

7 - Adaptations of California Native Plants

Revised: 04/30/2012

Lesson Description: This two-part lesson provides students with the opportunity to develop their observational skills while orienting them to the school garden.



Lesson Topics & Desired Outcomes

- To understand how native plants have adapted to different climate, topographical and geological conditions.
- To learn about California's plant communities and their characteristics.
- To learn about the adaptations and biodiversity of plants and animals and how they relate to each other.

Curriculum Connections

State Standards	3.1 Students know both genetic variation and environmental factors are causes of evolution and diversity in organisms. 3.5 Students know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.
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Lesson Logistics

SESSION	VOLUNTEERS	OBJECTIVES	SESSION LENGTH	INDOOR/OUTDOOR
1	3 Docents or 1 Docent and 2 trained parent volunteers	Two of five habitat areas.	45 Minutes	Indoor then Outdoor
2	3 Docents or 1 Docent and 2 trained parent volunteers	Three of five habitat areas.	45 minutes	Outdoor

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Objectives

To learn the physical adaptations of plants that allow them to survive and sometimes thrive in greatly varied environments and climates. To learn about the varied geography, climate, and topography of California, and how California native plants are adapted to living here.



Guiding Questions

You are learning about how adaptations are the key contributor to evolution. Have you ever stopped to think about how plants, critical to the survival of all life on earth, have adapted to their environments?



Key Words

Adaptation, Mutualism, Alelopath, Schlerophyll, Survival Strategy, Opportunistic, Ecology, Ecosystem, Plant Community, Succulance

MATERIALS

1. Plant Adaptations Work Sheets (6 double sided laminated sheets – one for each student, plus 1 answer sheet per student)
2. Cal Alive! CD Rom Tutorial and computer and projector in classroom
3. Plant signs placed next to plants featured in the lesson by docent ahead of time
4. 3 sets of laminated photo cards with photos of various plants in the garden, which help in case plants aren't in the best condition.

Preparation:

Leave extra time to place plant signs in the garden. Make sure that there is a working projector that will connect with the classroom laptop and play it before the class starts to make sure it is working properly.



Get 'Em Hooked! – 3 Minutes

- When we think of evolution, we usually think of animals, but plants evolve too, in direct response to their environment.
- We will be splitting up into 3 groups and exploring the native plant gardens in front of the school to see plant adaptations first hand.



Action! – 40 Minutes

Instruction: 15 minutes

- With the entire class, start the Cal Alive! CD-Rom, click on the Ecology box, then click on the Adaptation box and play the Biodiversity--Physical conditions portions.
- After the CD Rom is complete, talk about adaptations. An adaptation is a heritable characteristic of an organism that helps it survive and reproduce. Adaptations may be structural (thick fur), physiological (slow heart rate), or behavioral (hibernation.) Organisms do not choose to adapt. Rather evolution, usually through the processes of natural selection, results in adaptations. Under the right conditions, evolution can also result in the creation of new species. With time, different populations of a single species may become so different from one another that individuals in those populations can no longer interbreed, thus resulting in distinct new species.
- Natural selection operates because of the following conditions that are present in almost every population of organisms:
 - 1) individuals in a population differ from one another
 - 2) not every offspring produced by a population will survive to adulthood and reproduce
 - 3) offspring compete for limited resources.
- Natural selection takes place because the offspring that are best able to obtain and use resources (the ones with the most useful adaptations) are the most likely to reproduce and pass their traits on to the next generation.
- The environment shapes the adaptations of species through natural selection. Thus organisms that occur in dry places like Desert Scrub have adaptations that help them survive in dry conditions. Being well-adapted to a particular set of conditions may allow one species to flourish in a small area, but may make it more vulnerable to environmental changes. Species are never perfectly adapted to their environment because genetic mutations are constantly occurring and environmental conditions are constantly changing.

Transition to outdoors:

- Ask the teacher to divide the class into 3 groups and assign each group a docent. Give each student their 6-page laminated plant adaptations hand out worksheets and answer sheet. Students also need a hard writing surface. Remind students to be quiet as they walk to the garden with their groups so they don't disturb other classes.

- Tell students their goal is to complete 2 habitat worksheets on the first session (after the CD-Rom) and 3 habitats on the second session.

Outdoor Activity (30 minutes):

- Group leaders walk out to the front of the school with two groups in the sunny portion of the garden (one group on the left side and one on the right side of the front entry sidewalk) and one group in the shady portion along the entry driveway, to start. Begin by reading aloud the text for the first habitat listed for your group—summarizing a little to shorten the time. Then read the questions and tell students that the plants are marked according to which habitats they are found in, and the clues to the answers are either on the worksheet itself, on the plant identification card, or both. Each habitat worksheet will indicate where the plants featured are located. Assign the groups as follows:

Group 1: SUN garden: Coastal Scrub and Chaparral

Group 2: SUN garden: Cactus Scrub and Coastal Scrub

Group 3: SHADE garden: Riparian and Redwood Forest

- Walk around with your group of students and help them find the plants featured in their worksheet and answer the questions.
 - Have students compare the textures and smells of different leaves.
 - See if you can find any fruiting or flowering plants.
 - Look for bees, birds, butterflies and other creatures in the garden.
- Remind students that the garden is their habitat and we don't want to disturb them.
- Return to the classroom with time left for a quick wrap up.



Wrap it Up – 1 Minute

- Tell students they will be finishing up their worksheets tomorrow and will start right away going back to the garden.



Session #2:

Action! – 40 Minutes

Have students get out their work sheets and writing surface. Split class again into the same three groups and have them walk to the front of the school and visit the sunny or shady garden as directed below. Their goal is to complete three worksheets in the next 40 minutes. Remind them to read the material on each worksheet before answering the questions.

If the groups completed their two habitats in the previous session, have students complete their worksheets in the following order (so that not more than one group is looking at the same plants at the same time):

Group 1: Start in SHADE garden: Riparian and Redwood Forest, then moved to SUN garden: Cactus Scrub (Chaparral and Coastal Scrub if not finished).

Group 2: Start in SUN garden: Chaparral (Cactus Scrub and Coast Scrub if not finished), then move to SHADE garden: Riparian and Redwood Forest,

Group 3: Start in SUN garden: Chaparral, Cactus Scrub, and Coastal Scrub, then move to SHADE garden: (Redwood Forest and Riparian if not finished).

Assist and guide students per the instructions for session #1.



Wrap it Up – 8 Minutes

With the whole class back in the classroom, ask students about what they learned about plant adaptations. Ask for at least one adaptation they found interesting for each of the 5 habitats. They can refer to their worksheets.

Adaptations of California Native Plants

Background for Docents and Teachers:

Adaptations are the special features that allow a plant or animal to live in a particular place or habitat.

Plants are able to produce highly diverse offspring as a result of genetic mixing that occurs in the process of sexual reproduction. While some plants spread their pollen and their seeds with the help of the wind, many plants have formed symbiotic relationships with animals. Flowering plants co-evolved with insects and sometimes with birds and mammals. Bees and birds are important pollinators, being rewarded with nectar. Mammals are important seed dispersers, being rewarded with fruits and nuts.

How did plants and animals acquire seasonal adaptations? An individual's inheritance influences its ability to survive and produce offspring in any particular physical and biological environment. The environment selects individual organisms based on their inherited adaptations. The environment shapes individuals, but rarely alters the inheritance of their offspring. In general, seasonal changes favor plants and animals that happened to have traits that provide survival advantages when the environment changes. The diversity of offspring insures that some individuals are genetically endowed to survive change. The ability to survive a changing environment also provides survival traits for plants and animals that are dispersed into new environments, wetter, drier, hotter, colder, nutrient poor, or whatever.

Adaptations are the precursor for biodiversity, which is the variation of biological components in an area and can be observed as 1. Ecological biodiversity (populations, habitats, ecosystems, landscapes, bioregions, biomes); 2. Organismal biodiversity (individuals, subspecies, species, genera, families, phyla, kingdoms); and 3. Genetic biodiversity (nucleotides, genes, chromosomes, individuals, populations.)

Geology and topography play a major role in species and habitat diversity in California. In fact, the physical geography of California is more varied than that of any other state. In addition, California has all of the eleven major soil types found in the world. Without this tremendous diversity of landscapes and soils, we would not have as much climatic and ecological variation, and therefore not as much species and habitat diversity.

California is also the only region on the North American continent to have a Mediterranean climate, characterized by a long, dry summer and a short, wet winter. The annual cycle of rainy and dry seasons contributes in a major way to endemism—the evolution of organisms native to only one place or region—and to the development of new species that can live without water for much of the year.

Ecological interactions bring about variations in communities too. Physical factors that limit populations, specific adaptations to California's vast array of climates, population dynamics among generalists and specialists, and the complex interactions in communities with large numbers of different species all affect the biodiversity of organisms in the state.

Geology: The amazing richness of plant and animal species in the state can be attributed largely to its complex geological history and the climatic regime. The very fact that California is actually isolated biologically from the rest of the continent—by the Sierra Nevada, by deserts, by the Pacific Ocean—has encouraged new species to evolve rapidly. In addition, the complex topography creates the potential for networks of diverse habitat types—areas that are shaded versus exposed, elevated versus flat, narrow versus broad, interrupted versus homogeneous.

Plants in shaded areas can hold onto more water, but their leaves need to have lots of surface area to pick up light. Plants on hills may gain in height and access to sunlight, but may have to deal with cooler temperatures.

The wide range of soils in the state also impacts the kinds of vegetation that can grow, which explains not only the state's high plant diversity, but also its high level of endemism. Soil is very important for most plants. It provides a medium to support their growth and is a source of water and nutrients. Diverse soil types create many "choices" for vegetation. For example, the texture of soil (whether it is coarse like gravel, or fine like clay) has clear implications for drainage. Gravel soils such as those in alpine conditions, and even some desert areas, drain quickly, making it harder for plants to get water. The balance of nutrients is also a determinant of the presence or absence of plants; most plants for instance require a balance of magnesium and calcium in order to carry on metabolism, and yet some soils in California have an oversupply of magnesium that plants must adapt to. Different plants have evolved different adaptations to deal with different soil textures, soil salt content, and different levels of organic matter.

Climate: In California you can find some of the hottest, coldest, highest, lowest, wettest and driest spots on the continent. This variation has given rise to California's extraordinary biodiversity, as ecological communities have evolved in a wide variety of conditions.

Topography: California's topography leads to a comparatively high variety of weather patterns. Mountain ranges form barriers between continental and maritime air masses. So, over short physical distances, places of relatively equal elevation may experience very different weather. Higher elevations are generally cooler than low elevations. Most moisture comes into California from the west and passes eastward across the state. As air is forced upward over the Sierra Nevada, it cools and drops moisture on the western slopes. Consequently, areas of equal elevation on eastern and western sides of the mountains have very different quantities of precipitation. This is called the rain-shadow effect.

There are several ways in which these factors affect the biodiversity of California:

Growing season: Most native trees, shrubs, herbs and grasses do all their growing in the winter! This is totally contrary to the growing season in the rest of the country.

Summer dormancy: The corollary of high winter biological activity is low summer activity, in fact, dormancy for many plants, and estivation for many animals. Plants must either be directly adapted to summer drought or develop some way to locate year-round water sources like deep roots to reach ground-water or creeks.

Greatest Biodiversity

California now has the greatest biological diversity of all the states in the United States. California has by far the largest plant biodiversity and since most animals feed on plants, species-specific feeding preferences have evolved, and so has animal diversity.