
Gogo's Bee Co.
Honey
100% Pure Raw
Gogo's Bee Co.
A sweet Business
Our Future Flies on the Wings of
POLLINATORS


HONEY BEE

History of the honeybee

3633 B.C. Egypt – kept bees

1622 A.D. North America

1843 A.D. Kansas

1851 Langstroth developed the hive – still used today

1852, October 5 Langstroth patented the first movable frame hive

1853 A.D . West Coast

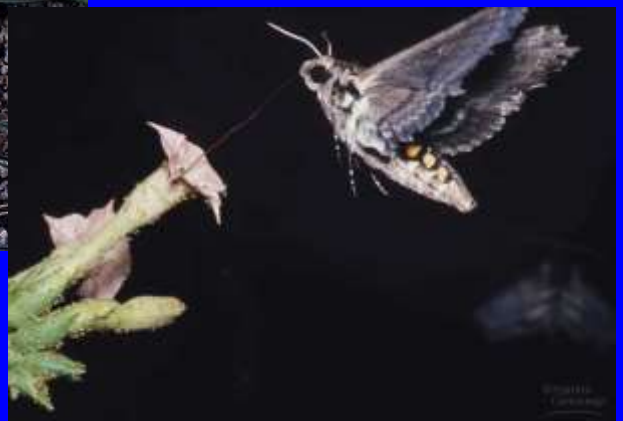
1976 A.D. Kansas names the honeybee state insect


Almonds, Eggplant, Strawberries,
Blueberries, Celery, Cherries,
Avocados, Beans, Apples,
Sunflowers, Cucumbers,
Hazelnuts, Turnips, Pears,
Apricots, Flax, Oranges,
Grapefruits, Honey and Coconuts
Do you eat these
fruits and vegetables?

Honey Bees

- All the fruits and vegetables you just saw needed some form of pollination to reproduce.
- The honey bee is one of the main pollinators in the animal kingdom.
- The honey bee pollinates an estimated 30% of the food eaten in the U.S.
- Another astounding statistic is that in the last 20 years the domesticated honey bee population has shrunk by 30-50% in the U.S.
- Honey bees were brought to the Americas in the 1620's from Asia and Africa.
- Even though different types of bees, birds, and even bats can pollinate plants, honey bees are the most prolific and productive of the pollinators.
- They are astounding insects whose way of life fascinates scientists even to this day.

Native Pollinators

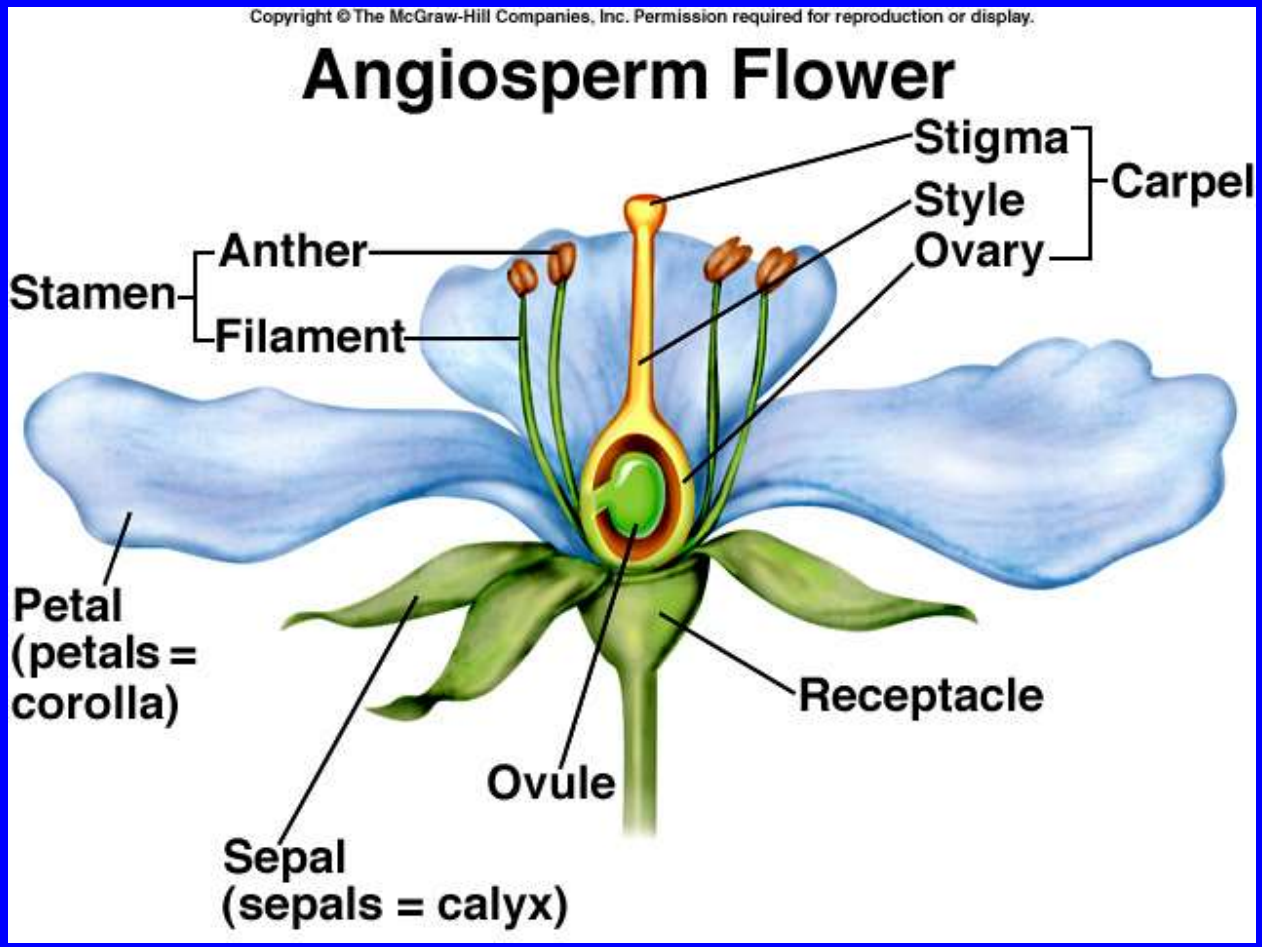


Pollination

- Definition: transfer of pollen from stamen to stigma

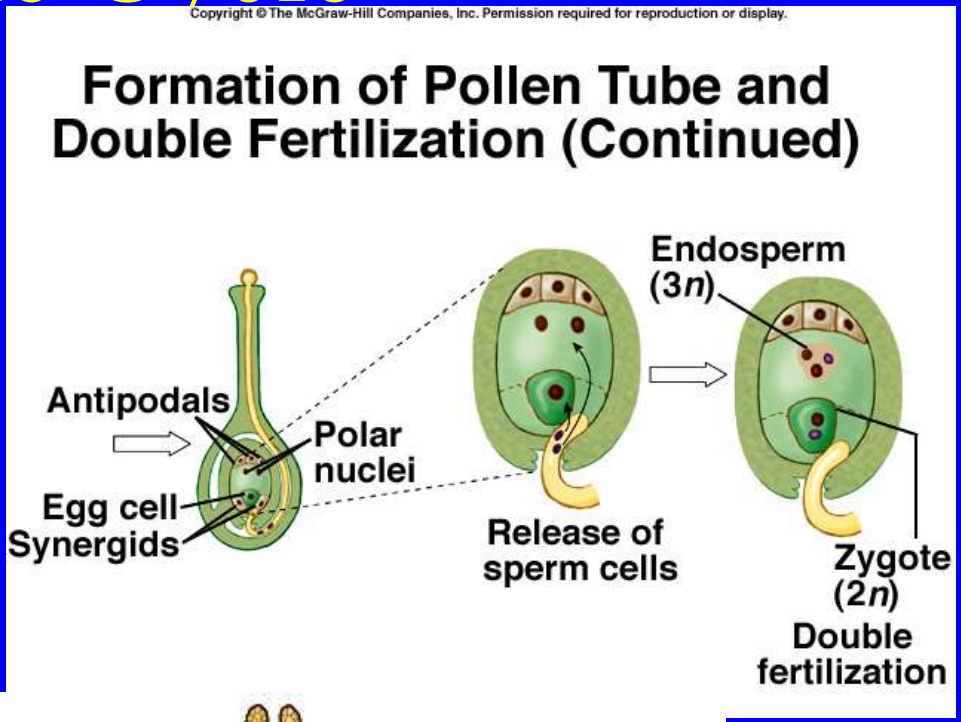
The flower

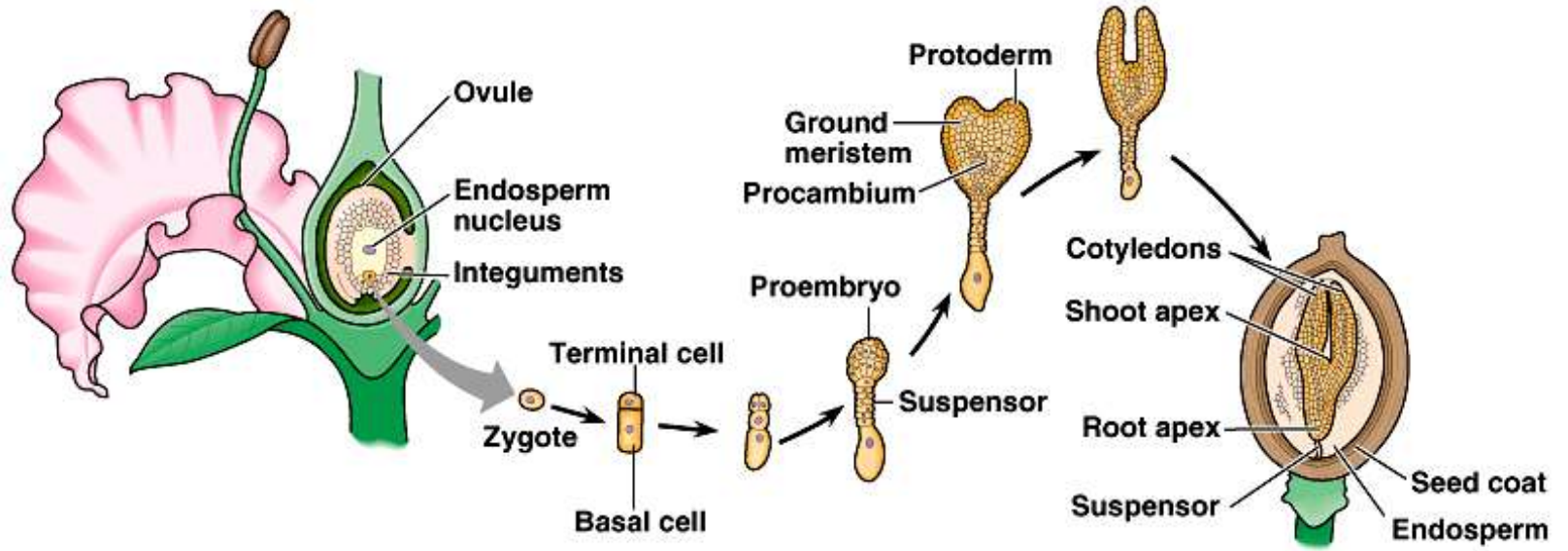
- Parts



Life Cycle

- Overview:
- Fertilization: union of sperm with egg to form zygote





Floral variation

- Parts may be fused
- Example, petals fused to each other.

Snapdragon flower

Floral variation

- Fusing of petals can form floral tube (nectar made at bottom)
- Only long-tongued pollinators can reach it.

Anisacanthus (Acanthaceae) flower

Floral variation

- Flowers with both stamens and pistils: perfect flowers
- Some flowers imperfect. Either pistillate (have pistil) or staminate (have stamens).

Pistillate flowers of *Sagittaria*

Staminate flowers of *Sagittaria*

Floral variation

- Note: some species make pistillate flowers and carpellate flowers on separate individuals
- This termed dioecy (MUST outcross to reproduce sexually)
- Monoecy is when both sexes on same individual.

Floral variation

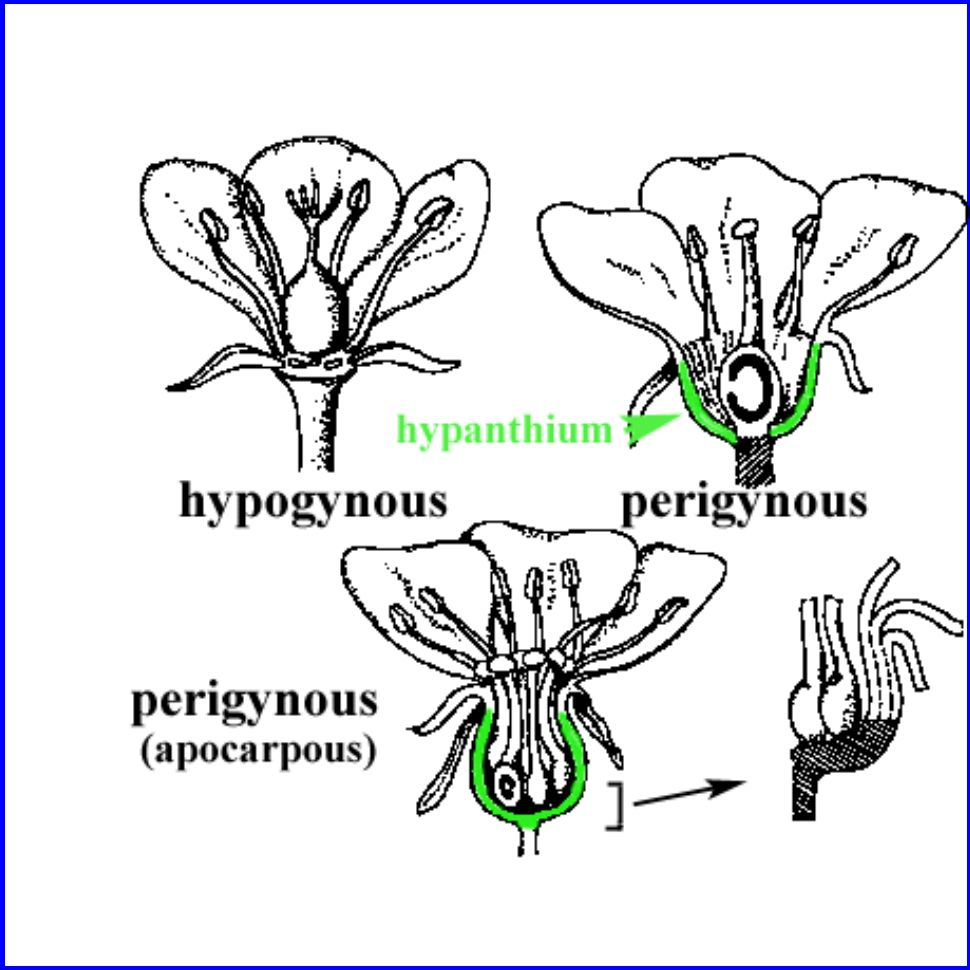
- Floral symmetry:
- Radial: can be divided into similar halves by several planes

Floral variation

- Floral symmetry:
- Radial: can be divided into similar halves by several planes
- Bilateral: can be divided into mirror images by 1 plane.

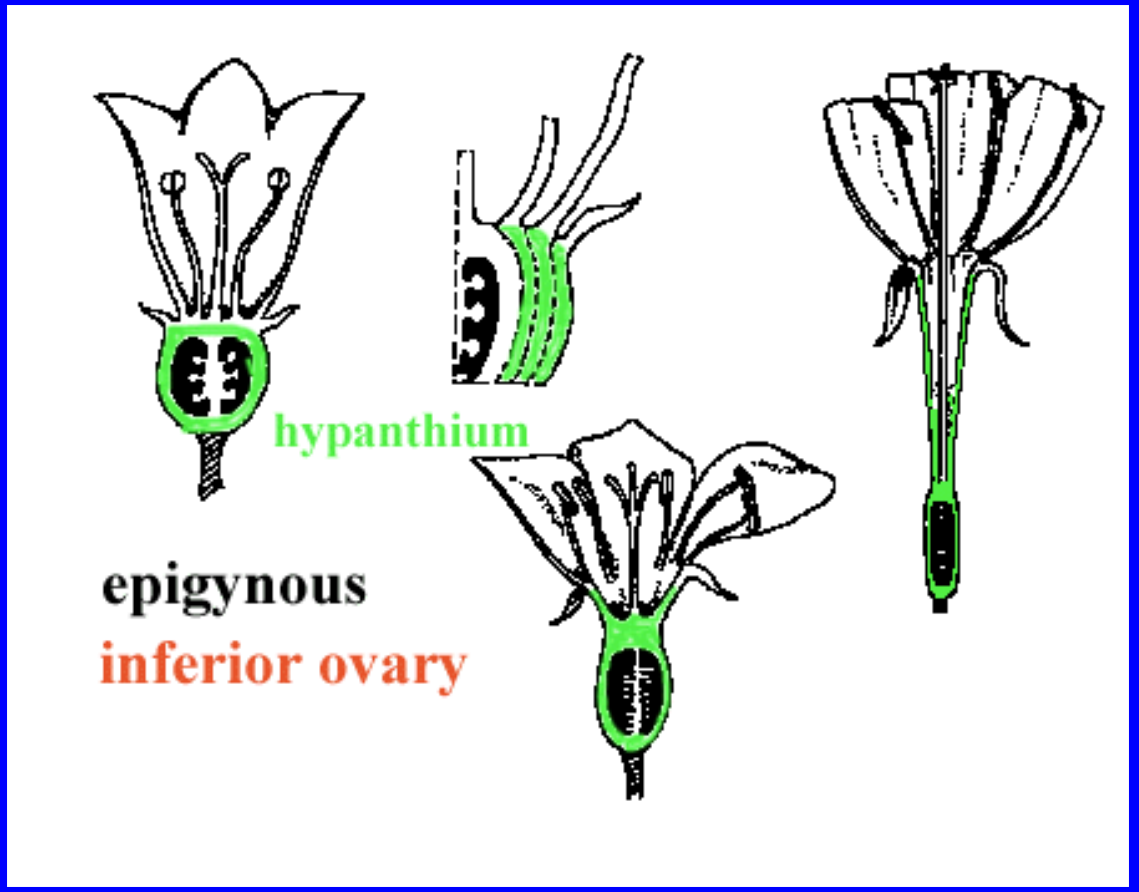
Floral variation

- Ovary position
- Superior ovary: other parts attach below ovary (hypogynous: “hypo-” =below, “gyn-” =female)



Floral variation

- Ovary position
- Inferior ovary: other parts attach above ovary (epigynous: “epi-”=above, “gyn-”=female).

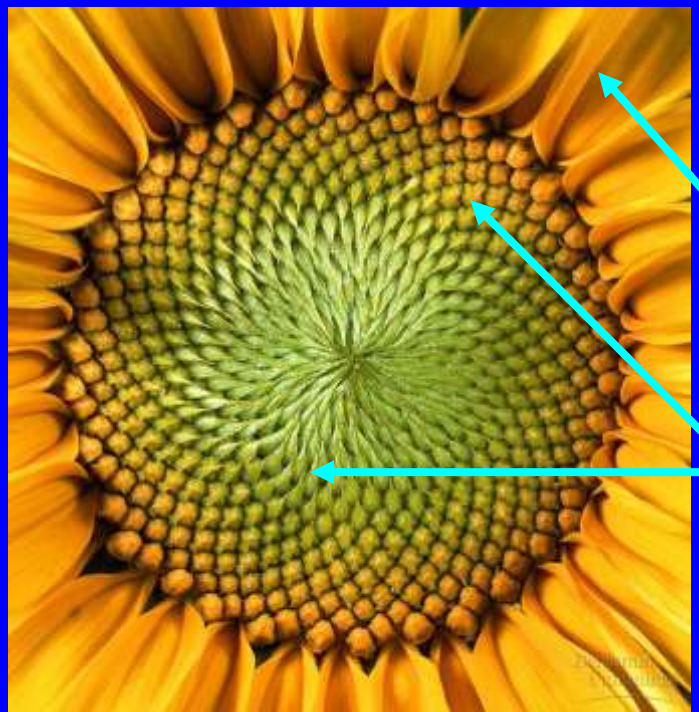


Floral variation

- Example of inferior ovary: squash flower (this one is pistillate).

Floral variation

- Some flowers assembled into groups of flowers: inflorescence
- Special inflorescence type: head
- Example, sunflower and its relatives
- Ray flowers have large fused petals (corollas fused), disk flowers small and crowded.



Floral variation

- Flowering dogwood (*Cornus florida*)
- Inflorescence: white structures are modified leaves (bracts) that act like petals.

Inflorescence

Closeup showing individual greenish flowers

Pollination

- Why are flowers so varied? Many form mutualism with animals to achieve pollination

Mutualism Exceptions

- Some flowering plants are wind pollinated (anemophily)
- Some are water pollinated (hydrophily)

Small, greenish grass flowers

Pollination as Mutualism

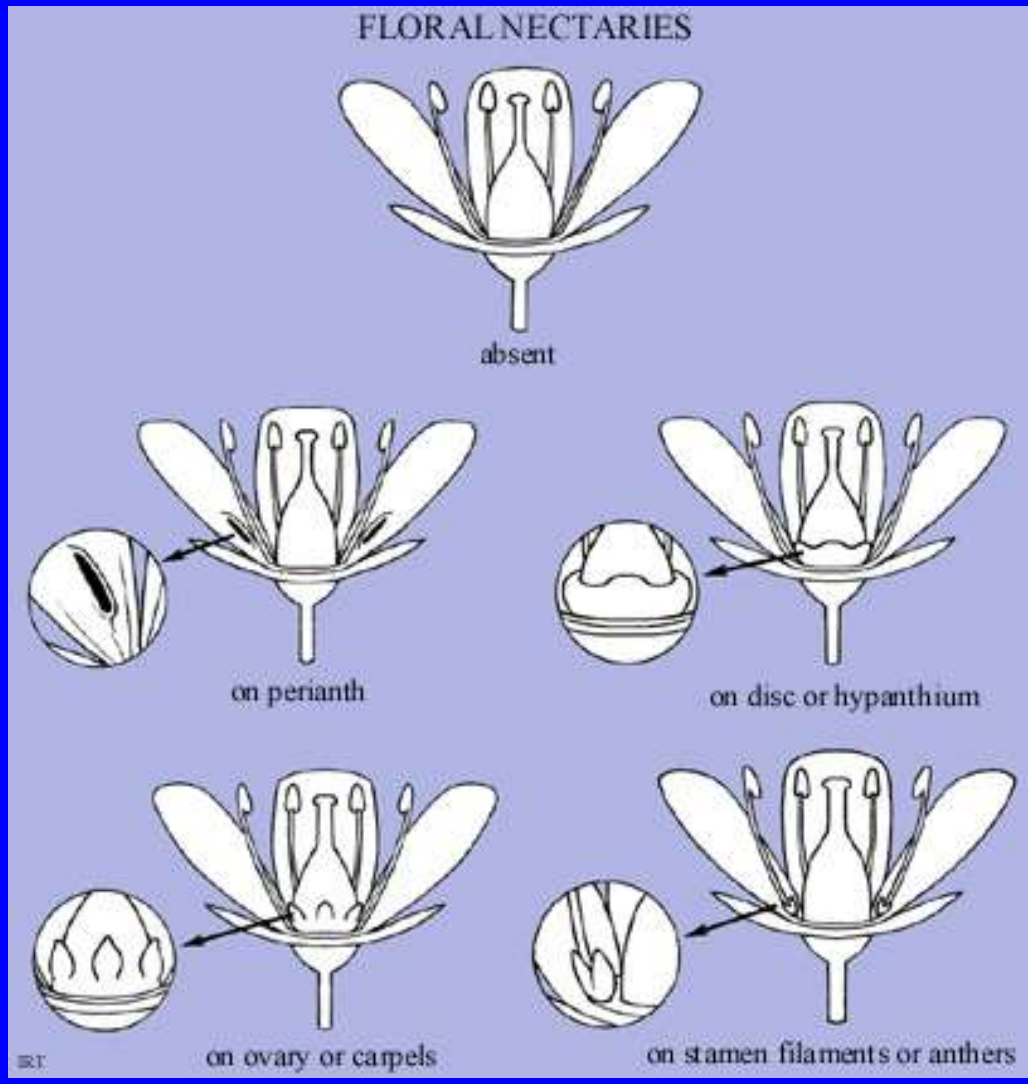
- Most flowering plants are pollinated by animals
- This usually viewed as mutualism (where both species benefit)
  - Plant gets pollen transferred
  - Animal gets “reward”

Rewards

- Pollen: high in protein
- Also has lipids, minerals, starch
- Can be renewed by:
  - sequential anther dehiscence (multiple stamens)
  - poricidal anthers (buzz pollination)

Rewards

- Nectar: sugary fluid produced by nectar glands (nectaries) in flower
- 10-60% mono- or disaccharides
- May have amino acids too (butterfly flowers)
- Renewable reward!



Rewards

- Oils/Resins: some used as construction materials, “cologne” (male solitary bee uses oil as female attractant), food for larvae (*Krameria*)
- Edible petals (pineapple guava: New Zealand)

Krameria wax gland: wasp food!

Pollination

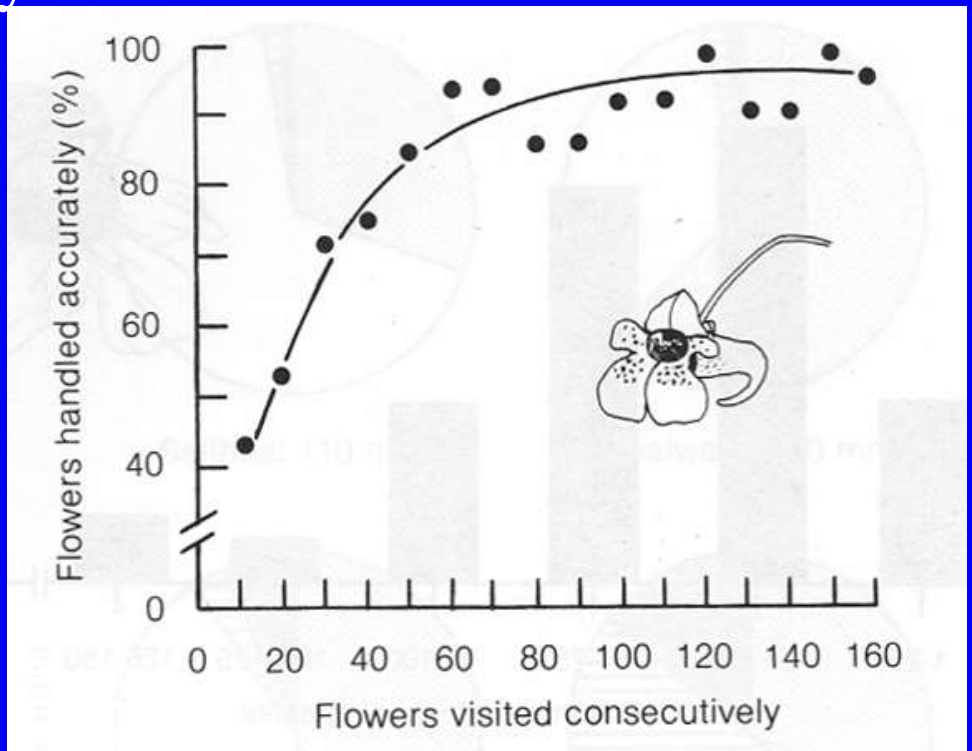
- Benefits of animal pollination for plant
  - 1) Directed dispersal of pollen. Can get delivered from stamen to stigma with less waste
  - Floral cues and attractants:
    - Color and shape
    - Scent
    - Warmth (thermogenic plants: rare)

Skunk cabbage

Pollination

- Benefits of animal pollination for plant
  - 1) Directed dispersal of pollen.
  - This aided by learning of floral visitors: decreases "handling time"
  - Fosters "floral constancy" (visiting single species on foraging trip) by bees

Bumblebee visits to touch-me-not



Pollination

- Style of flower as “selective racetrack”
- Is there evidence that this works?
- Example, Coyote melon
- Gourd growing in U.S. deserts.

Pollination

- Style of flower as “selective racetrack”
- Study done in 2000 showed that
  - 1) takes 900 pollen grains to fully pollinate flower
  - 2) 1 pollinator visit puts 650 grains/flower. By 2 hours, >4000 grains deposited on stigma
  - 3) Seeds produced from over-pollinated flowers produced more vigorous seedlings (compared to seeds from flowers with <900 pollen grains on stigma).

Outcrossing

- Major benefit of sexual reproduction: generate genetic variation
- This enhanced by mating with others (outcrossing)

Specialization

- May be learned
- May be species-specific
  - Monolecty: Flowers of 1 plant species visited
  - Oligolecty: Flowers of few plant species visited
  - Polylecty: Flowers of many plant species visited

Specialization

- Benefits of taxonomic specialization
  - Better service: can match phenology of plant/pollinator
  - Decrease competition (must match flower/pollinator traits)
  - Plant: Minimize stigma clogging with heterospecific pollen

Pollination conditions

- Bee pollination: Melittophily
- Bees are:
  - intelligent, agile
  - visual animals: good eyesight (including UV light)
  - good smellers (good sense of smell)
  - day-active

Pollination conditions

- Bee pollination
- Bee pollinated flowers are:
  - Colorful (usually not red)
  - Have landing platform: place where bee can land on flower
  - Mildly fragrant.

Pollination conditions

- Bee pollination
- Bee pollinated flowers:
  - May have nectar guides: patterns of lines or dots that can guide bee to reward
  - Sometimes these only visible in UV light (which bees see).

Orchid flower with nectar guides (lines) on petals

Petals in visible light (top) and UV (bottom)

Pollination conditions

- UV reflectance photo (right)

Static charged flowers

- The small hairs are used to sense electric fields coming out of flowers and then use them to find sources of pollen, according to the new research

Types of bees

- Solitary Bees
- Social Bees

Solitary Bees

- Of the 4000 species of bees in North America – 90% are Solitary
- 30% (around 1,200 species) are wood and tunnel nesting bees (mason, leaf cutter, carpenter)
- 70% (around 2,800 species) are ground nesting bees (mining bees)

Solitary Wood And Tunnel Nesting Bee Life

- Must have nest material (mud, Leaves, wood) (May be very specific maple leaf)
- Must have a food source (100 – 1500 feet)
- Sweat bees generally only travel 200 yds from their nest – Perdita only travel a couple hundred feet from their nest.
- Divide tunnel with walls to separate cells
- Seal entrance.

- Perdita Bee

- leafcutter Bee

Solitary Ground Nesting Bee Life

- Dig nest in bare are sparsely vegetative soil
- Must have a food source close by
- Don’t collect material for nest – smooth wall with their abdomens and apply a waxy or oily substance to protect their brood.

- Polyester bee

Tawny mining bee

Traits

- Typically do not sting.
- Good pollinators

Social Bees

- Honey bees (44 Species)
- Bumble bees (47 Species)
- Sweat bees (200 Species)

Bumble Bees

- One queen
- Nest sites
- Queen collect nectar and pollen – small amounts
- Can regulate their temperature
- Once some brood hatches queen does not leave hive
- New queen hibernates

Sweat Bees

- Similar to life cycle of Bumble bee.
- Occasionally sisters start a communal nest. One laying the eggs and the other foraging.

- Bumble bee

- Sweat bee

Traits

- Very defensive of hive
- Bumble bees can buzz-pollinate – disengage their wings from their flight muscles and shake their entire body (middle C)
- Typically do not sting away from hive.
- Forage distance depends on size – bumble bees up to a mile – sweat bees less.

What can you do to help?

- Provide homes

- Water
- Food

Pollination conditions

- Beetle pollination: Cantharophily
- Beetles are:
  - Clumsy
  - Have poor vision
  - Dumb(er)
  - Active during the day (many flower-visiting ones).

Pollination conditions

- Beetle pollination
- Beetle pollinated flowers are:
  - Relatively large or grouped into large inflorescences
  - Light colored
  - Smelly (fruity or spicy smell)

Dogwood inflorescence

Inflorescence of *Xanthosoma* with beetle from it

Pollination conditions

- Bird pollination: Ornithophily
- Birds are:
  - agile
  - long-beaked
  - visual: see red colors well
  - poor “smellers”

Pollination conditions

- Bird pollination
- Hummingbirds (native to Americas) can hover: don’t need to land to access flower rewards.

Pollination conditions

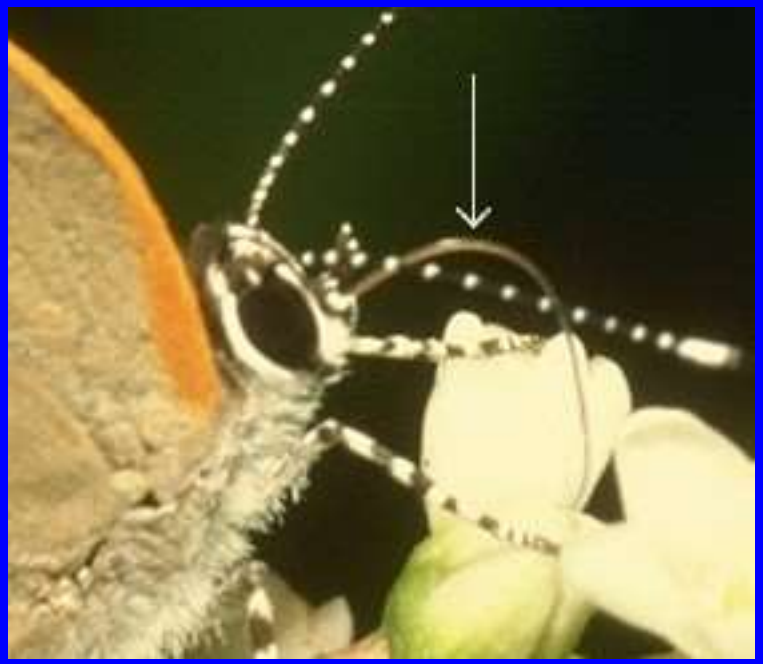
- Bird-pollinated flowers are:
- red or orange
- have nectar hidden by long floral tube
- little or no fragrance
- no landing platform

Aloe

Anisacanthus (Acanthaceae) flower

Pollination conditions

- Butterfly pollination: Psychophily
- Butterflies have: good vision, good sense of smell, long coiled tongue. Must land on flower to visit it (can't hover).



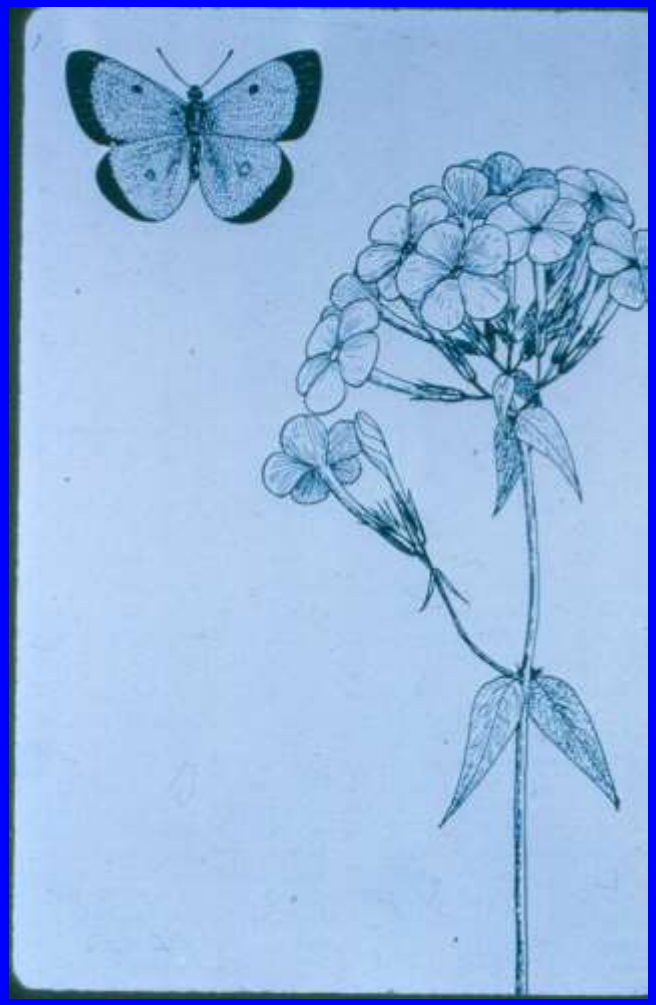
tongue extended

coiled tongue

Pollination conditions

- Butterfly-pollinated flowers:
  - Color varies (blue, yellow, orange)
  - Landing platform present
  - Nectar at bottom of floral tube

Plumbago flowers



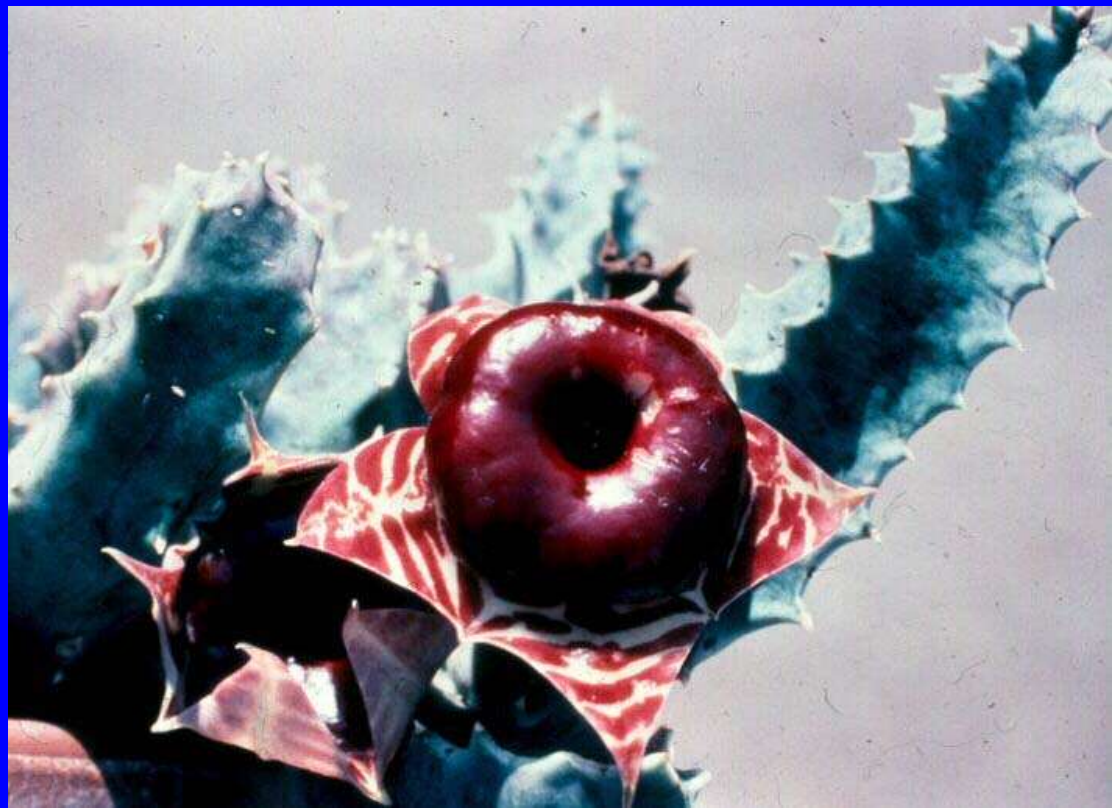
Phlox flowers

Pollination conditions

- Fly pollination: Myophily
- Flies have good sense of smell, especially flesh flies
- Attracted to rotting meat (lay eggs in meat, larvae are maggots).

Pollination conditions

- Fly-pollinated flowers: Sapromyophily
  - Smell like rotting meat
  - Look like rotting meat (dark red, purple)
  - Offer no reward: flies fooled by flower.



Stapelia flower

Pollination conditions

- Bat pollination: Chiropterophily
- Bats are flying mammals
  - Nocturnal
  - Eyesight good but echolocate
  - Good sense of smell
  - Agile, can hover when visiting flower.

QuickTime™ and a Cinepak decompressor are needed to see this picture.

Pollination conditions

- Bat pollination
- Bat-pollinated flowers
  - Open at night
  - Produce lots of pollen and nectar as rewards
  - White or light-colored
  - Fragrant (sweet odor)
  - May be pendant (hang down from branches).

Parkia flowers

Pollination conditions

- Bat pollination: Mainly a tropical phenomenon
- In U.S., saguaro cactus is one of few bat-pollinated species.

Saguaro flowers

Saguaro cactus

Pollination conditions

- Moth pollination: Phalaenophily
- Moths have:
  - Poor vision (nocturnal)
  - Excellent sense of smell
  - Long coiled tongue.

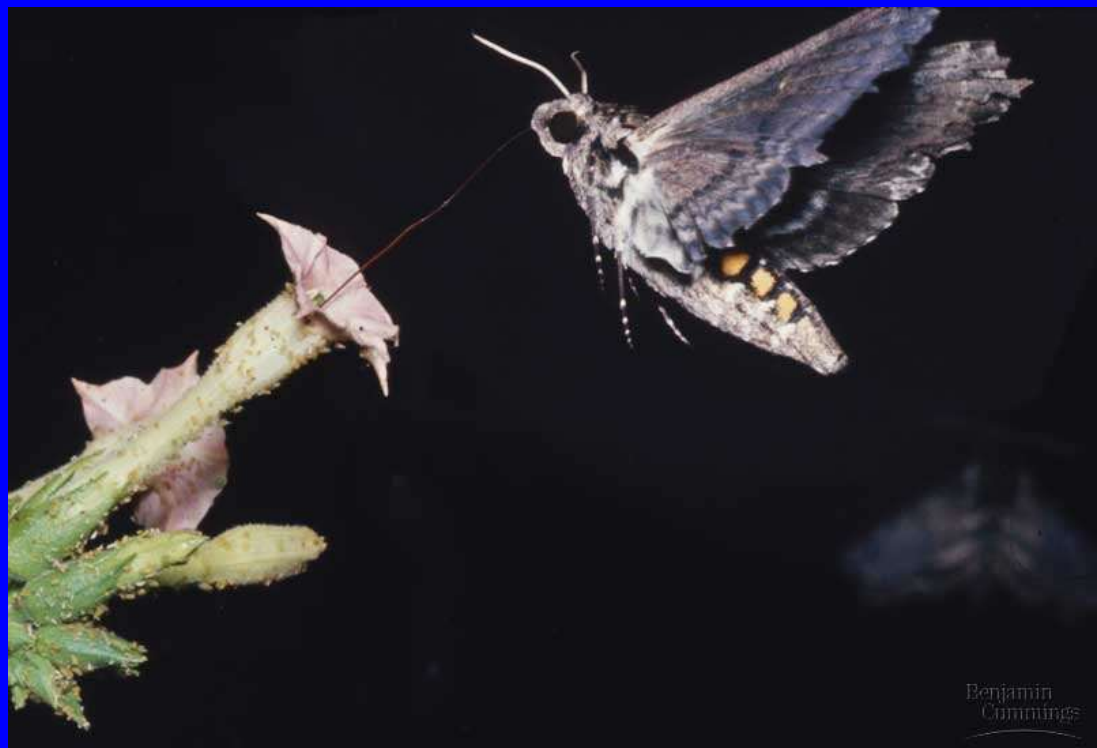
Pollination conditions

- Moth pollination
- Moths:
  - Some (hawkmoths) can hover when visiting flowers.

Hawkmoth

Pollination conditions

- Moth pollination
- Moth-pollinated flowers:
  - Open at night
  - Sweet fragrance
  - White or light-colored
  - Nectar in tube.



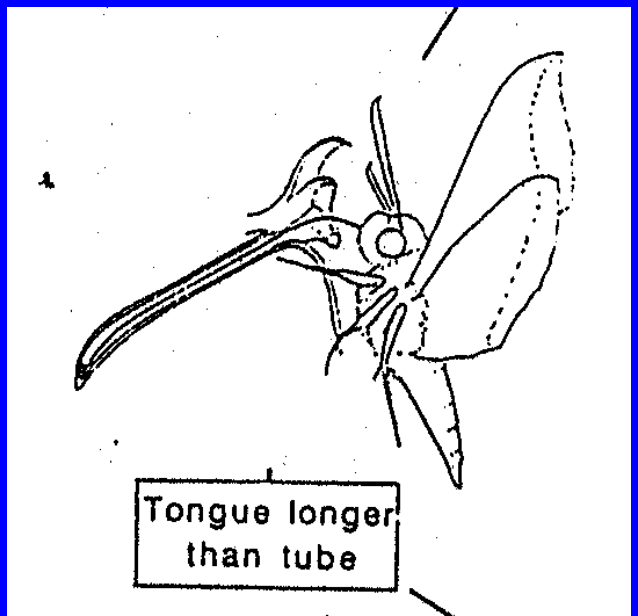
Pollination conditions

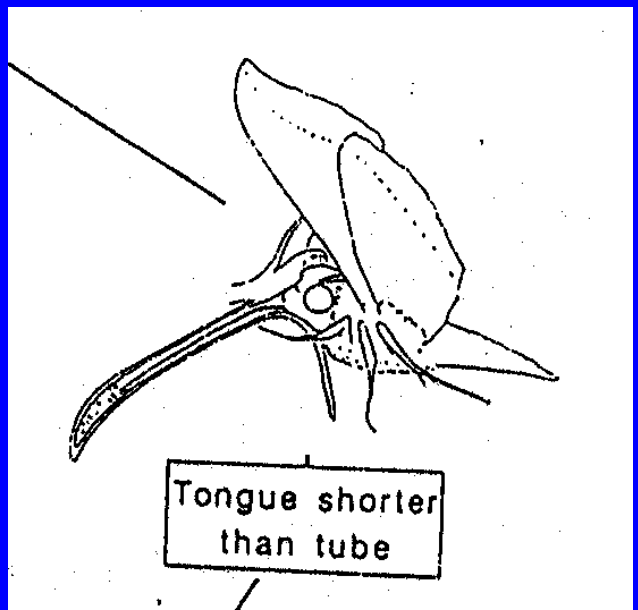
- Interesting moth story: nectar spur
- Nectar spur is long pouch, at bottom of which is nectar
- Moth uses long tongue to reach nectar

Nectar spurs on columbine

Pollination conditions

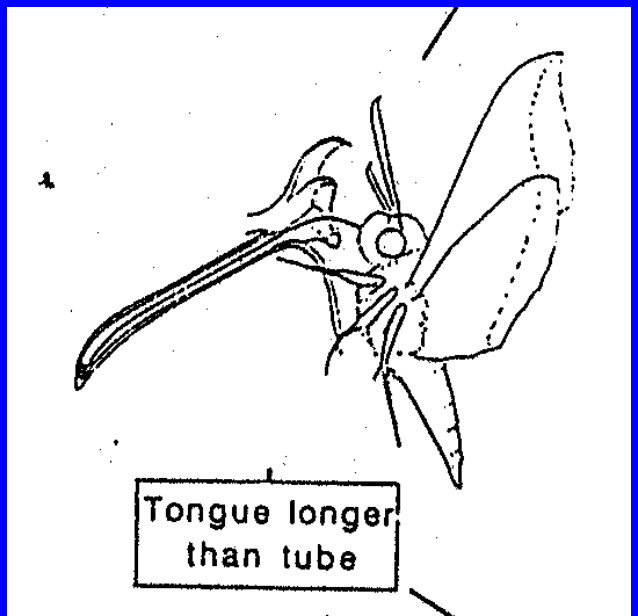
- Interesting moth story: nectar spur
- Nectar spur is long pouch, at bottom of which is nectar
- Moth uses long tongue to reach nectar
- Only if tube is longer than tongue will moth have to push into flower far enough to pick up pollen
- So, long spurred flowers reproduce better.

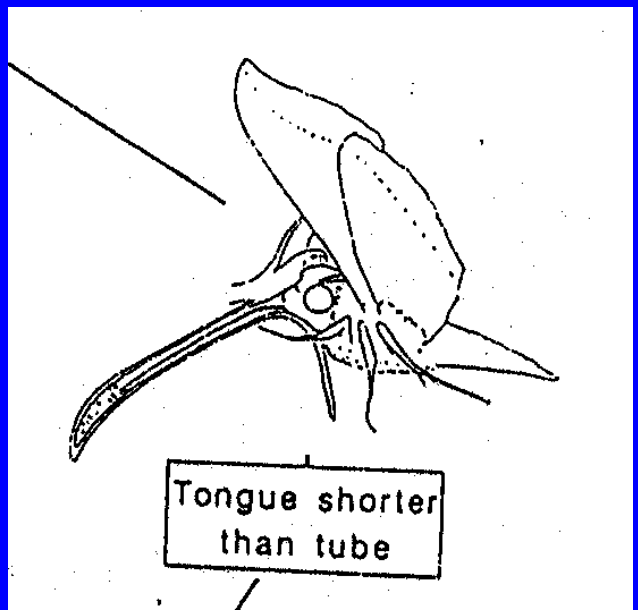




Pollination conditions

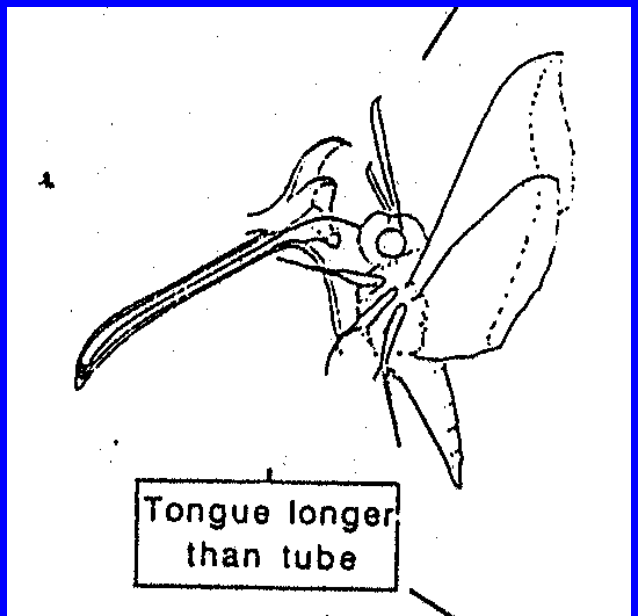
- Which leads to longer moth tongues to reach all of the nectar in the longer tubes
- Which leads to longer tubes.....

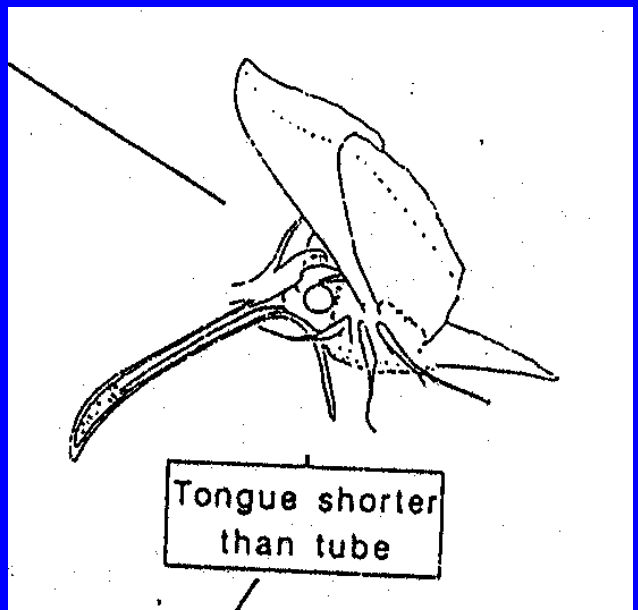




Pollination conditions

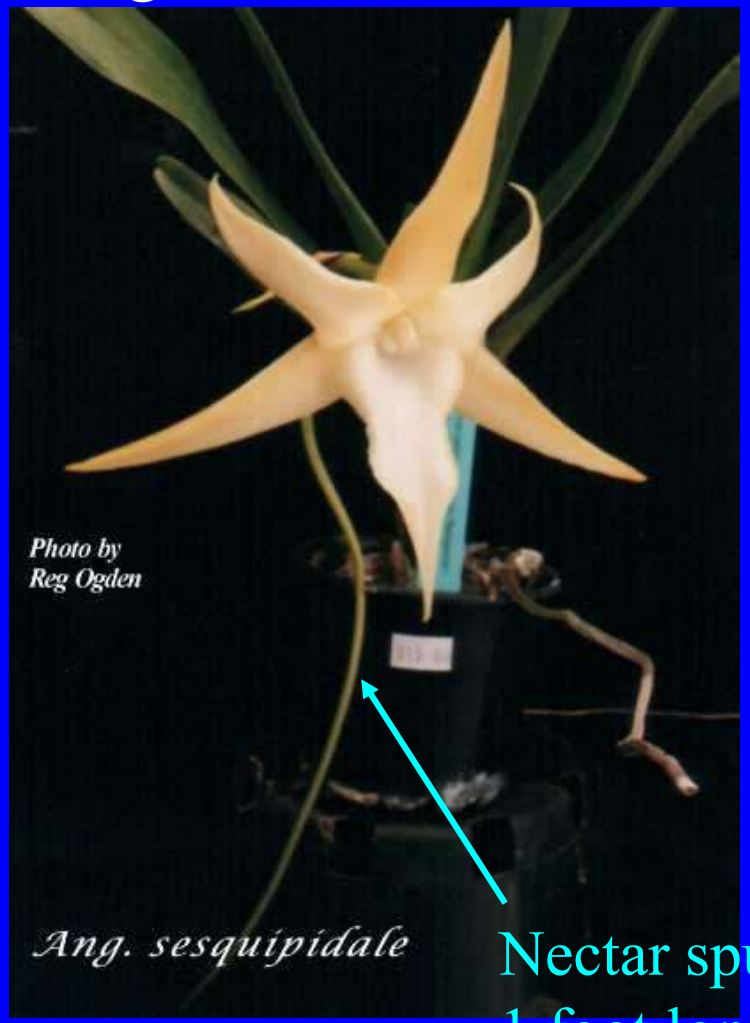
- Which leads to longer moth tongues to reach all of the nectar in the longer tubes
- Which leads to longer tubes.....
- Some moth-pollinated orchids with long nectar spurs (almost one foot long!)
- Moth has extremely long tongue!





Pollination conditions

- Moth pollination
- *Angraecum* orchid from Madagascar.



Nectar spur almost 1 foot long!

Sexual Mimics

- Flowers that mimic female bees or wasps
- Look like females
- Smell like females: chemical mimicry. One study showed flower more attractive than real female!!

Sexual mimic orchids

Pollination conditions

- Sexual mimics
- Males attempt to mate, pick up pollen, then fly to another flower and repeat process
- No reward supplied!.

A male wasp “mating” with an *Ophrys* flower (how embarrassing...)

GOGO's Bee Co.

Tim Gogolski

822 Romine Ridge Road
Osage City, KS 66523

Voice: (785) 249-5544
Email: Gogosbeeco@gmail.com
Facebook: gogos bee co