Why are the flowering plants so diversified and successful?

One reason: flowers promote pollination leading to reproduction with genetic continuity (or genetic exchange and variation)
Promotion of pollination

--flower traits take advantage of "pollination vectors":
wind or animals (insects, birds, bats)
--traits that can be modified through evolutionary
mechanisms include: structures (of pollen,
anthers, stigmas, petals, etc), petal patterns,
colors, odors, nectar as food reward
--examples: petal patterns for recognition of
rewards: nectar guides, orchid petals as mimic
for pollinating wasp's mate
The simplest vector is wind--for these acacias, pollen is blown from anther to style.
Oak trees have flowers of separate sexes--that is, flowers with only stamens and flowers with only pistils. These are pistillate flowers of an oak. The large amount of pollen is also distributed by wind.
The true “genius” of flowering plants is their relationship to insects, such as bees…
Bees tend to like blue, yellow, white flowers (reflecting in the UV)…
...and so do some flies
A Painted Lady Butterfly sips nectar from a disc flower of Cutleaf Coneflower (*Rudbeckia laciniata*) in the mountains of New Mexico.
Beach Sage (*Lantana involucrata*), in the family Verbenaceae, has clusters of small flowers that are visited by butterflies, such as this Gulf fritillary.
The Moonvine \textit{(Ipomoea alba)}, a member of the morning glory family, has white flowers that open and become fragrant in the evening to attract night-flying moths. The Tobacco Hornworm Sphinx has a tongue that matches the length of the narrow flower tube of the Moonvine. While the moth sips nectar, it inadvertently picks up pollen, which is transferred to the next flower.
The Corpse Flower (*Amorphophallus titanum*) is actually an inflorescence, with many male and female flowers on the spadix and covered by the spathe. It grows for 2-4 weeks, then opens in the evening and emits a powerful odor of rotting flesh that attracts flies.
Birds can be pollen vectors
Red, tubular flowers are often pollinated by humming birds (which have long tongues)…
Bats also can be vectors. These *Datura* flowers are typical bat-pollinated flowers. Unfortunately, I could not get a picture, since the bats come only when it is dark.
Regulation of genetic exchange

- Genetic constancy: preserves gene combinations with exceptional survival value (good for plants with specific genes for stressful habitats and for those with specific genes that provide physiological adaptability)

- Genetic variability: produces new combinations with potential survival value, allows for evolutionary adaptations to new environments and situations (e.g. new pathogens)
How plants promote genetic constancy:

1) vegetative reproduction: e.g., sprouts from potato tubers

2) apomixis (parthenogenesis--new generation without fertilization)
   • e.g., dandelion: meiosis omitted in development of embryo sac; egg, 2n, develops into embryo
   • e.g., citrus: adventitious embryos develop from 2n tissue around embryo sac

3) self-pollination
   • perfect flowers like beans favor this if pollen, stigma mature at the same time
   • sometimes, closed petals prevent cross pollination
   • self-pollination leads (tends) toward homozygosity, reduced recombination, but it does not remove alleles from population (except for alleles that are lethal when homozygous)
How plants promote genetic variability

Cross pollination--generally allowed, but not enforced, in plants with perfect flowers

1) stamens, pistils mature at different times

2) structures promote cross pollination by insects: separation of stigma from anthers
How plants promote genetic variability

3) imperfect flowers
   • Staminate, pistillate flowers on the same plant ("monoecious", e.g., cucumber, corn, oak)
   • Staminate, pistillate flowers on different plants ("dioecious", e.g., ash, willow, hemp)

4) self-incompatibility
   • Genetically-controlled, biochemical mechanism preventing fertilization by pollen from same genotype
--S locus, with many alleles (*Brassica*, >60 alleles)

--gametophytic system: pollen genotype depends on gametophyte (in each pollen grain) (e.g., *Nicotiana*)

--sporophytic system: pollen genotype depends on sporophyte (in anther) (e.g., *Brassica*)

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compatible

gametophytic incompatibility
e.g., Nicotiana

stopped in style
S product RNAase?

sporophytic incompatibility
e.g., Brassica.

stopped in stigma,
callosum?
Flower compatibility may affect evolution:

Self compatibility -> genetic constancy -> high speciation, high extinction -> low diversification
Self incompatibility -> genetic variability -> low speciation, lower extinction -> high diversification

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Summary

• Flower shapes, sizes, colors, nectar, odors are designed to promote (or inhibit) pollination

• Genetic constancy promoted by vegetative reproduction, apomixis, self-fertilization

• Genetic variability is promoted by separation of stamen and pistil (in time or space), imperfect flowers, self-incompatibility
Which is self-compatible?

Which has a sporophytic system of self-incompatibility?