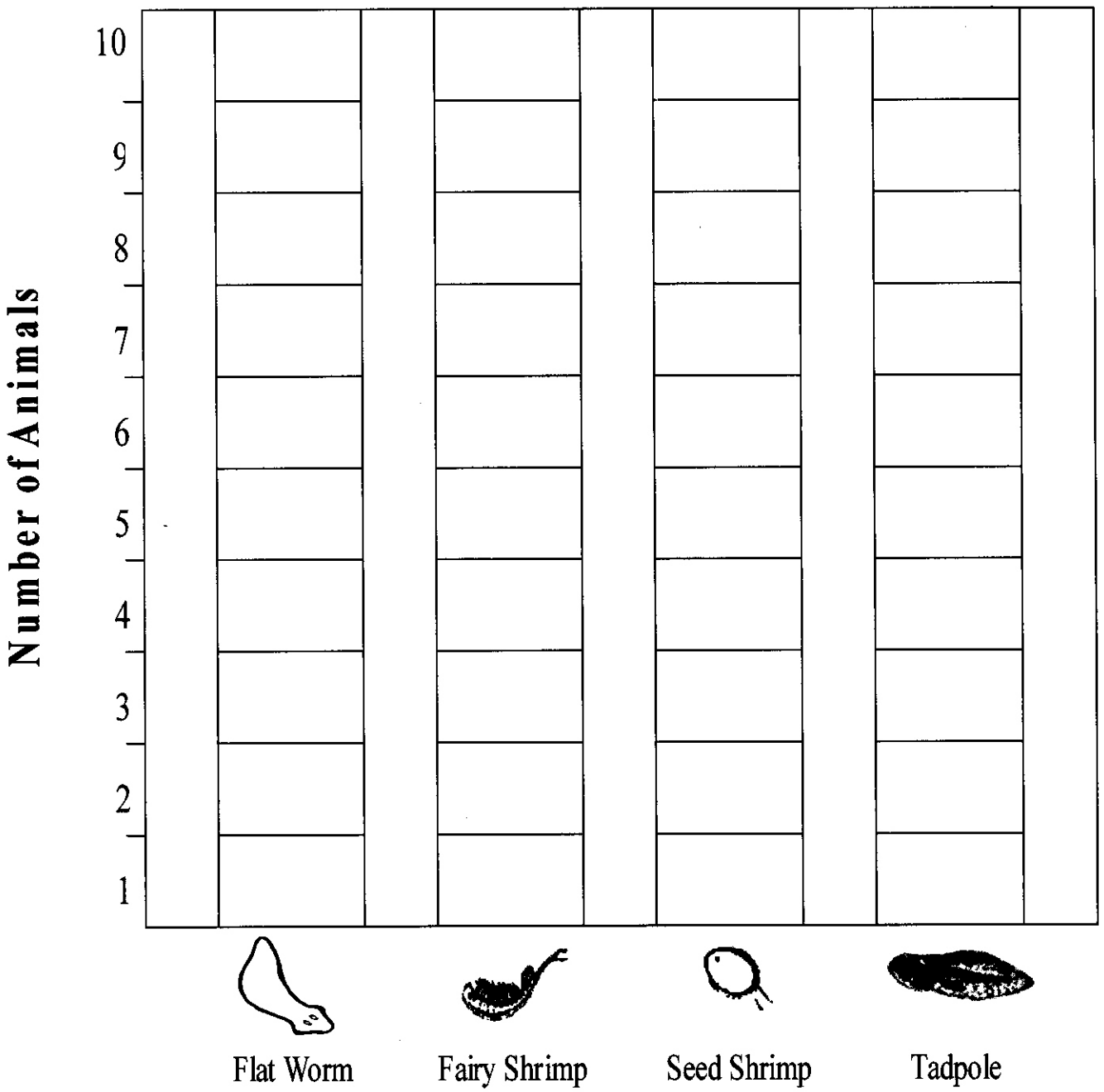
Instructions: One way to easily show how many of each flower lives in a habitat is by making a bar graph. Starting at the bottom, fill in one square for each flower in the vernal pool from the "flower pie" worksheet.



Adapted from: Splash

NAME:_____

Instructions: One way to easily show how many of each animal lives in a habitat is by making a bar graph. Starting at the bottom, fill in one square for each animal in the vernal pool from the "critter pie" worksheet.



Name/Group Name: _____

Vernal Pool Data Sheet

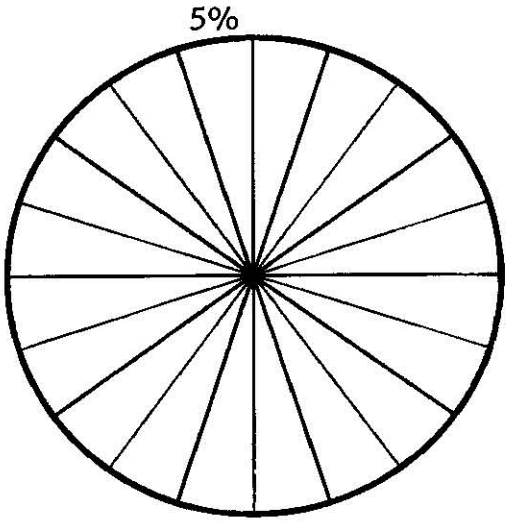
Date	Time	% Cloud Cover	Temperature (°C or °F)	Transect 1 (cm)	Transect 2 (cm)	Depth (cm)	Notes

Name: _____

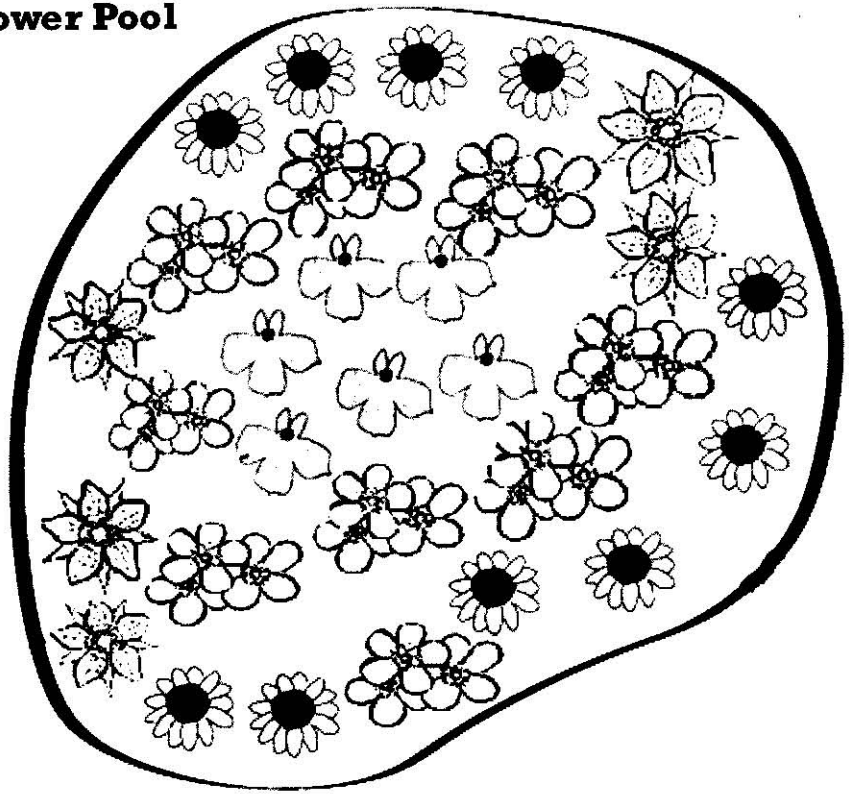
Flower Pie Activity

Scientists often count plant populations so they can determine what grows in an area. They monitor the population to see if it is increasing, decreasing, or stable.

Directions: Count the number of each type of flower and complete the table. Create a color key in the table and complete the pie graph using the color key. How could you use this type of data to see if vernal pools are different from each other when they flower?



Flower Pool



Data Table	Color Code	Count	Fraction	%
Dwarf Wooly Meadowfoam				
Gold-Fields				
Popcorn Flower				
Downingia				
Totals				

Adapted From Splash

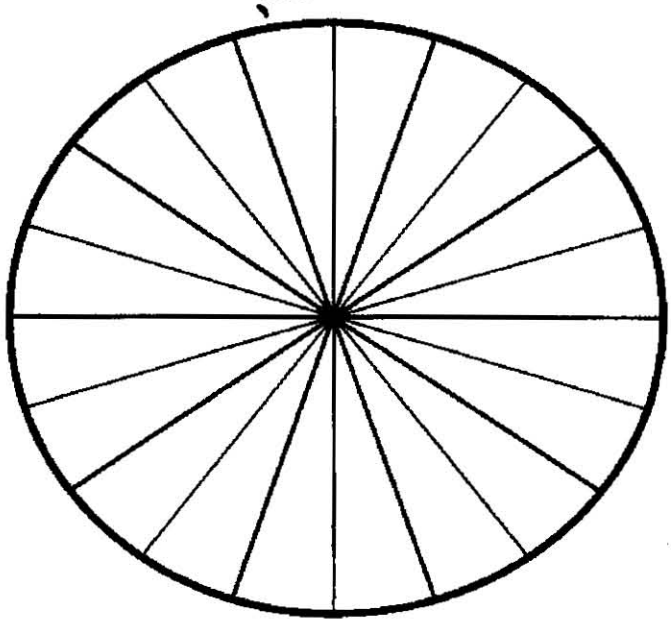
Vernal Pool Macros Activity sheet

Name: _____

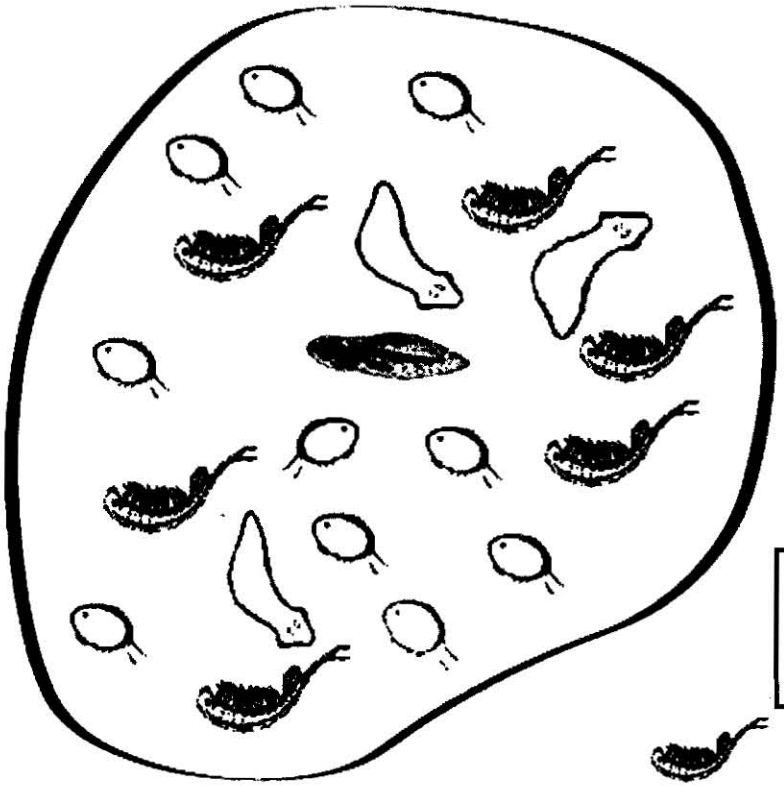
Directions: Count the number of each type of macro-invertebrate and complete the table. Create a color key in the data table and use the color key to complete the pie graph. What could a scientist learn by counting the population of a different macro-invertebrate each week? Each year? Write your answers on the back of this sheet.

Macro Pie Graph

5%



Macro-invertebrate Pool



Data Table	Color key	Count	Fraction	%
Fairy Shrimp				
Seed Shrimp				
Tadpole				
Flat worm				
Total				

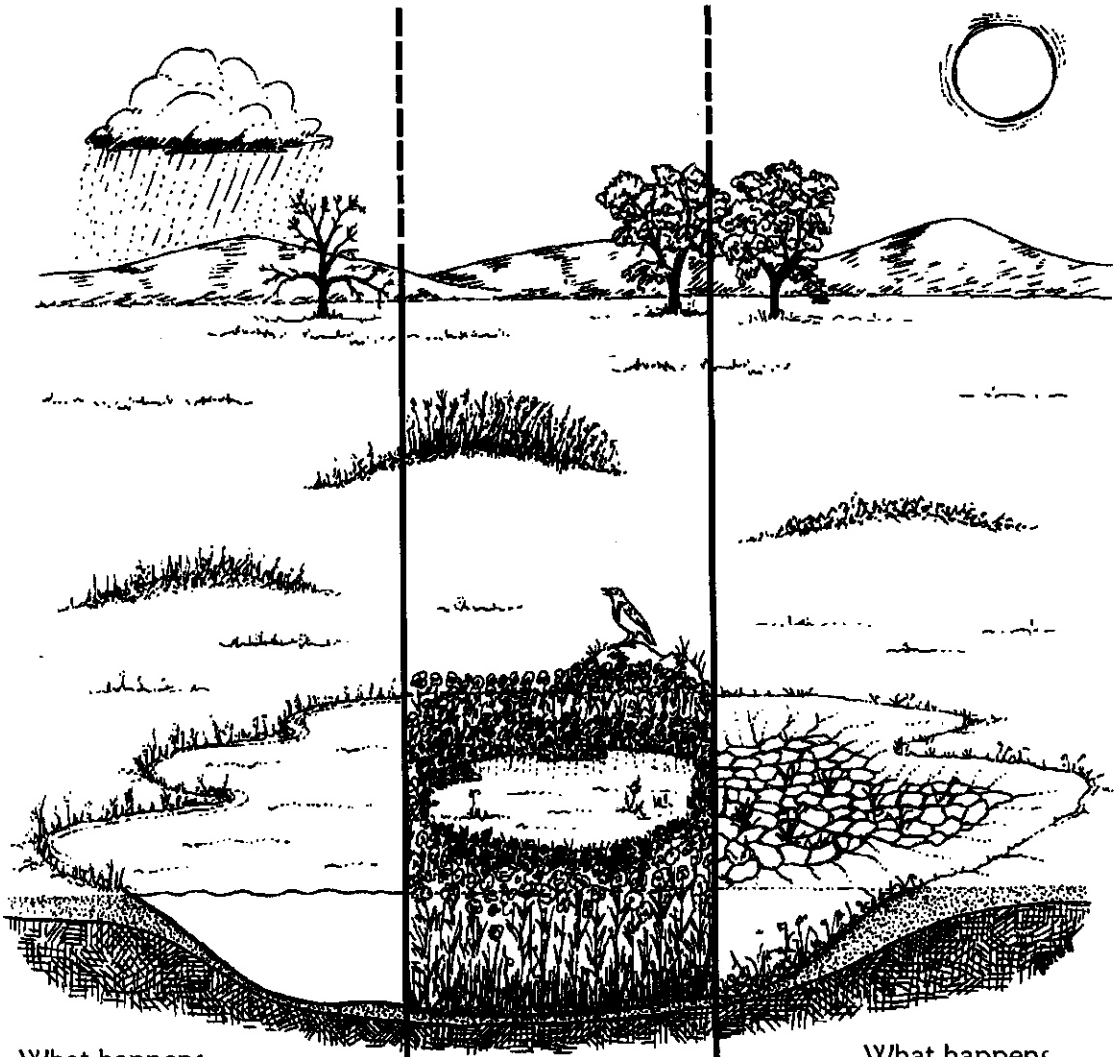
Adapted from: Splash

Name _____

Three Phases of a Vernal Pool

Write the name of the three phases:

_____ _____ _____



What happens during this phase?

When does this phase usually occur?

What happens during this phase?

When does this phase usually occur?

What happens during this phase?

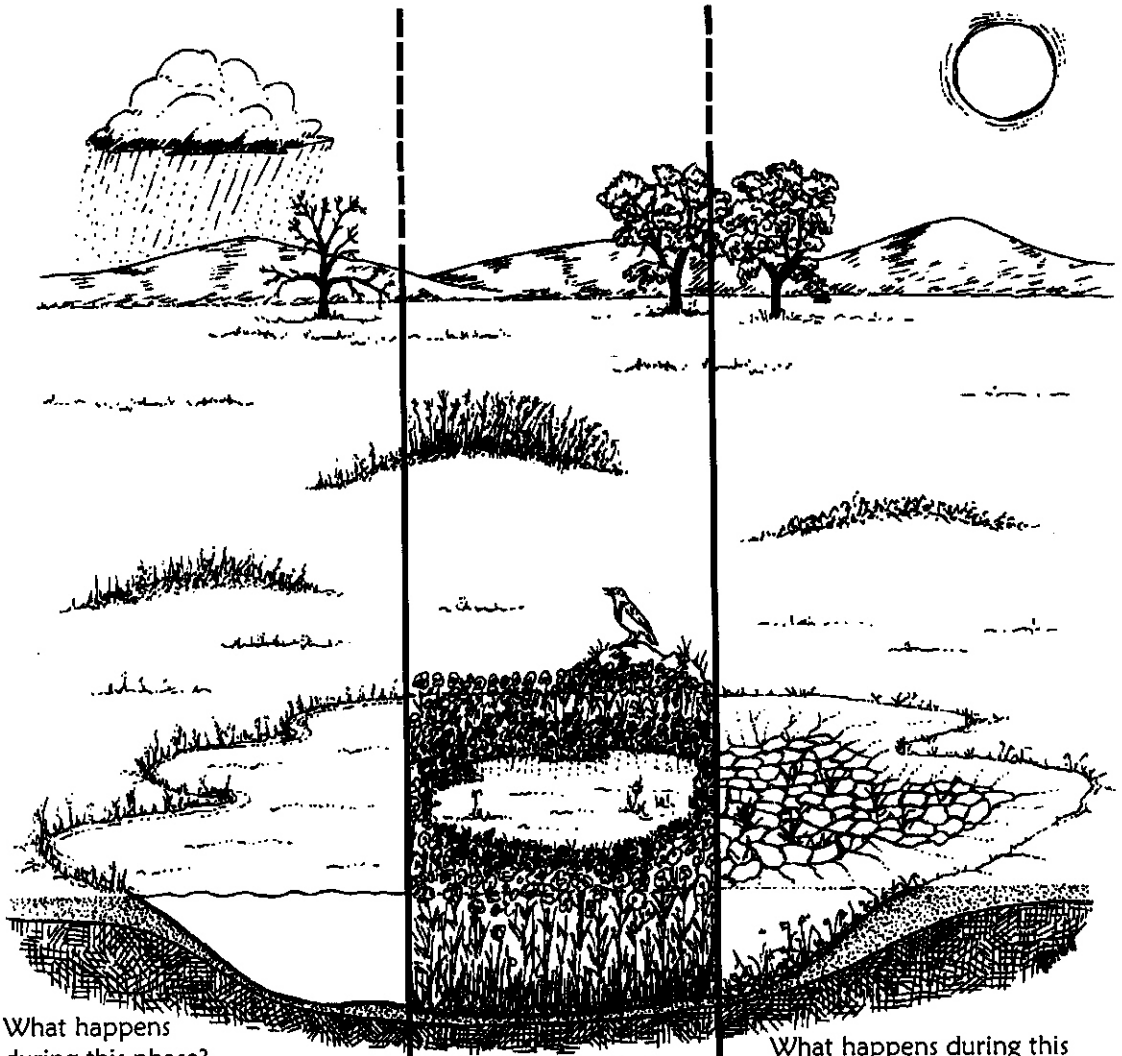
When does this phase usually occur?

Name _____ *ANSWER KEY*

Three Phases of a Vernal Pool

Write the name of the three phases:

Wet Phase _____ Flowering Phase _____ Dry Phase _____



What happens during this phase?

The Vernal pools fill with water. Organisms begin to hatch and reproduce.

When does this phase usually occur?

Winter/Early Spring

What happens during this phase?

Flowers bloom and seed quickly, pools start to evaporate. Cysts are laid in the pools.

When does this phase usually occur?

Spring

What happens during this phase?

The pools have evaporated and are dry. Cysts and seeds lay dormant waiting for the pools to fill. It is hot and dry.

When does this phase usually occur?

Summer/Fall

Adapted from Splash