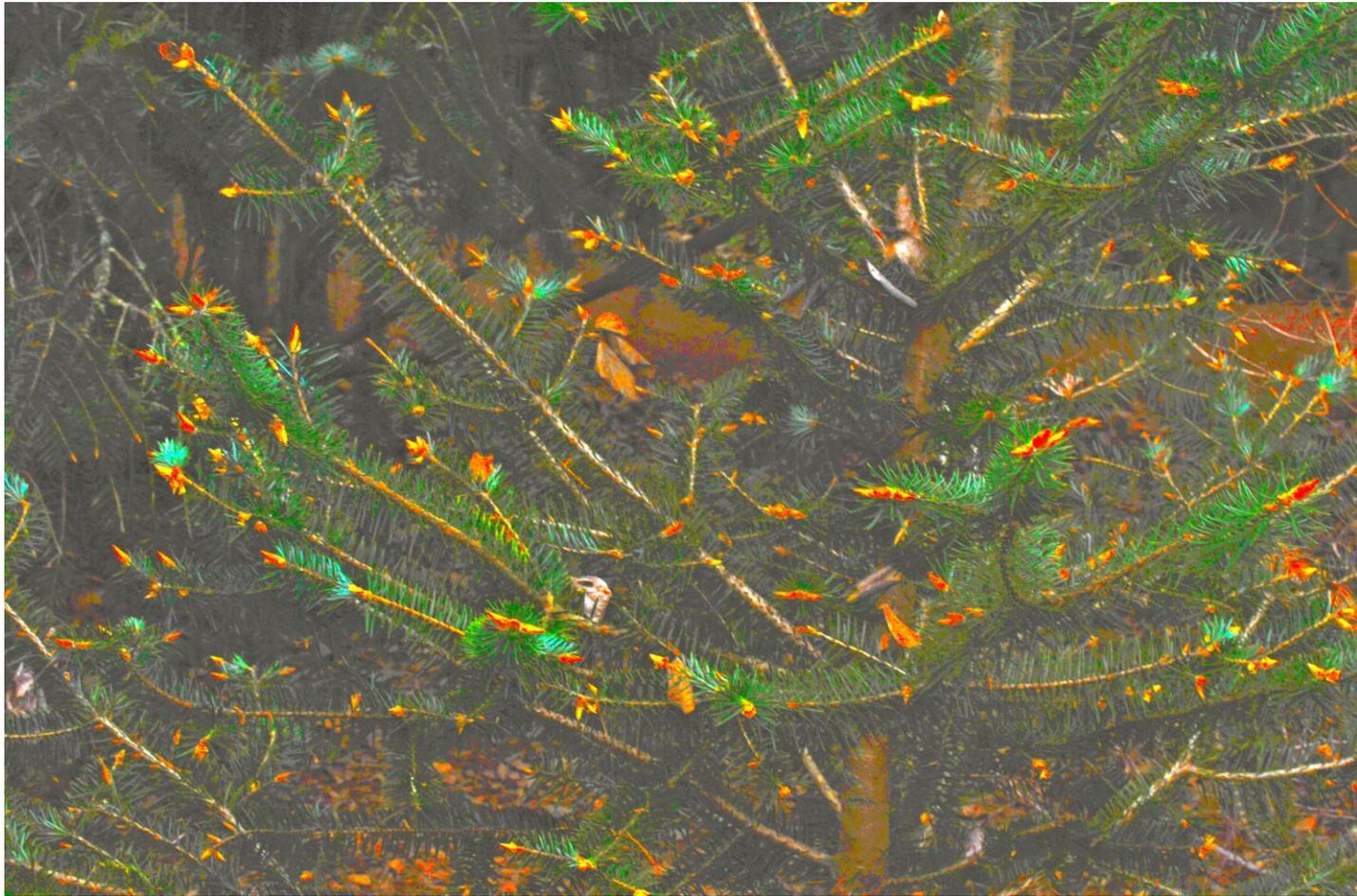


STEMS, SHOOTS, & ROOTS

SHOOTS COMPRISE STEMS WITH
THEIR ATTACHED LEAVES

Stems and leaves develop as a unit called the shoot. Shoots grow from buds when conditions are favorable. Lateral buds produce side branches while terminal buds allow the main shoot to grow longer.

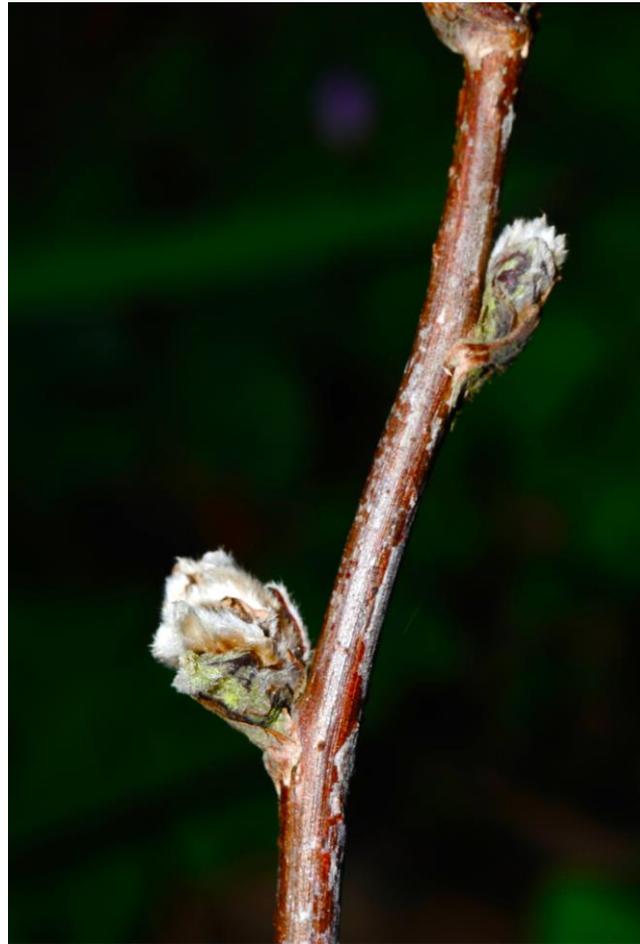
BUDS: *Abies bracteata*. Buds are the basis for growth of the shoot. Inside each bud is a complete miniature of the shoot system



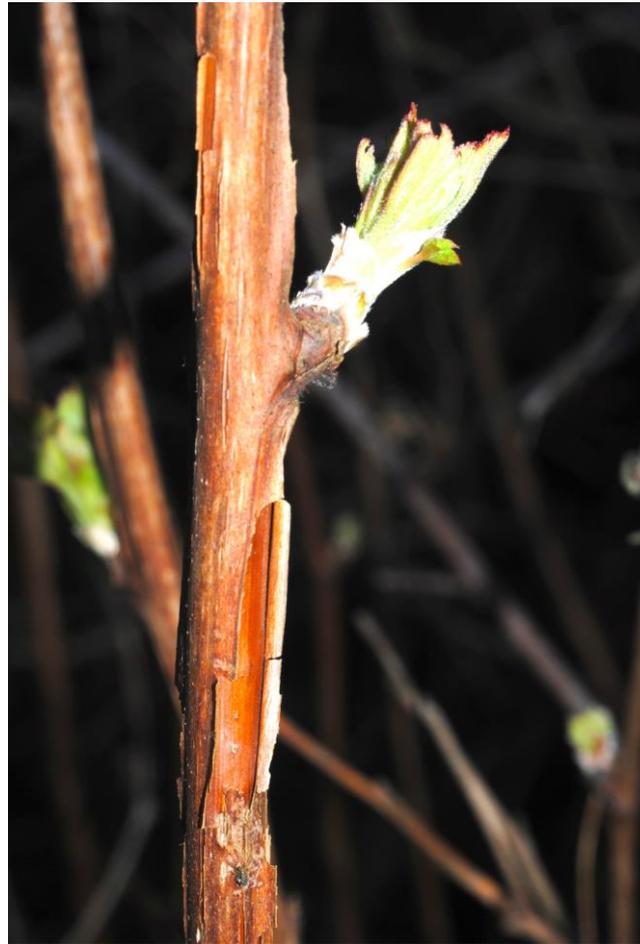
Here you see the two positions of vegetative buds: terminal and lateral or axillary.



These buds of thimbleberry, *Rubus parviflorus*, are swelling as the days warm, but have not yet opened.



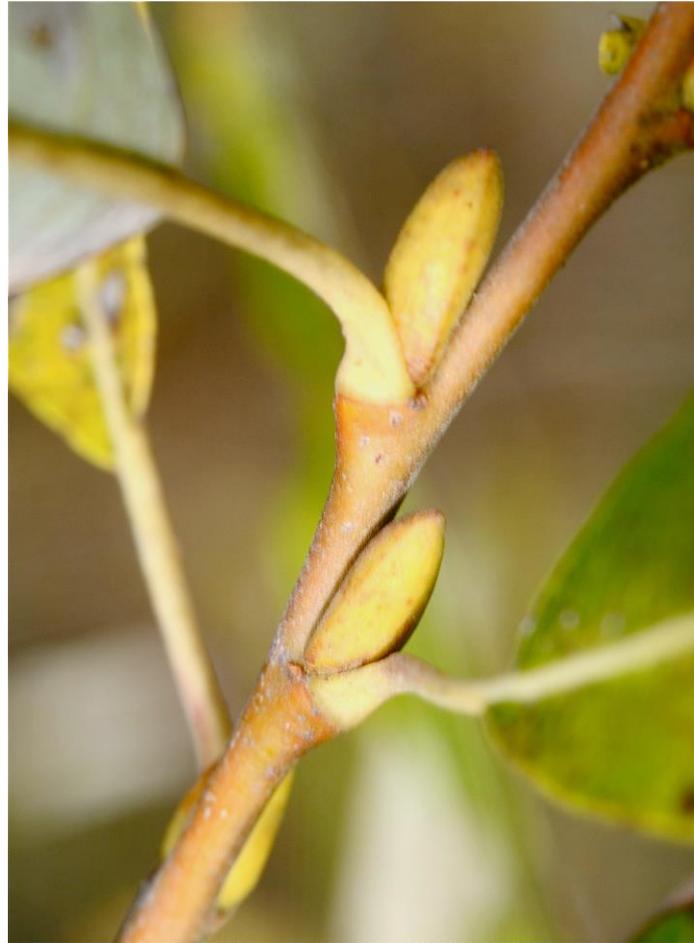
Buds: buds opening. Note the bud scales at the base of the new emerging shoot.



Buds: axillary position. The term refers to the bud being borne in the angle or *axil* of the leaf.



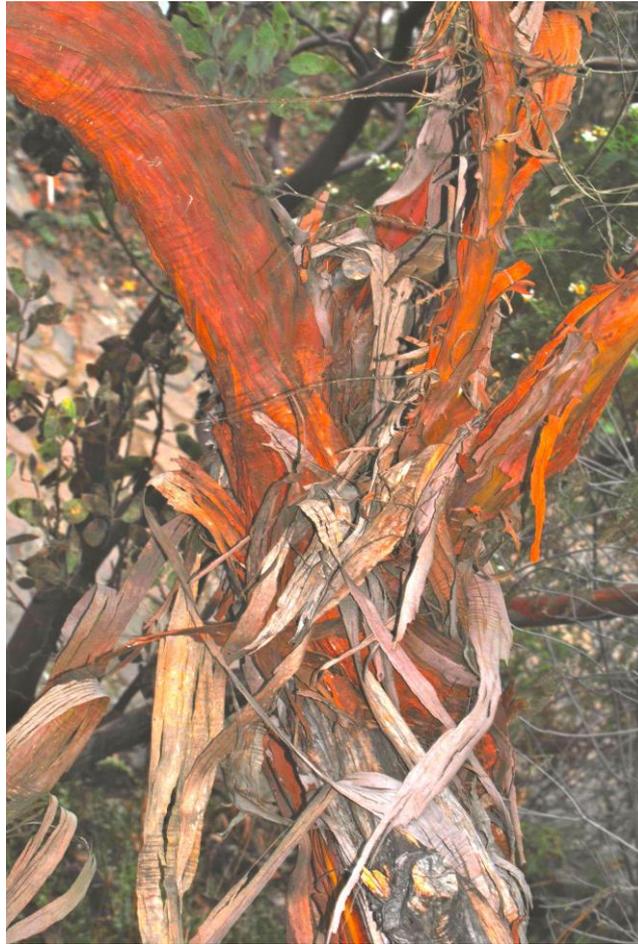
These axillary willow buds are protected by bud scales before opening.



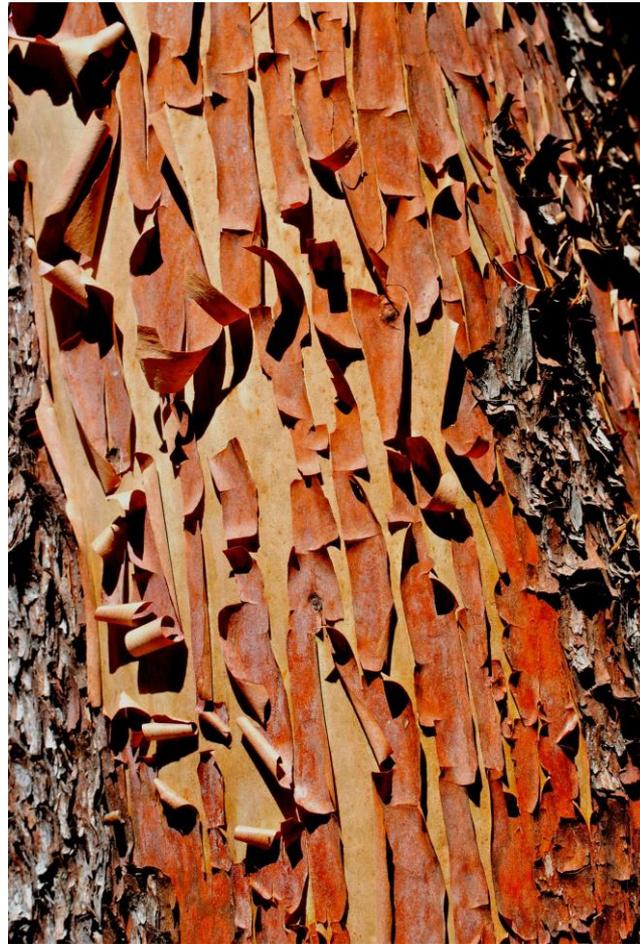
Bark : *Abies magnifica* or red fir. Bark color and pattern are good identifiers of trees and shrubs.



Bark: *Adenostoma sparsifolium* or red shanks. Note how the bark peels in long strips as it's sloughed off. Bark is renewed every year.



Bark: madrone or *Arbutus menziesii*. The new bark is smooth but with age develops curls that peel off each year.



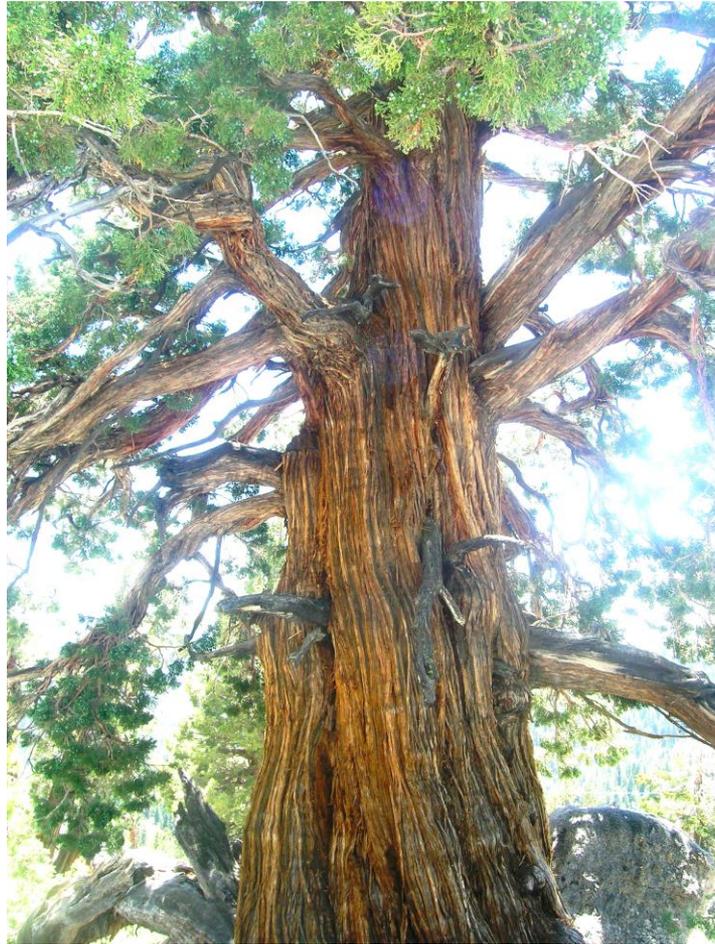
Bark: palo verde, *Cercidium floridum*. This bark has chlorophyll and photosynthesizes because the tree loses its leaves as conditions dry.



Bark: ocotillo



Bark: *Juniperus grandis* or Sierra juniper. Here the reddish bark contains tannins which fight fungal infection.



Bark: *Pinus albicaulis*, white bark pine. Different pines have different bark patterns when mature.



Bark: *Pinus contorta murrayana* lodgepole pine. Note the difference between this and whitebark pine.



Wood: *Pinus albicaulis*. Because bark has living cells, it's sloughed off as soon as a tree dies, exposing the wood inside.



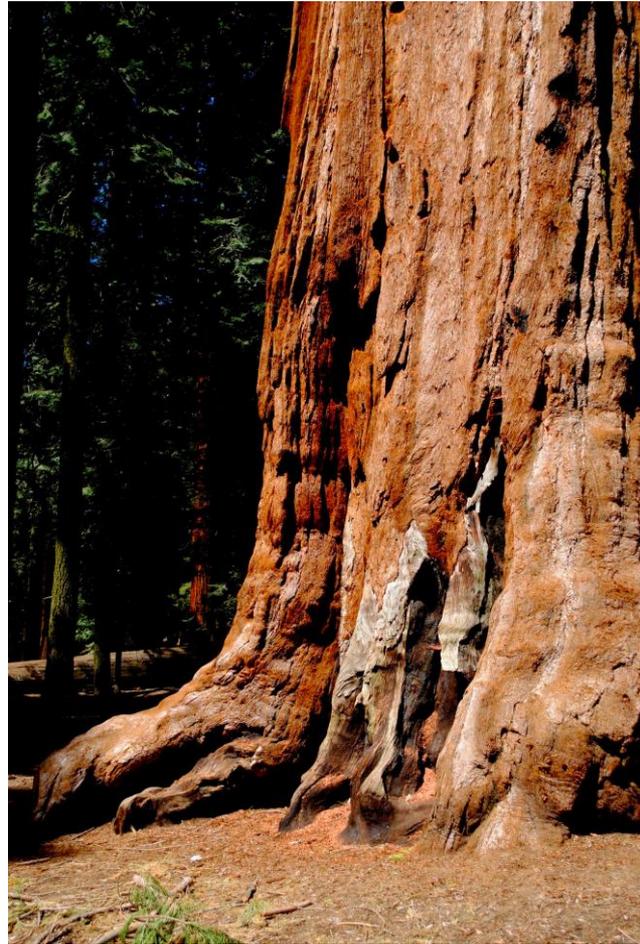
Bark & wood: *Pinus balfouriana* or foxtail pine. The bark is always a relatively constant thin layer around a core of ever-increasing wood in trees.



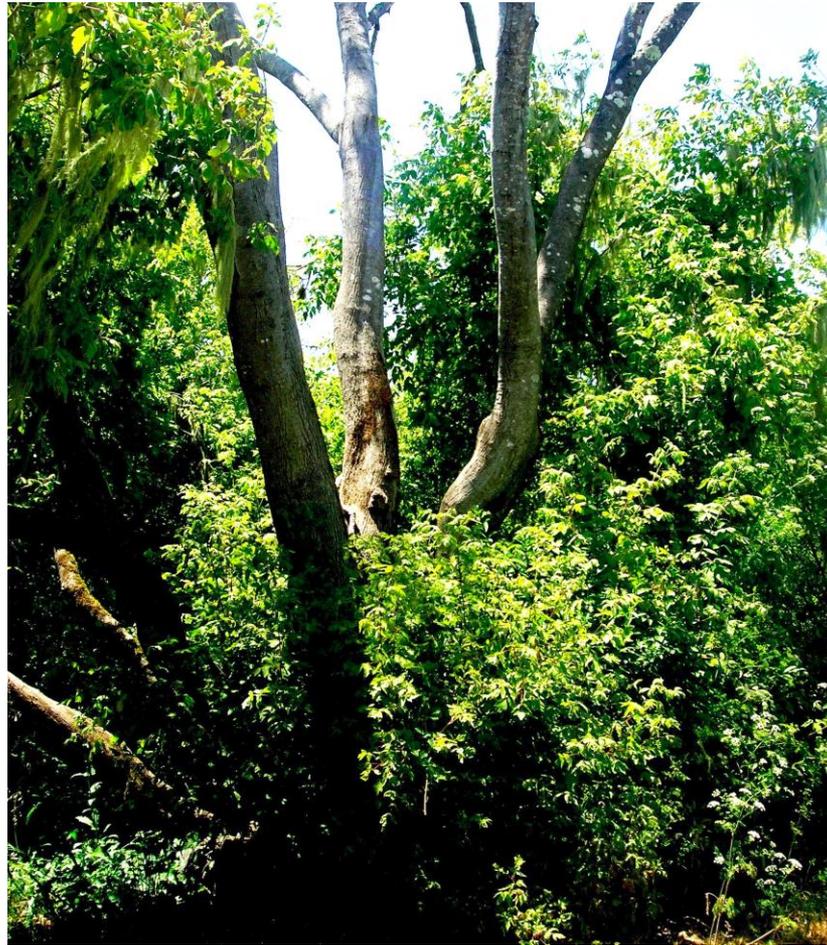
Bark w lenticels: *Prunus emarginata*, bitter cherry. Lenticels are breathing pores allowing oxygen exchange in young bark. Later, the bark grows in patterns that allow oxygen exchange without the lenticels.



Bark: *Sequoiadendron giganteum*. The bark of the giant sequoia is unusually thick and forms a protective layer against fire.



Stump sprouts: *Acer negundo* box elder. Many trees and shrubs have dormant buds at the root crown that can sprout when the parent is injured.



Stump sprouts forming colony: aspen, *Populus tremuloides*.
Aspens spread by regular stump sprouting to form large clones
of trees.



Stump sprouts from a burl: *Arctostaphylos glandulosa*. Many chaparral shrubs adapt to fire by stump sprouting from an enlarged root crown or burl.



Photosynthetic stems: *Chondropetalum*. In some grasslike plants, the leaves are reduced to brown scales and photosynthesis is taken over by the stems.



Photosynthetic stems: *Ephedra* or Mormon tea is a desert shrub where green leaves would lose too much water, so the stems are photosynthetic.



Photosynthetic stems: *Lepidospartum*. The scale broom looks superficially like the Mormon tea but in bloom looks totally different.



Photosynthetic stems: *Equisetum*. The primitive horsetails also photosynthesize through stems.



Cladophylls: *Phyllocladus*. This strange southern hemisphere conifer has modified its side branches into flattened leaflike structures called cladophylls.



Modified stems: bulbs. This soap plant stores its food and water underground in a bulb that consists of a bud surrounded by modified leaves.



fibers around bulbs represent the bases of outer modified leaves that protect the inner part of the bulb.



Modified stems: parasites, dodder. The genus *Cuscuta* has brownish stems that penetrate the host plant then wrap around it. This dodder is in bloom.



Modified stems: parasites, snow plant, *Sarcodes sanguinea*. This spectacular mountain plant attracts pollinators by its red stems and flowers but lacks chlorophyll, so its roots hook up with underground fungi for nourishment.



Modified stems: twining, *Dichelostemma volubile*, twining brodiaea. These stems wind around upright plants for support, allowing them to climb.



Modified stems: tendrils. For vines whose stems don't twine, the tendril allows the vine to grasp a neighboring plant for support.



Modified stems: inflated stem, *Eriogonum inflatum* or desert trumpet. Despite appearing to hold water in a desert setting, these stems are hollow inside.



Modified stems: runners or stolons of beach strawberry, *Fragaria chiloensis*. Runners allow the plants to cover a large territory and produce a multitude of identical baby plants.



Modified stems: floating, duckweed or *Lemna*. These tiny green stems float by air pockets inside.



Modified stems: stems buried underground. Many apparently stemless plants like this footsteps-to-spring bury their stems safely underground awaiting from the harsh winds of the habitat.



Modified stems: prickles, *Rosa californica*. Prickles are outgrowths of the stems' skin or epidermis, protecting the plants from predation.



Modified stem: prickles between spines, *Ribes menziesii*, canyon gooseberry. The spines at the nodes are actually modified leaves.



Stem succulents: *Asclepias albicans*. In the coachwhip milkweed, the stems both photosynthesize and store water against the dry desert environment.



Stem succulents: ocotillo, *Fouquieria splendens*. This cactuslike desert plant only leafs out after rains.



Stem succulents: *Echinocactus polycephalus*. The multiheaded barrel cactus, like its brethren photosynthesize and store water in its stems. The spines are modified leaves.



Succulent stems: *Echinocereus triglochidiatus*, mound cactus. The multiple stems overlap to form mounds which design offers additional protection from drying out.



Succulent stems: *Opuntia erinacea*. The old man prickly pear keeps its green stems vertical as another way of reducing water loss in the desert.

