S.P.R.O.U.T.S.

For Teachers
Lesson Plan for Pre– and Post-Visit Activities

Grade Level(s): 5th & 6th

Setting: Classroom or Outside

Duration: 1 hour

Standards Addressed:

5th Grade

6th Grade

Introduction:
Welcome to the **Rangers in the Classroom SPROUTS Journal Guide for Teachers.** During two classroom visits your students will become familiar with the field of phenology: the study of the timing of seasonal life cycle events in plants and animals. The SPROUTS program uses phenology to ignite your students interest in natural processes. While making observations of a tree on your campus, students are encouraged to ask questions and to investigate the natural world. Once your students are in the habit of making nature based observations they will be primed to learn more complicated subject matter. Phenology is project based learning and can provide a foot hold for your students to step up in their scientific studies.

Objectives:
After completing this program, 5th and 6th grade students will be able to:
1. Explain the meaning of phenology.
2. Identify the vegetation and reproductive parts of a California valley oak tree.
3. Review (if needed) the process of photosynthesis and why it is important for plants.
4. Explain the life cycle of the California valley oak.
5. Name the oak phenophases being observed in trees in their school yard.
6. Identify species that rely on the California valley oak and the potential impacts the timing of phenophase events may have on their survival.
7. Describe how the timing of phenophase events can change in response to global climate change.

Materials:
° SPROUTS Journal per student (teacher is responsible for printing)

Materials available for loan:
° The Life of an Oak: An Intimate Portrait by Glenn Keator
° Oaks of California by Bruce Pavlik, Pamela Muick, and Sharon Johnson
° Flower Model

SPROUTS

For Teachers
Lesson Plan

This guide is designed to help you and your students prepare for your SPROUTS classroom visits.

PRE-PROGRAM
Please complete the following activities prior to your first SPROUTS Ranger Program:

1) Each student receives their own SPROUTS workbook.
2) Discuss with the students that each season of the year tress will look a little different. Instruct each student to color the cover of their SPROUTS workbook to reflect what they think the oak tree will look like. Consider including animals that may be using the oak for shelter or a food source.
3) Bring the class outside to the tree you have selected to monitor throughout the remainder of the school year. As a class, review the *Meet your tree!* activity questions. Instruct students to work in small groups to complete this page in their journals.
4) Complete the *Life Cycle of an Oak* activity by labeling each plant part correctly using the vocabulary words provided. (The Life of an Oak: An Intimate Portrait by Glenn Keater may be a helpful tool for this activity.)
5) Complete the "What Kind of Tree Made the Leaf in Front of Me" activity. There are photos on the page next to the dichotomous key. Each leaf is on the dichotomous key and by following the break down, students will be introduced to the technique scientists use to identify different plant species. **The answer key can be found toward the end of this document.**

Notes:
Most likely, the trees in your school yard have not leafed out by the start of the SPROUTS program—that's okay! This program is designed to acquaint you and your students with plant observations and to learn how to record what you discover. It is just as important to record that a phenophase is not occurring as well as when it is.

All phenophases, as well as the intensity/abundance estimates, are optional when you are observing. If your students feel overwhelmed by having to answer how many fruits you see, or what percentage of the leaf canopy is open, you can skip these questions, and just circle *Yes* or *No* for your observations.

To input your observations, join the National Phenology Network's Nature's Notebook, set up an account for your class, and begin your observations!
https://www.usanpn.org/natures_notebook

BETWEEN SPROUTS PROGRAMS
Following your first classroom visit and before your second ranger visit, please complete the following activities:

1) Students should **collect phenophase data** 1-2 times per week. Complete the data sheets in the back of the journal and update the Nature's Notebook website after each data collection.
2) Following each data collection session, separate the students for a short solo time where they are to record any natural observation, question, or drawing. Allow a minimum of 5 minutes for the students to reflect upon the natural environment found on campus. Bring the students back together and discuss their observations as a group.
3) Further your students understanding of Oaks and tree processes with the **background information** that follows. You also have the ability to "check-out" from us; a flower model and The Life of an Oak: An Intimate Portrait by Glenn Keator. Use any technique that you feel is appropriate to deliver this supporting background information. SCICON has a few great activities for your students to work through. Register your 5th grade class online (http://www.tcoe.org/scicon/grade5/DayTripRequestForm.asp) to visit SCICON and select the focus topic "Trees" you will then receive the activities; "There's A Forest In My Life", "There's A Tree In My Backyard", "The Secret Tree Behind the Bark" "A Long Road To Travel", and "Let The Sunshine In."

Oaks in California background information:

I. California is home to 19 species of oak.

A. Some grow tall, while others are ground-hugging shrubs.

B. Some retain their leaves year-round, while others drop their leaves at the onset of a drought.

II. California Valley Oak (*Quercus lobata*), General Natural History:

- *Quercus lobata* - Latin/botanical name for valley oak. (Quercus = Latin for oak); quer (Celtic) meaning fine, cuez (Celtic) meaning tree. Lobata (Latin) meaning deeply lobed. Common name - valley oak
- Unique to California with wide distribution through the Central Valley.
- Largest oak in California.
- Thrives in a habitat with deep rich soil.
- Requires year-round access to groundwater.
- Usually found below 2000 feet in elevation, but may be found up to 5600 feet if the roots can reach adequate water supplies.
- Can live to be 600 years old.
- Thick silvery colored bark that looks like alligator hide.
- Winter deciduous tree with a round spreading canopy.
- The valley oak is the only known food plant of *Chionodes petalumensis* caterpillars
- Young trees grow straight up during the first 10 - 30 years.
- Largest Valley Oak on record had a 9.3 foot diameter.(Illustrate size with pre-cut rope.)

III. Oak Life Cycle and Parts

A. What seed or fruit does the oak tree produce? In the case of the oak, an acorn is its offspring and it will produce the next oak tree.

1. The acorn of the valley oak is long (up to 2”) and pointed. Mature valley oaks can produce up to a ton of acorns in a good year. Acorns usually fall in October.
2. What does the acorn need to be successful? Germination is dependent on a number of factors.
    a. The acorn must be buried and secure under a blanket of leaf litter and organic materials.
    b. Plentiful moisture.
    c. Mild temperatures.
3. Germination may happen in fall and early winter or in the spring if conditions are just right.
4. The acorn swells with the moisture and bursts open at the pointed end into a radical and an epicotyl. (Demonstrate with live sapling).
    a. The radical grows downward and develops into the taproot.
        - A young (10-40 years old) valley oak's tap root can reach 60 feet deep, to search for groundwater.
        - As the tree matures, the tap root sloughs off and the tree develops a tiered root system with feeder and sinker roots that permeate different layers in the soil profile, generally from two to four feet below the soil surface. This allows the tree to avoid, rather than endure drought.
    b. The epicotyls grows upwards and develops into the stem or trunk of the tree.
5. Most of the initial energy in the acorn goes towards developing the root system before the epicotyls begins its growth towards the sun.

B. The seedling

1. After germination, the seedling grows as quickly as possible to get the two most important ingredients for survival: light and water.
    a. The roots spread down and out in search of water.
        1. As the tree grows, the roots also give the tree support and absorb nutrients from the soil.
    b. The seedling must also start producing as many leaves as possible, so it can start making food from the sun’s energy.
2. Most seedlings do not survive as there is much competition for food, light and water.

C. Trunk and branches form the framework of the tree. Height, size and shape of this framework is affected by environmental conditions (wind, water, light, soil) genetics and hormones. This framework supports the weight of thousands of leaves

1. Trunk

a. Acts as the plant's internal plumbing system bringing water and nutrients from the roots to the leaves and moving the food/glucose from the leaves to other parts of the plant.
b. Can be herbaceous like a bendable tulip stem or woody like an oak tree trunk.
c. The vascular system of the tree consists of two types of tissue:
1. Phloem or inner bark is the pipeline through which sugar and other foods are moved within the plant, xylem or sapwood moves water and dissolved minerals from the soil.
2. These tissues form a complex system that extends from the tip of the roots to the surface of the leaves.
d. Each year of growth can be seen in the tree's annual rings of alternating light and dark rings of wood.
1. Annual rings are really a new ring of xylem cells. The light colored portion of the ring is the spring growth. The summer growth is slower and the cells are smaller, which make this part of the ring darker.

2. Branches
a. Reach upward and out toward the sunlight

D. Leaves
1. In valley oaks are deeply lobed growing 2 – 4 inches long and up to 2 inches across. (Width is approximately one-half its length.) They appear matte green on top and pale green on the underside.
2. Designed to capture sunlight, which the plant uses to make food through the process of photosynthesis.
a. How often do you think about food? How many times each day do you eat? When you are hungry, what do you do?
1. Raid the cupboards or the refrigerator, go to the store or a restaurant etc.
2. We do these things because we (humans) are consumers or heterotrophs.
– We get our energy from the food we eat.
4. Plants cannot eat food like humans and animals.
5. Plants are known as producers or autotrophs, since they must produce their own food.
– Producers/autotrophs use light energy from the sun to produce the food they need through a process called photosynthesis.
b. Who can explain what photosynthesis is?
1. The word comes from the Greek words: *photo* meaning "light" and *synthesis* meaning "putting together."
– It is the process most plants go through to make or

synthesize food using solar energy from the sun.
- The process happens inside the cells of green plants.
- It is easiest to think about photosynthesis like a recipe. Plants need some very specific ingredients for it to happen: sunlight, water, carbon dioxide and chlorophyll.

2. Formula for Photosynthesis
   - $6\ H_20 + 6\ CO_2$ + sunlight —> $C_6H_{12}O_6 + 6O_2$
   - water + carbon dioxide —> glucose + oxygen
   - In short, chlorophyll uses the energy of sunlight to combine water and carbon dioxide and transform them into glucose and oxygen.
   - Glucose is used in various forms by every creature on the planet
3. Who cares about photosynthesis?
   A. You should if you like to eat.
   - Photosynthesis may be the most important biological process on earth.
   - Photosynthesis is the process by which plants convert the energy in sunlight to kinds of energy that can be stored for later use.
   - All of our food requirements are met either directly by the plant products we eat or indirectly by the herbivorous animals (i.e. cows, chickens, pigs etc.) we eat.
   - If there is no photosynthesis, there is no food.
   B. You should if you care about climate change.
   - Photosynthesis helps control the makeup of our atmosphere by absorbing carbon dioxide and releasing oxygen.
   - Understanding photosynthesis is crucial to understanding how carbon dioxide and other "greenhouse gases" affect the global climate.

E. Buds
1. Specific hormones influence the development of buds.
   a. Some of the buds develop into leaves and other form the reproductive parts of the plant.
2. Buds contain the keys to the future
3. Produced during the summer months when the most sunshine is available for food
4. Buds sit dormant on the tree throughout the winter.
5. The timing of the bud burst in spring is finely tuned to temperature.
   a. As the days warm, hormones called auxins increase the tree's intake of water, which promotes bud burst.

F. Flowers
1. In valley oaks, individual trees produce both male and female flowers and are wind pollinated.
2. Flowers are the reproductive parts of most plants.
3. Become the fruit after pollination.
4. Perfect or bisexual flowers
    a. Have both male and female parts.
5. Imperfect or unisexual flowers
    a. Have only one or the other: a male stamen or female pistil.
    b. Oaks are flowering plants within this category.

G. Parts of a Flower
1. Sepals
    a. Part of the flower that cover and protect the petals when at bud stage. On an open flower, they are the usually green parts around the base of the flower like small green leaves.
2. Petals
    a. Petals are modified leaves that surround the reproductive parts of flowers.
    b. They often are brightly colored or unusually shaped to attract pollinators.
3. Stamen
    a. Male part of the flower.
4. Anther
    a. Top part of the stamen that produces a sticky powder called pollen.
5. Pistil
    a. Female part of the flower.
6. Stigma
    a. Sticky top of the pistil that traps pollen.
    b. Pollen travels down the pistil to fertilize the ovules in the ovary.
7. Ovary
    a. Forms the base of the pistil.
    b. Develops into the fruit (covering for the seeds) after pollination.
8. Ovules
    a. Protected within the ovary.
    b. Contains egg cells that develop into seeds after pollination.
    c. Become the seeds inside the fruit.

H. Pollination
1. Pollination is very important as it starts the production of seeds that grow into new plants.
2. It is necessary for seeds to form in the flowering plants.
3. Technically, it is the movement or transfer of pollen from a stamen (male part) to a pistil (female part).

a. Self-pollination: When pollen from a plant's stamen is transferred to that same plant's stigma.
b. When pollen from a plant's stamen is transferred to a different plant's stigma, it is called cross-pollination.
1. Cross-pollination can only happen with plants of the same species (i.e. pollen from an oak could not pollinate a rose).
2. Produces stronger plants through a mixing of genetic material.

4. The flower dies after pollination.
5. Plants usually rely on animals or the wind for pollination.
1. Animal pollination – Who are some animal pollinators?
- Plants that are pollinated by animals often are brightly colored and have a strong smell to attract the animal pollinators.
- When animals such as bees, butterflies, moths, flies or hummingbirds pollinate plants, it's accidental. Usually they are at the plant to get food (pollen or nectar). If the animals accidentally rub against the stamens while feeding, the pollen gets stuck all over their bodies. When they move to another flower to feed, some of the pollen can rub off onto this new plant's stigma.

2. Wind pollination
- The wind picks up pollen from one plant and blows it onto another.
- Plants that are pollinated by wind often have long stamens and pistils to “release” and “catch” the pollen.
- They can be dully colored, unscented, and with small or no petals since they do not need to attract pollinators.

IV. Don’t forget to collect phenophase data twice each week and record the student’s data on the Nature’s Notebook website! Browse the site and see how oak trees across the country are responding or compare/contrast the habitat of Califonia’s oak trees with those in another state and discover when phenophases occur in each! Most of all, have fun

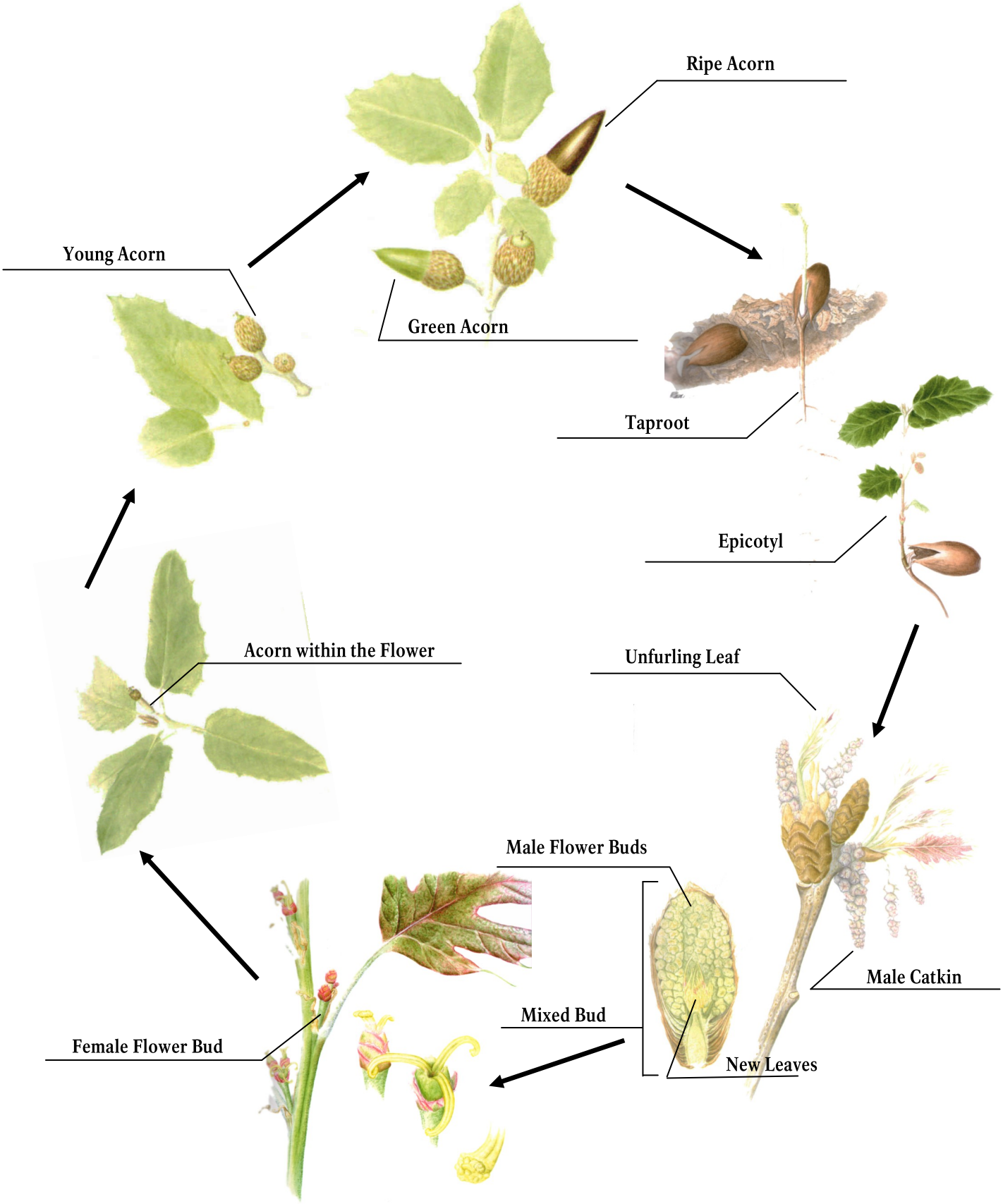
Resources

California Phenology Project—www.usanpn.org/cpp
Chisholm, Graham, Oaks: California’s Lost Legacy. The Nature Conservancy, 1987.
Keator, Glenn, *The Life of an Oak: An Intimate Portrait*. Berkeley, CA: Heyday Boods, 1998.
Pavlik, Bruce and Pamela C. Muick, *Oaks of California*. Los Olivos, CA: Cachuma Press and the California Oak Foundation, 2006.
Kaweah Oaks Preserve—www.kaweahoaks.com
Sequoia and Kings Canyon National Parks Education Pages—www.nps.gov/seki/forteachers
www.nps.gov/seki/forteachers/phenology.htm
U.S.A. National Phenology Network—www.usanpn.org
Watts, Tom, *Pacific Coast Tree Finder: A pocket manual of identifying Pacific Coast trees*. Rochester, NY: Nature Study Guild Publishers, 2004.

Life Cycle of an Oak (answer key)

Use these Vocabulary Words to fill in the blanks and name the plant parts!

(Young Acorn, Taproot, Unfurling Leaf, Epicotyl, Mixed Bud, Male Catkin, Ripe Acorn, Green Acorn, Female Flower Bud)



Leaves to Key Out (answer key)

Write the name of the leaf under each photo.

California Black Oak

California Ash

California Buckeye

Quaking Aspen

Fremont Cottonwood

Valley Oak

Vocabulary

Acorn—noun—The special nut associated with oaks and tanbark oaks.
Cambium—noun—a layer of cells in plant roots and stems that produces the new tissue responsible for increased girth, particularly sap-conducting tissues, xylem and phloem, and bark.
Catkin—noun—A chainlike arrangement of many tiny, petal-less greenish or brownish flowers.
Chlorophyll—noun—the green coloring in leaves and plants, which is essential to the production of glucose during photosynthesis.
Climate—noun—The prevalent long term weather conditions in a particular area. Climatic elements include precipitation, temperature, humidity, sunshine and wind velocity and phenomena such as fog, frost, and hail storms. A vast number of elements taken as an average.
Dendrochronology—noun—the study of the annual growth rings in trees, wood, or wooden objects, especially as a way of dating wooden remains or determining past climatic conditions.
Epicotyl—noun—The growing tip of the embryo. This growing tip ultimately produces the entire above-ground shoot stytem that eventually becomes the trunk, branches, and leaves of the mature oak tree.
Hypothesis—noun—a tentative explanation or educated guess for a phenomenon, used as a basis for further investigation.
Mixed Bud—noun—A bud that contains both leaves and a stem as well as potential flowers.
Petal—noun—one of the often brightly colored parts of a flower surrounding the reproductive organs.
Phenology—noun—the science of studying the timing of life events of plants and animals, and how seasonal and long-term changes in climate influences these life events.
Phenophase—noun—a visible stage in a plant or animal's life cycle.
Photosynthesis—noun—the process by which plants convert the energy in sunlight to usable glucose.
Pollen—noun—the fertilizing element in flowering plants.
Sapling—noun—a young tree, especially one that is not over 4 inches in diameter at breast height.
Scientific Method—noun—the system of advancing knowledge by formulating a question, collecting data about it through observation and experiment, and testing a hypothetical answer.
Seedling—noun—a young plant grown from seed before it becomes a sapling.
Taproot—noun—a primary root that grows vertically downward and gives off small lateral roots.