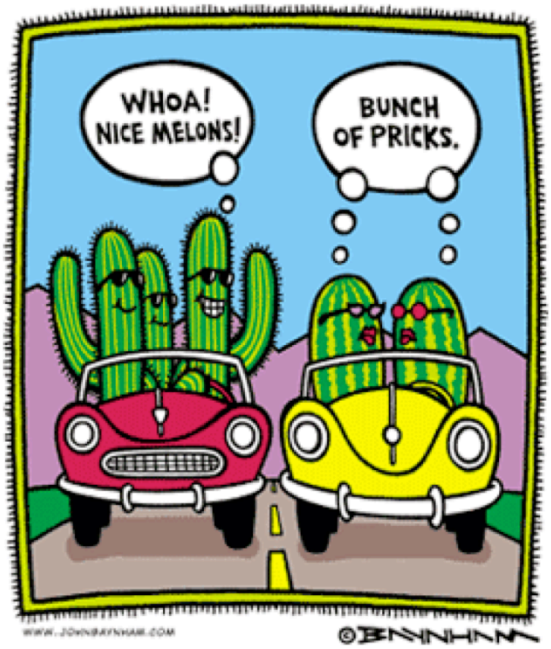
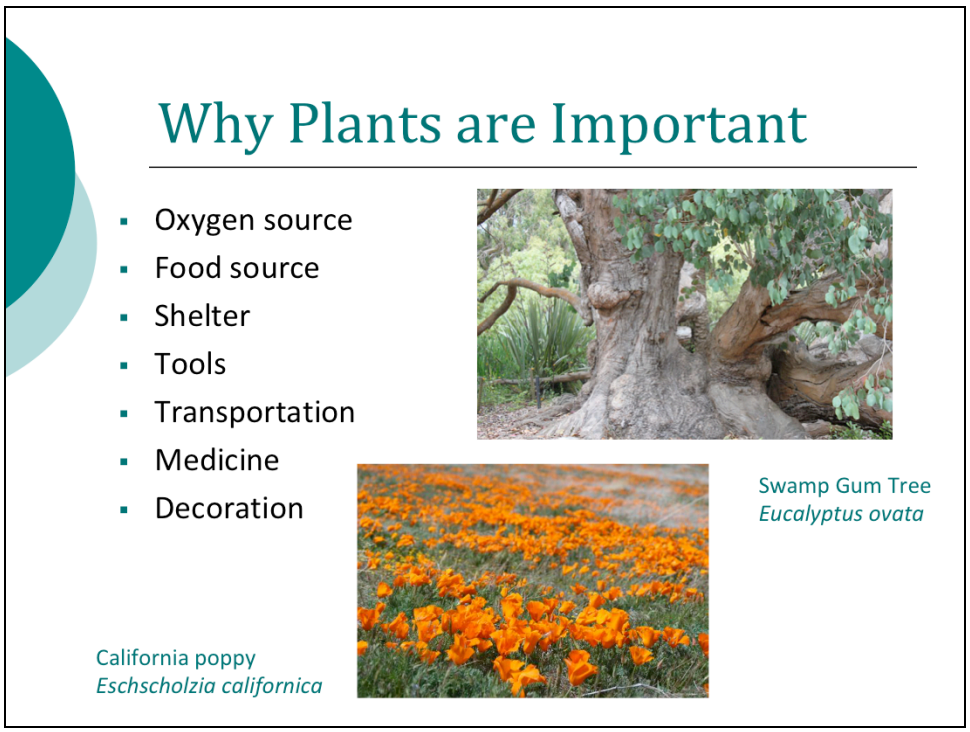
Plants



Plants are similar to animals in that they are both trying to survive and pass their genes on to the next generation. If they are not able to adapt to changing conditions, then they will die out. Just like animals, each plant species is thought to have a separate, unique niche; no two plant species can occupy the exact same niche.



Without plants, life as we know it today would not exist. Oxygen is a waste product of photosynthesis. The build up of oxygen in the air allowed for the evolution of aerobic organisms, who take in oxygen and release carbon dioxide during respiration. Respiration is a key component to life in most organisms.

Plants and animals are interconnected. Plants are producers and a vital component at the bottom of the food chain; plants provide a source of energy for other organisms either directly or indirectly. Biomes are defined by plants and climate. It is the plants that serve as shelter and nesting places for birds and other animals and a plant's roots help hold down the soil and help stop erosion.

Some animals like the chimpanzee and the crow that have used parts of plants as tools for foraging for food. Humans also make tools from wood, especially handles of rakes, axes etc…

Humans use plants in innumerable other ways such as fiber for clothing, wood for furniture, shelter and fuel, paper for books, spices for flavor, rubber for tires, and drugs for medicines, to name a few. A good example of a plant that is used for medicine is an aloe plant. Inside the leaves of an aloe plant are compounds that soothe burns on our skin.

E.O. Wilson, an American biologist, estimated that there are 30,000 edible plant species, 7,000 species are cultivated for food, 41% of prescription drugs used in the United States come from living organisms and 70% of anticancer drugs come from rain forest plants. Plants have become an ingrained part of our lives.

In 2010, Italian scientists developed a way of turning rattan wood into bone that is almost identical to the human tissue. Rattan is the name for approximately 600 species of palms. This could have a major implication in the medical field.

Finally, plants have an enormous sensory appeal and our lives are enhanced through parks, gardens & wilderness areas or decorations for our homes. Walking through a natural setting seems to have universal appeal.

Classification of Plants

- Nonvascular plants: mosses, liverworts and hornworts
- Vascular plants:
  - Seedless plants: ferns and clubmosses
  - Seed plants:
    - Nonflowering (**Gymnosperm**): cycads, ginkgos and conifers such as pines, firs, cedars, redwoods, and cypress
    - Flowering (**Angiosperm**): roses, daisies, and apples

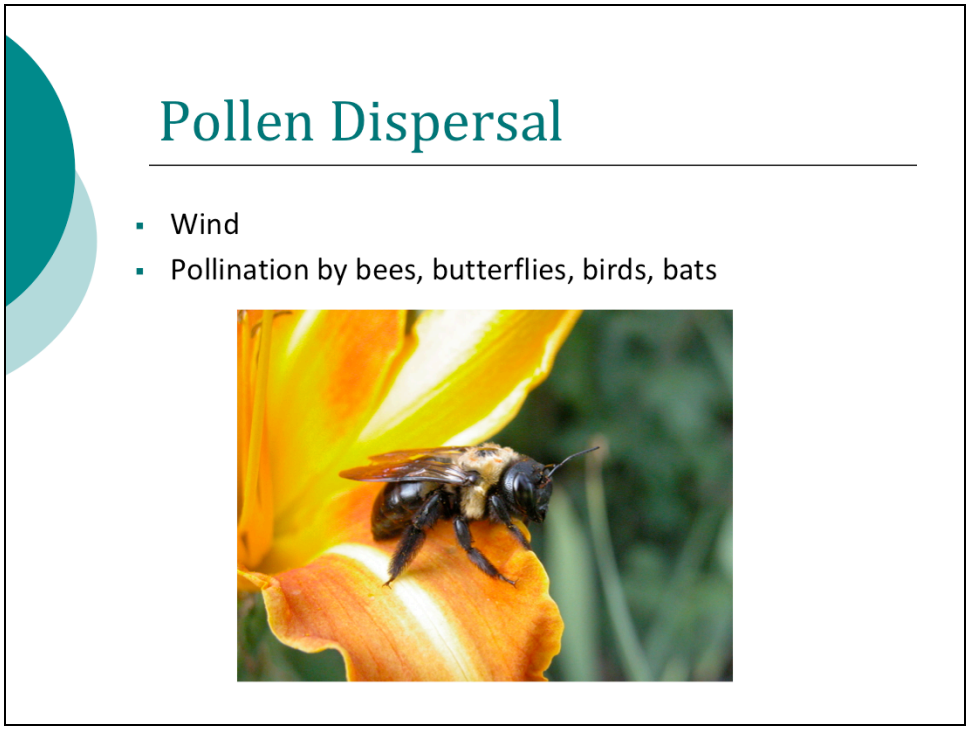
Pincusion Protea
Leucospermum sp.

All plants evolved from a common ancestor. Plants began in the seas as aquatic green algae and moved to land as competition for resources increased. This was around the time of the first vertebrates. It is generally recognized that the colonization of land by plants and their subsequent radiation and diversification are profoundly important episodes in the history of life. The major biomes are defined by these plants. These photosynthetic plants brought oxygen into the air that animals needed for respiration.

Moving from water to land posed new problems for plants. Plants needed structural support for their bulk; they needed a way for absorbing nutrients and conserving water; they needed to be able to reproduce outside of a watery environment. The evolution of cellulose as a component of the cell wall, provided a protective framework for a plant cell to survive. Cellulose reinforced the plant's structure and helped plants keep their shape and allowed plants to grow to greater heights.

The key adaptation in the evolution of land plants was seeds. Evolution of the seed protected the embryo from parasites, drying out, digestive juices of animals and excessive temperatures. The seed allowed plants to establish themselves in new drier habitats and create new biomes. Nonflowering plants (**gymnosperms** – Greek meaning "naked seeds") were the first to develop with wood. Wood served a secondary function of support for the plant and was the evolutionary innovation that allowed some plants to achieve their tall stature. The canopies provided by those tall trees gave vertebrates new opportunities to get out of the water and start moving around on land.

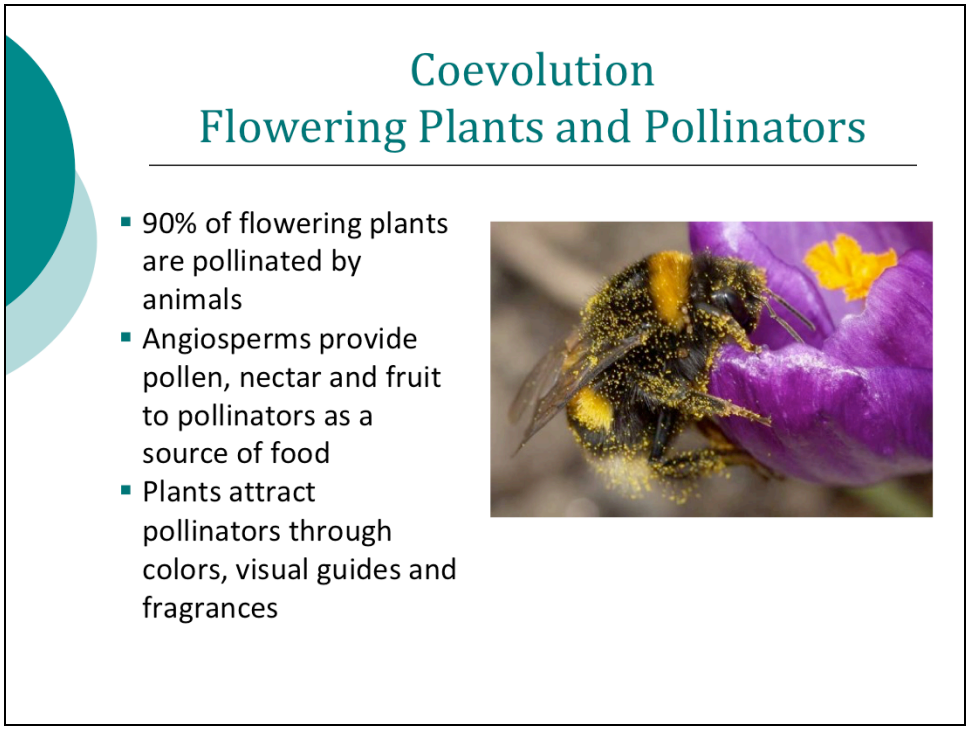
Lastly we have flowing plants (**angiosperms)**. Flowering plants account for about 80% of the terrestrial plants today. Flowering proved to be an unusually effective means of reproduction. The diversity and success of the flowering plants that dominate today are due in large part to beneficial interaction with pollinators such as bees, butterflies, beetles, birds, and bats.



Plants evolved two different means of dispersing their pollen, by wind or by pollination through the actions of animals such as insects, birds and bats. Nonflowering plants rely on wind for pollination; conifers are an example of **wind pollinated** species. Wind-pollinated plants do not have showy flowers and are seen in Northern temperate forests of North America. Brightly colored petals, fragrances, and nectar are a waste of material and energy for a wind pollinated species. When pollen is carried by the wind the chance of landing on the correct species is low. These species therefore produced a copious amount of pollen in order to increase their chances of survival. Some wind-pollinated trees release their pollen a month or more before leafing out when they can be more easily pollinated because there is less blockage by the leaves.

With the evolution of flowering plants, an insect would fly from flower to flower increasing the probability the pollen would land on the same species. Pollination by insects depends on adaptations that attract the insect, ensuring a greater success in pollinating. Plants entice pollinators through scents, colors and shapes, and foods. Adaptations that increased the plant's distinctiveness were advantageous.

Plants know how to attract animals when they need them. Buds are green and closed until the flowers are ready to be pollinated Flower pollination may occur later in the summer when the peak of insects occurs. . Fruit stays green until the seed has developed and ready to be dispersed. Seeds need time to mature and the attention of animals is discouraged until then. Different species stagger their pollination to avoid competition for the pollinators at the same time.



The **coevolution** of flowering plants and pollinators is a key to their successful radiation and abundance today. 90% of flowering plants are pollinated by animals. The process of pollination requires the male pollen grains to be transported to the female receptive part of the same species of plant, which produces a greater variety in the species. Flowering plants entice pollinators to their flowers by providing pollen, nectar and fruit. The sweet nectar is an adaptation to allure insects at no real cost to the plant and the plant in return has the benefit of a certain pollinator visiting its flower and being pollinated. In the mere act of gathering pollen and by visiting more than one flower, pollinators unwittingly transfer the pollen and aid in the fertilization of that plant. Both the plant and the pollinator benefit from and exert selective pressure on the other, so they evolve together (**coevolution**).

Flowers are colored and may have visual guides on their petals that attract and guide pollinators to their nectar. Some flowers have visual cues that can only be seen in ultraviolet light. This limits the type of animal that can see the cues. Some insects are restricted to certain colored flowers and these colors are meant to be seen during the daylight. Brightly colored flowers attract daytime pollinators whereas white or other light colored flowers are meant to attract night-time pollinators such as moths and bats. The lighter colored flowers tend to have stronger smells associated with them. This helps guide the pollinator who may not be navigating by sight alone.

Plants developed fragrances during their evolutionary development These aromas developed for two reasons. Leaf, root and bark fragrances defend a plant against being browsed or chewed. Flower and fruit fragrances attract animals for pollination and seed dispersal. The nature of the flower odor varies according to the group of pollinators attracted. The goals of these two strategies are often opposed to each other with bad smelling leaves and sweet smelling flowers.

Nectar can sometimes protect the plant; some flowering plants that want to prevent insects from eating their body parts will secrete nectar on the outside of the plant that will attract predatory insects which then eat the insects that attack the plants.

Seed Dispersal

- Wind, gravity and water
- Hitchhikers
- Digestions
- Caching of Seeds

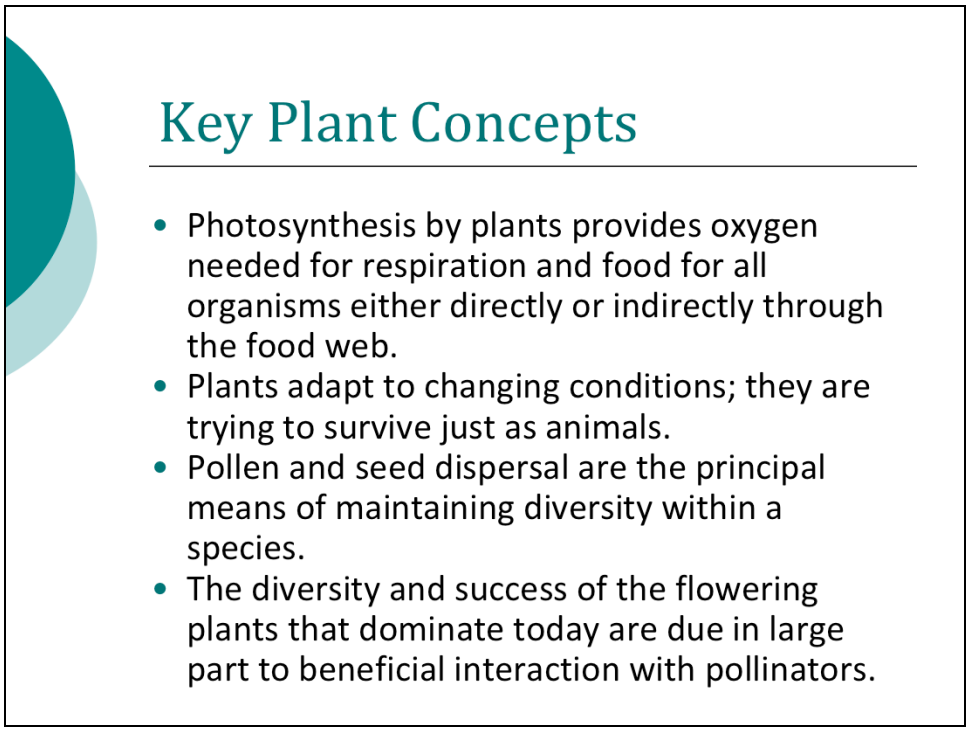
Pride of Madeira
Echium candicans

Different seeds have different shapes and features that help them to travel away from their parent plant and to a new place to grow; maple trees have helicopter-like seeds and dandelions have parachute-like seeds; some seeds fall straight to the ground while others are taken away by nearby streams, rivers or by the wind.

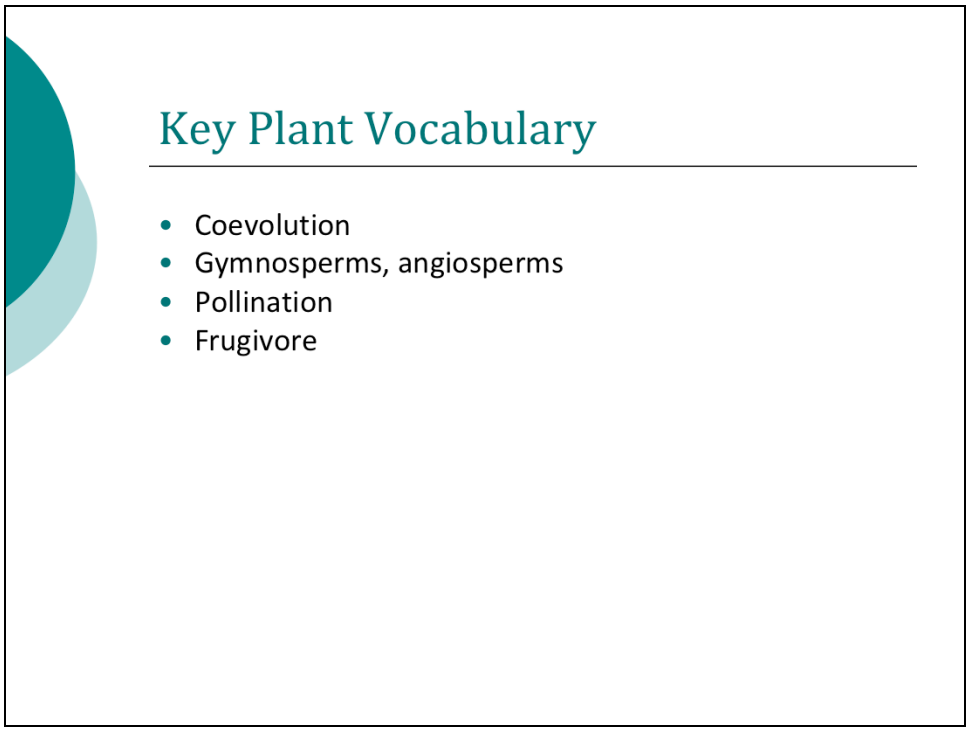
Animals are seed dispersers through their digestion; fruit is eaten and the seeds pass through the animal's digestive system. Sometimes only the outside of the fruit is eaten and the seed is thrown away. Raptors may become secondary seed dispersers by preying on **frugivores** such as birds or lizards and then dispersing the seed themselves. Ruffed lemurs feed primarily on fruits and nectar; the seeds of the fruit they eat pass through their digestive tract and are propagated throughout the rainforests in their feces, helping to ensure new plant growth and a healthy forest ecosystem.

Many plants rely on animals for seed dispersal of their seed without any reward to the animal; the barbs of seeds attach to fur and feathers or human clothing and hitchhike to another area before they fall or are brushed off. A bear's pelt is a great place for a seed to catch a ride.

By hiding acorns in the ground, squirrels help new oak trees grow. Birds also hide seeds for later. This requires huge spatial memory but sometimes these cached seeds are forgotten and sprout.



Corresponds to the Botany Study Guide in the Docent Notebook. For specifics on the Zoo's horticulture collection read the Plants Fact Sheets and the Conservation Corner Study Guide in the Docent Notebook.



Definition:

Angiosperm: a plant having its seeds enclosed in an ovary; a flowering plant.

Coevolution: The process of reciprocal evolutionary change that occurs between pairs of species or among groups of species as they interact with one another; two (or more) species reciprocally affect each other's evolution.

Frugivore: an animal that feeds primarily on fruit

Gymnosperm: a seed-producing plant that have unenclosed seeds; non-flowering seed plants.

Pollination: the process by which pollen is transferred from the anther (male part) to the stigma (female part) of the plant, thereby enabling fertilization and reproduction.