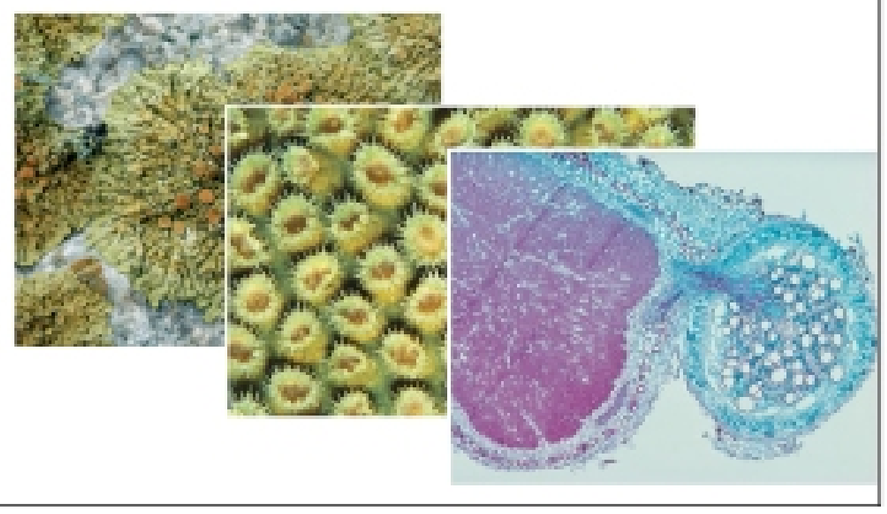
Mutualism

Mutualism: inter-specific relationship from which both species benefit

Mutualism

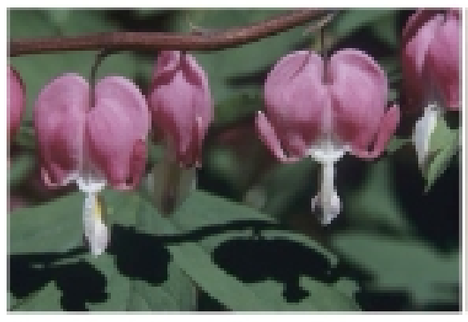
Symbiosis: intimate (generally obligate) inter-specific relationships from which both partners benefit



Mutualism

Pollination by animals (ie birds, bees, moths, butterflies, beetles, ants, mammals)
Pollinators receive food rewards (nectar and pollen), plants have pollen moved to other flowers
How did this mutualism evolve? What are the origins?

1. Antagonistic origin in a predator/prey relationship



How did this mutualism evolve? What are the origins?
1. Antagonistic origin in a predator/prey relationship

Early plants were probably wind pollinated and insects were predators feeding on spores, pollen or ovules

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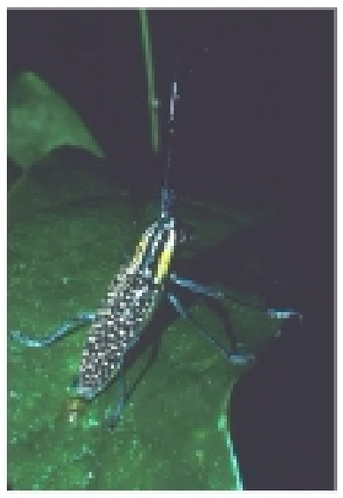

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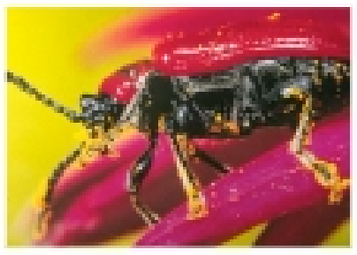
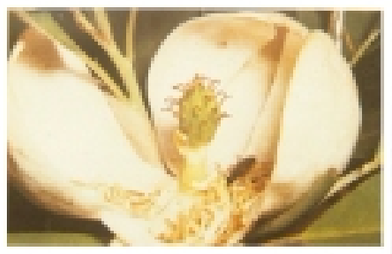
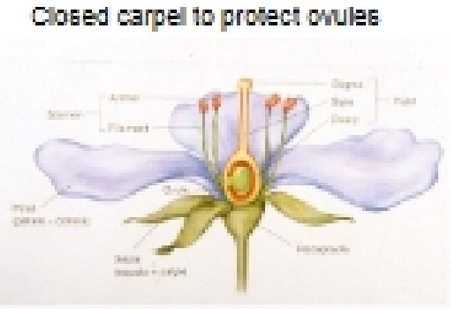


By chance, some floral visitors were less damaging and perhaps even beneficial in moving pollen between plants, thus selecting for traits in plants that would minimize damage and cost and maximize pollen transfer

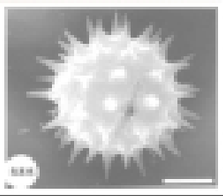
How did this mutualism evolve? What are the origins?
2. Evolution of plant traits that minimize negative impact of insects
   a) protect ovules and pollen



Closed carpel to protect ovules



Defend pollen with chemical or physical defenses



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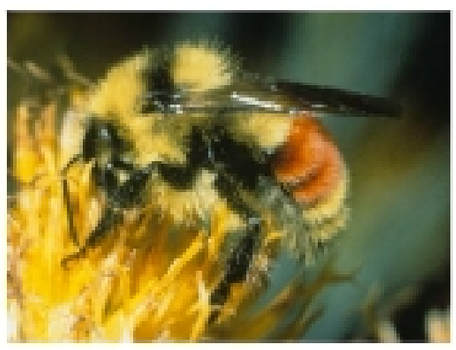
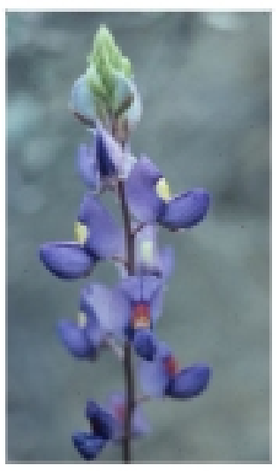
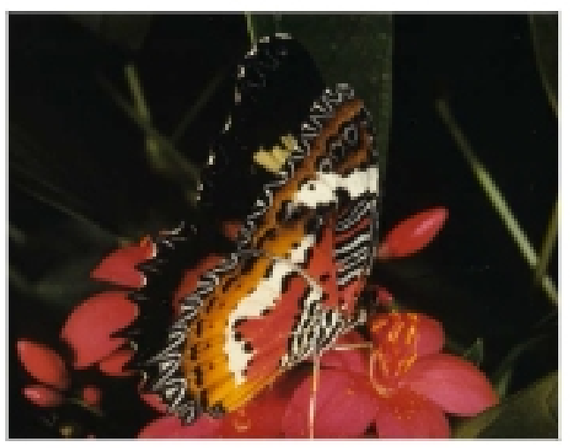


Bees are sophisticated pollen predators



Bilateral symmetry in flowers minimizes pollen predation by bees

How did this mutualism evolve? What are the origins?
2. Evolution of plant traits that minimize negative impact of insects
   b) minimize cost of rewards



Pollen is an expensive reward, but nectar is cheaper

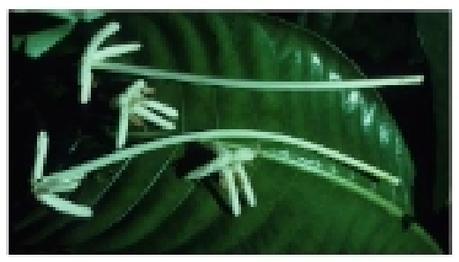
How did this mutualism evolve? What are the origins?
3. Evolution of traits that attract beneficial insect pollinators

Visual attraction

Visual attraction with UV patterns

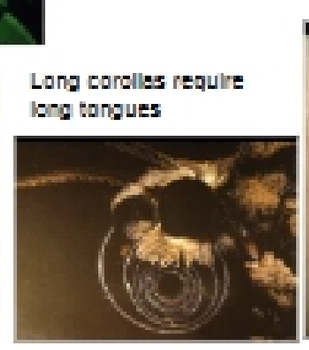
Olfactory attraction
(nocturnal pollinators)

How did this mutualism evolve? What are the origins?
4. Evolution of traits that increase specialization



By restricting access to only the most efficient pollinators, pollen will more likely be transferred to a conspecific (same species) rather than wasting pollen on the wrong species

Long corollas require long tongues



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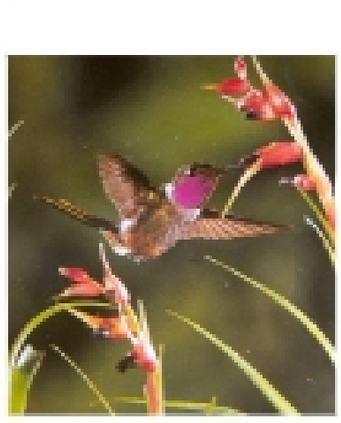

Evolution of syndromes for a subset of pollinators, e.g. humming bird flowers are red, tubular, easy access for hovering birds, high amounts of nectar, low concentrations

How did this mutualism evolve? What are the origins?
4. Evolution of traits that increase specialization

Evolution of syndromes for a subset of pollinators, e.g. bat-pollinated flowers are white, open for easy access, high amounts of nectar at night, lots of pollen to compensate for high nectar costs