

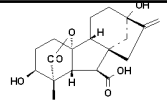
Plant hormones:

- produced in many parts of the plant
- have many functions

Illustrated with 4 plant hormones:

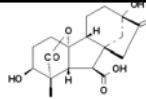
- Gibberellins
- Auxin
- Cytokinins
- Ethylene

Gibberellins

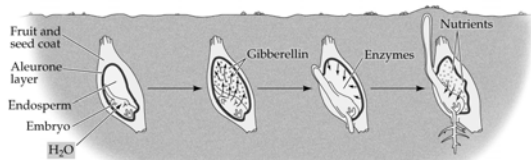


- Gibberellins illustrate how plant hormones have **multiple roles** related to different aspects of plant life.
- And* are produced in at **multiple parts of the body**.

Gibberellins – Function 1: Nutrient Release

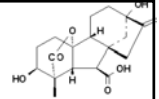


- Mobilize enzymes that release nutrient reserves in grass seeds.
- Gibberellins → protein digestion → digestive enzymes



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Gibberellins – Function 1: Nutrient Release

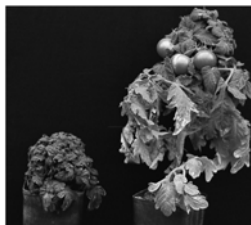


- Barley malt is sugar and incompletely digested starch produced during the germination of barley.
- Enhance barley germination and malt production (Malting) in the liquor industry.



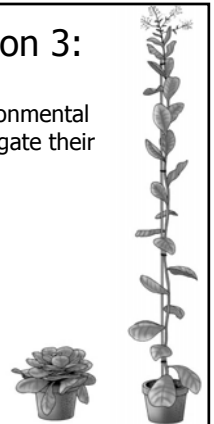
Gibberellins – Function 2: Stem elongation

- Stem elongation requires gibberellins.
- Mutants that don't produce gibberellins are dwarfs.
- When gibberellins are added they grow normally.



Gibberellins – Function 3: Bolting

- Rosette growth until an environmental cue cause them to **bolt** (elongate their shoots).
- The cue results in gibberellin production.



Without gibberellin With gibberellin

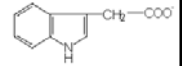
Gibberellins – Function 4:

Fruit growth

- Developing seeds produce gibberellins → stimulate their growth
- Seedless grapes are smaller than seeded ones.
- Farmers spray them with gibberellins to get normal large grapes.



Auxin



Indol-3-acetic acid (IAA)

Auxin illustrates:

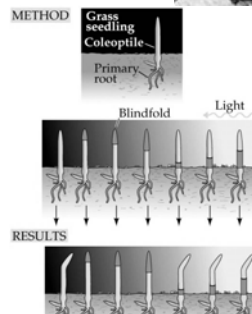
- how plant hormones have **multiple roles** related to different aspects of plant life.
- *And* are produced in at **multiple parts of the body.**

Auxin and Darwin's Experiments on Plant Movement



Tutorial 38.1

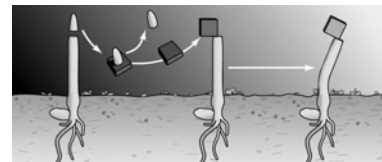
- Covered Tip: Don't bend
- Bending happens below the sensory site on the tip.
- Darwin reasoned that a **message must travel** from the tip to the growing region.
- 'Message' later shown to be **auxin**



Auxin

Tutorial 38.2:

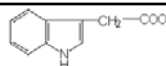
- Auxin can move thru permeable membranes
- Auxin signal can remain on the gelatin from the tip



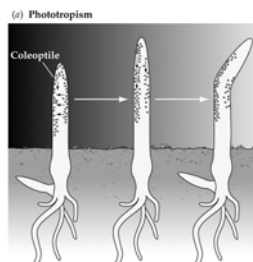
Auxin

Auxin **stimulates growth.**

- on the shaded side
- **Auxin causes the cellulose wall to loosen**, so turgor pressure can expand the cell, resulting in growth.
- If the cell loosens more on one side, it bends.

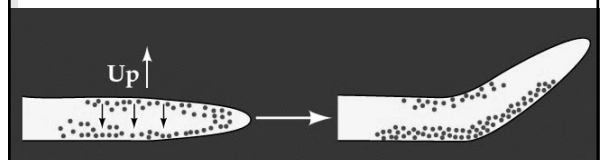


Indol-3-acetic acid (IAA)



Auxin does many other things

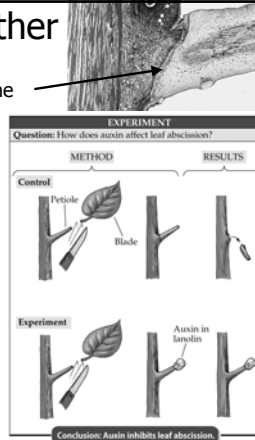
- Gravity response of shoots (in the dark):
 - ◆ Auxin moves to the lower side of the shoot.
 - ◆ Causes more rapid growth there.
 - ◆ The tip curves upward.



Auxin does many other things:

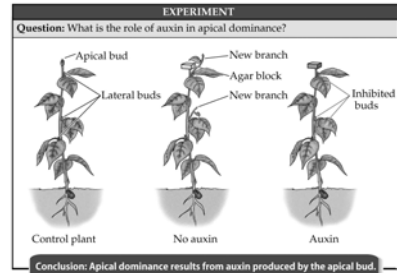
- Keeps leaves from falling until the right time:
 - Auxin produced in the leaf blade keeps the leaf stem from falling off.

Abscission zone



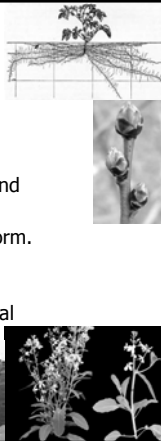
Auxin does many other things:

- Apical Dominance** – growth of main stem, little branching
 - Remove apex and lateral buds grow out.
 - Replace apex with an auxin solution and lateral branches do not form.



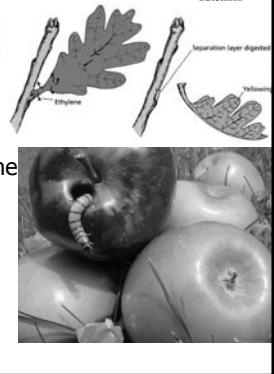
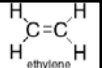
Cytokinins

- Produced in plant roots.
- Shoot vs Root growth
 - High ratio of cytokinin to auxin: buds and shoots are formed.
 - Low ratio of cytokinin to auxin: roots form.
- In stems, the ratio of cytokinin to auxin determines the bushiness of a plant (apical dominance?)
- Delay senescence of leaves.



Ethylene Promotes Senescence

- A simple gas.
- Promotes leaf abscission (counters auxin).
- Hastens ripening of fruit:
 - "One bad apple spoils the whole bunch"
 - Positive feedback



Hormones

- A particular aspect of plant life is often regulated in complex ways by **multiple hormones**, e.g.,:
 - Ethylene vs auxin in leaf abscission.
 - Cytokinin vs auxin in apical dominance and shoot vs. root formation.



38.1 Plant Growth Hormones

HORMONE	TYPICAL ACTIVITIES
Abscisic acid	Maintains seed dormancy and winter dormancy; closes stomata
Auxins	Promote stem elongation, adventitious root initiation, and fruit growth; inhibit lateral bud outgrowth and leaf abscission
Brassinosteroids	Promote elongation of stems and pollen tubes; promote vascular tissue differentiation
Cytokinins	Inhibit leaf senescence; promote cell division and lateral bud outgrowth; affect root growth
Ethylene	Promotes fruit ripening and leaf abscission; inhibits stem elongation and gravitropism
Gibberellins	Promote seed germination, stem growth, and fruit development; break dormancy; mobilize nutrient reserves in grass seeds

See Table 38.1, for a summary of hormones.

Sex or not?

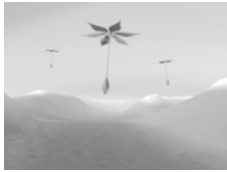
- In plants, **sex or not** usually means **seed or vegetative reproduction**.

Seeds:

- Good at dispersal
- Good at dormancy

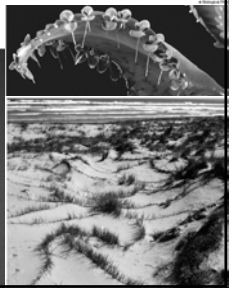
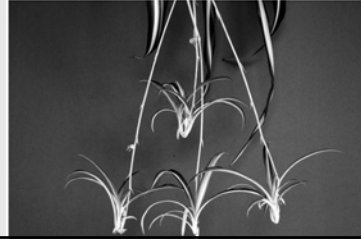
Vegetative spread:

- Well-supplied, big offspring
- Connection may mean parent is a source of resources.
- Shorter distances.
- More accurate placement.



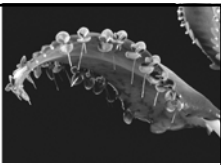
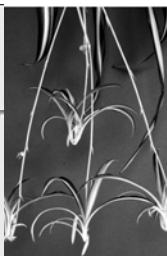
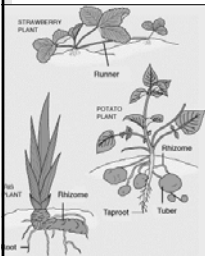
Sex or not?

- Some plants **can** reproduce asexually by seed: e.g., dandelions.
- **Most** do it by vegetative reproduction.



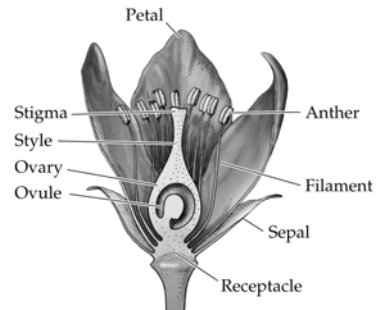
Vegetative reproduction

- Usually involves stems.
- Sometimes leaves are involved.



Sexual Reproduction

The flower is an angiosperm's device for sex.



Fertilization

- 2 sperm cells are released
- One fertilizes the egg
- The other fuses with the 2 polar nuclei.
- Double Fertilization?
 - ◆ Embryo
 - ◆ endosperm

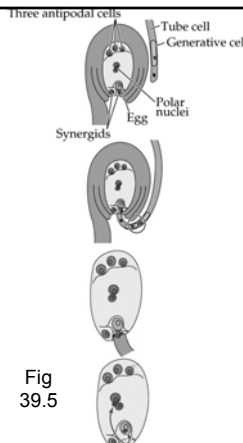
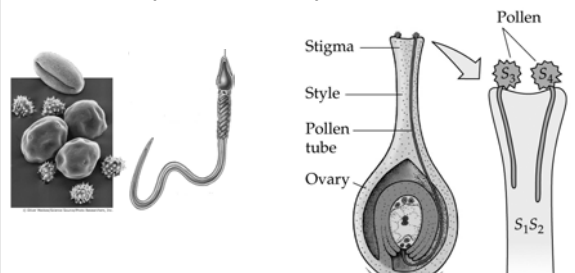


Fig 39.5

Is pollination the same thing as fertilization??

Because pollen is not sperm.



Ecology of Flowers

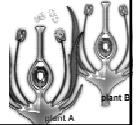
- Much of the rich diversity of angiosperms is reflected in floral variation.
- Most floral variation relates to pollination.



Plant Gender

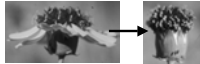


- Being modular means the sky is the limit on gender variation.
- **Hermaphroditic flowers. – BUT –**
- Some specialized **male and female flowers on the same plant.**
- In either case, **individuals** are both male and female and **can pollinate themselves.**



Selfing vs Outcrossing

- Not an issue for most animals!
- **Selfing** can be good or bad.
- Good:
 - ◆ Recovers the **cost of meiosis.**
 - ◆ Solves the problem of **finding a mate.**
 - ◆ Don't have to spend a lot on dating and make up.
- Bad:
 - ◆ **Inbreeding Depression**
 - ◆ Less and less variable offspring



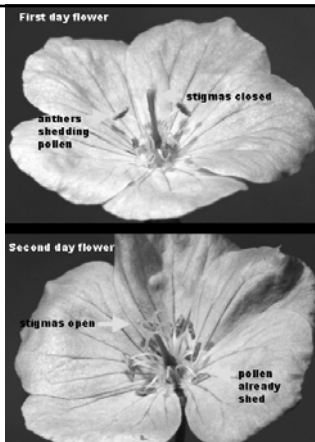
Selfing vs Outcrossing

- Much of the structure and function of flowers can be explained as **adaptations for avoiding selfing** and involving pollen and seeds in outcrossing.



Pollination ecology

- Separation ensures outcrossed pollination.
- **Spatial** separation of sex organs.
- **Temporal** separation of sex organs.



Pollination ecology

- Some plants are **generalized** and attract many different pollinators.

Milkweed

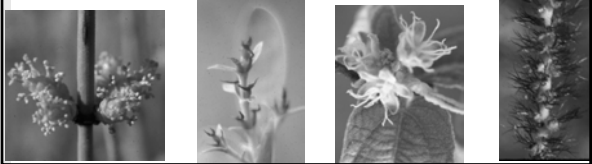
- In one study, over 30 species of insects visited the flowers.



Pollination ecology - Specialized modes involve many different pollinating agents

Wind Pollination

- Copious pollen produced in "salt shaker" flowers.
- Usually **big feathery stigmas** to catch pollen.
- No need for attractive odors or visual display



Specialized **animal pollination** often involves **corresponding traits** of flowers and animals



Fly Pollination

"Carrion flowers"

- Mimic carrion or feces in odor and color.
- (Flies are tricked - no benefit.)



Bee Pollination

- predominant form of animal pollination.
- flower depth → landing platforms.
- intricate, semi-closed flowers common.

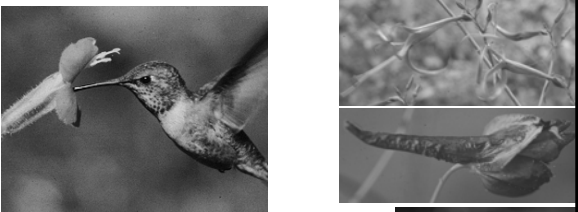


Butterfly Pollination

- **flowers - vividly colored**
- coiled straw-like proboscis to sip nectar from **deep tubes**.
- they need a place to land - blossoms **often flat**.

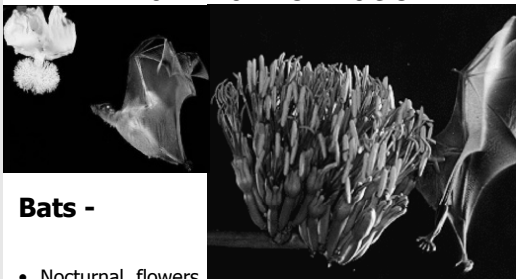


Bird Pollination



- Over 1,000 species are pollinators.
- America: **hummingbirds**.
- Long **tubular red flowers** with **no landing platform**.

Mammal Pollination



Bats -

- Nocturnal flowers.
- Flowers often smell "like bats".
- Drab colors.
- Exposed away from the plant because bats are somewhat clumsy fliers.