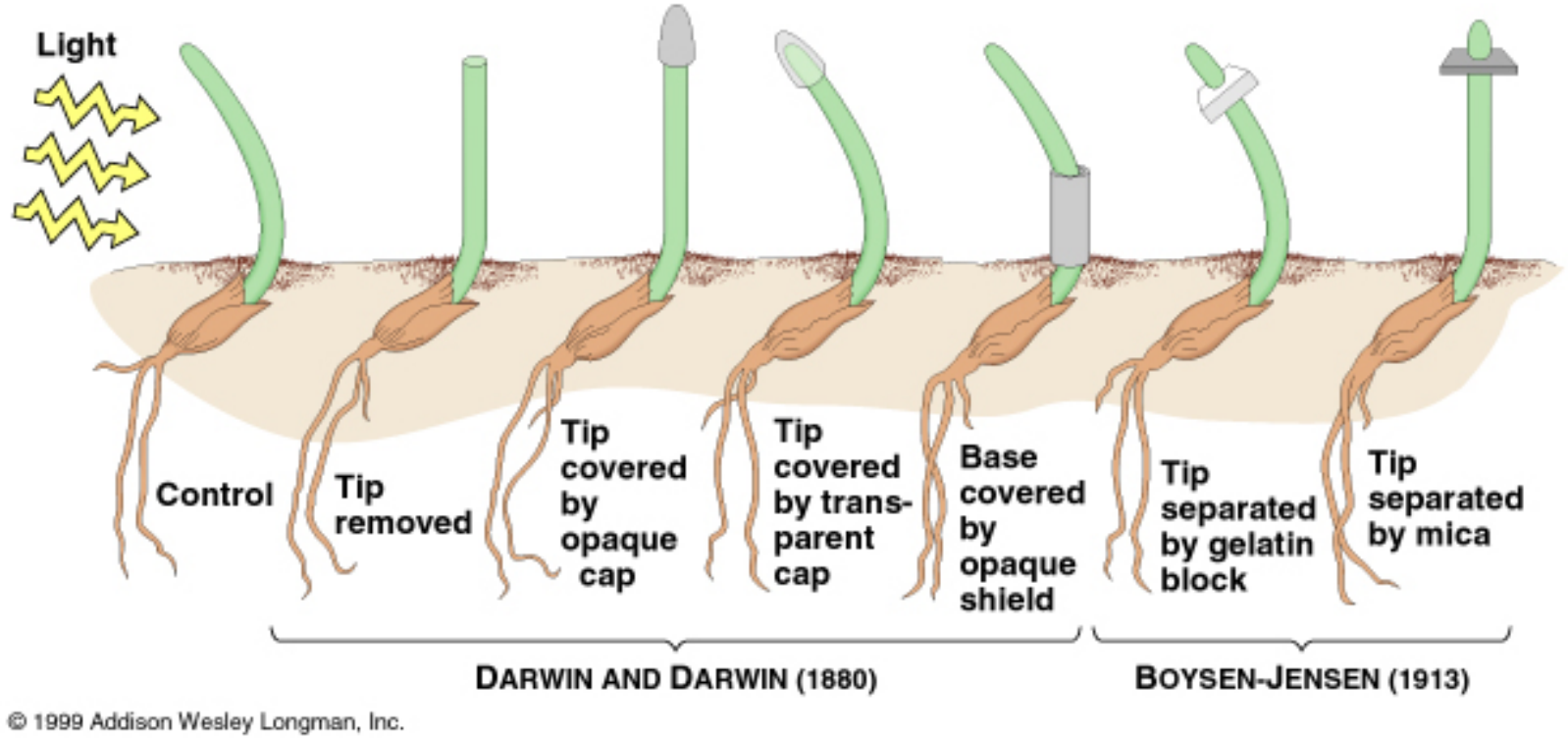
Plant Growth Regulators

Plant Growth Regulators - control growth, development and movement

EARLY EXPERIMENTS ON PHOTROPISM SHOWED THAT A STIMULUS (LIGHT) RELEASED CHEMICALS THAT INFLUENCED GROWTH

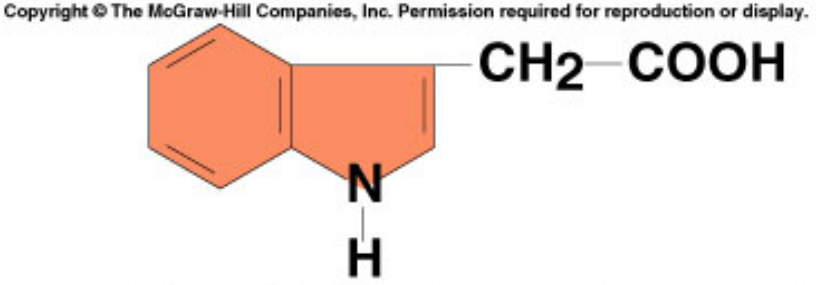


Results on growth of coleoptiles of canary grass and oats suggested that the reception of light in the tip of the shoot stimulated a bending toward light source.

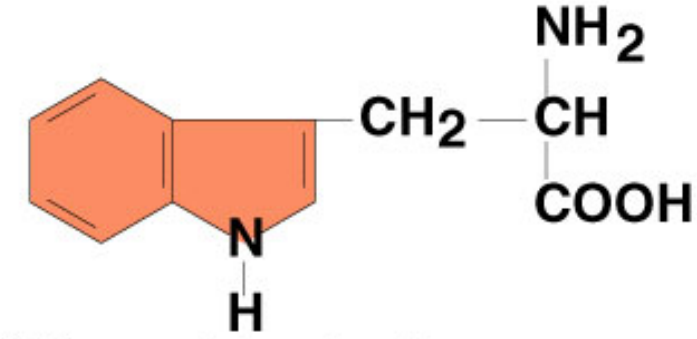
General plant hormones

- **Auxins** (cell elongation)
- **Gibberellins** (cell elongation + cell division - translated into growth)
- **Cytokinins** (cell division + inhibits senescence)
- **Abscisic acid** (abscission of leaves and fruits + dormancy induction of buds and seeds)
- **Ethylene** (promotes senescence, epinasty, and fruit ripening)

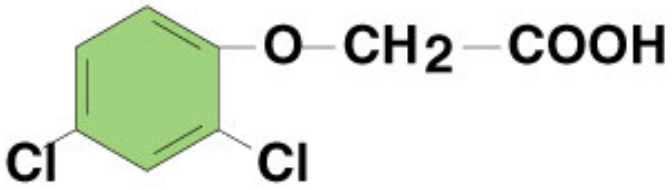
Auxins



(a) IAA (Indoleacetic acid)

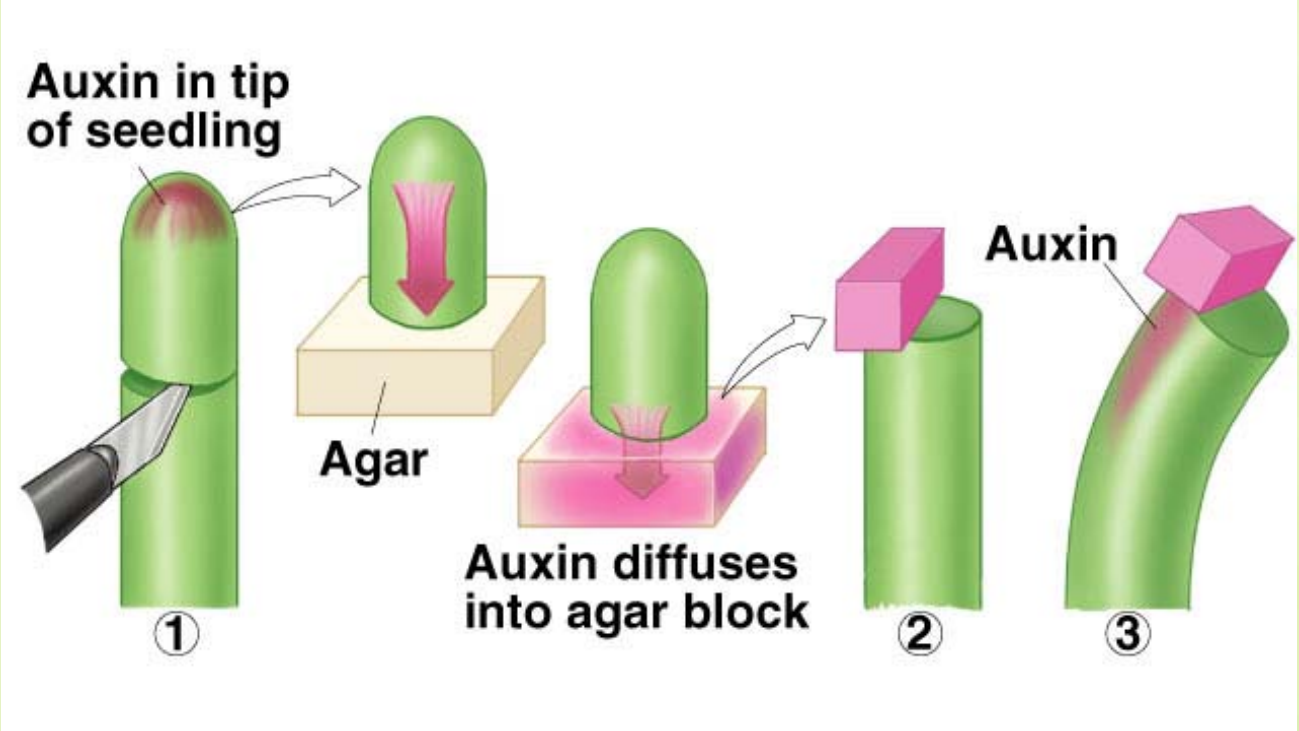


(b) Tryptophan

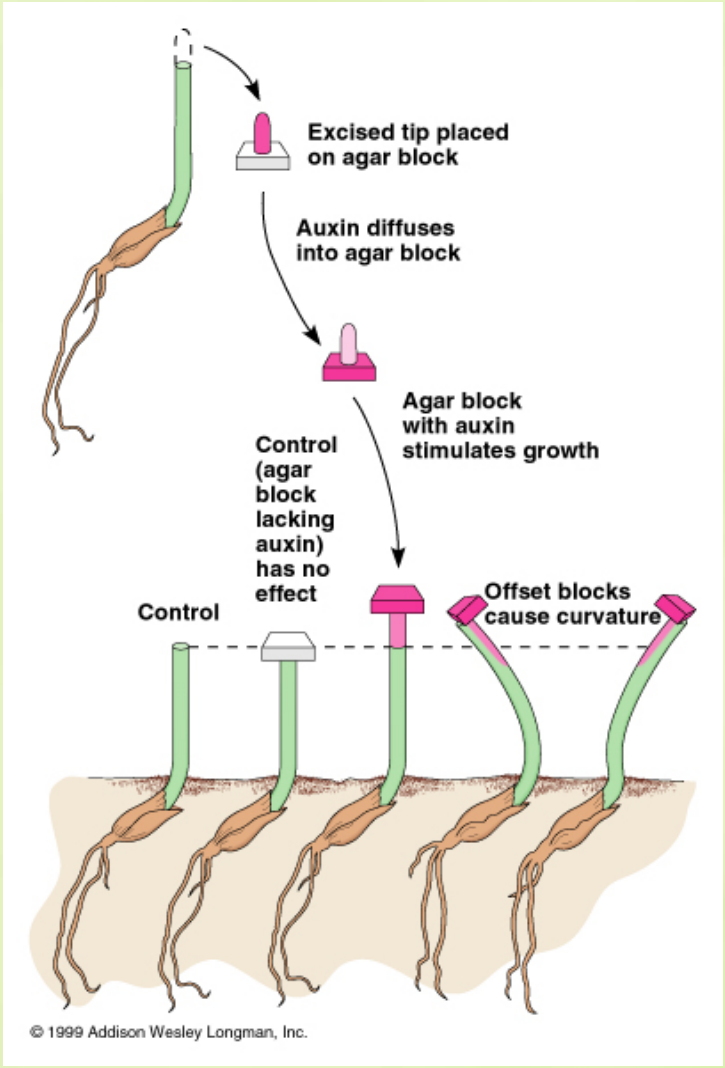


(c) Dichlorophenoxyacetic acid (2,4-D)

- Auxin increases the plasticity of plant cell walls and is involved in stem elongation.
- Arpad Paál (1919) - Asymmetrical placement of cut tips on coleoptiles resulted in a bending of the coleoptile away from the side onto which the tips were placed (response mimicked the response seen in phototropism).
- Frits Went (1926) determined auxin enhanced cell elongation.

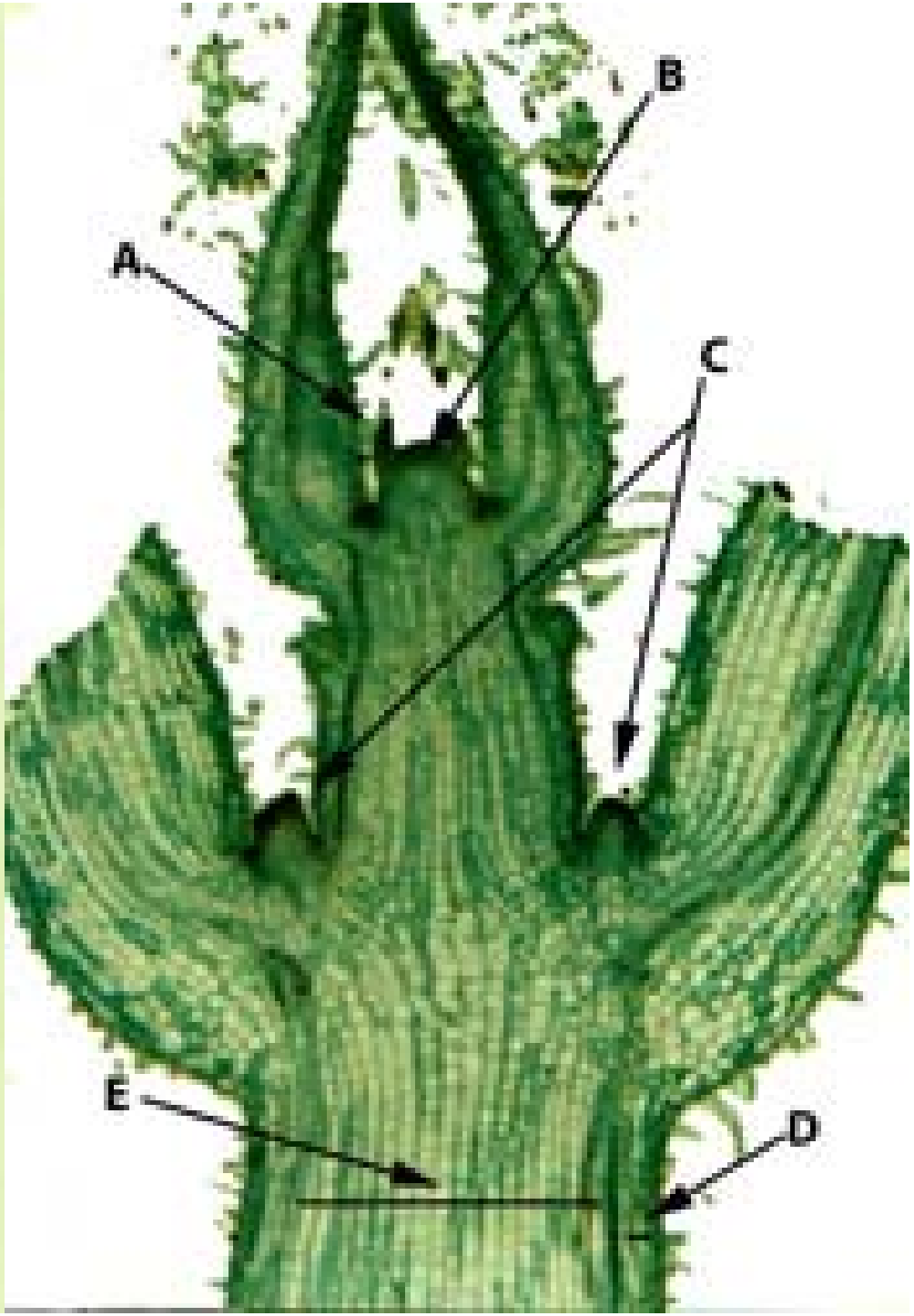


Demonstration of transported chemical

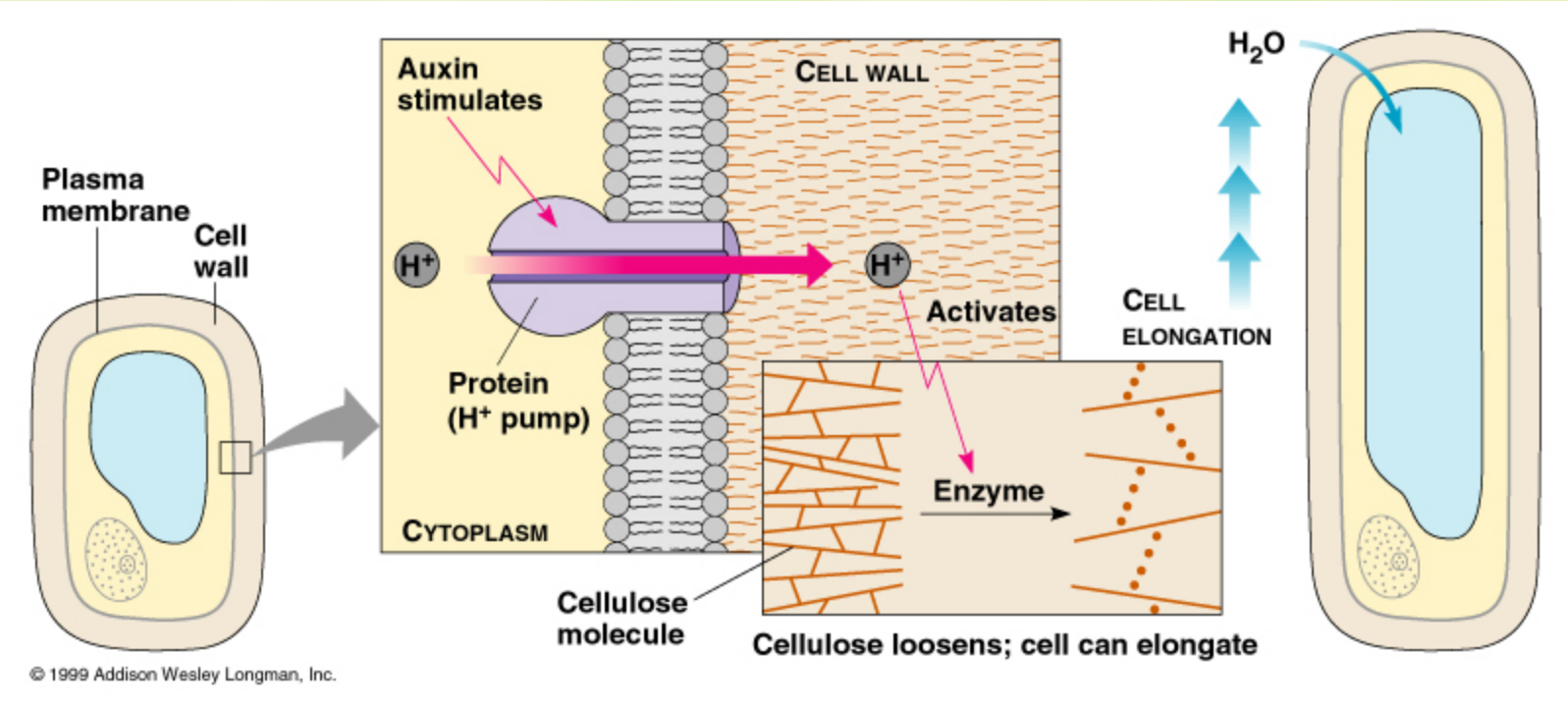


Auxins

- Stem elongation
- Produced in tips of stems (“B” in photo)
- Migrate from cell to cell in stems

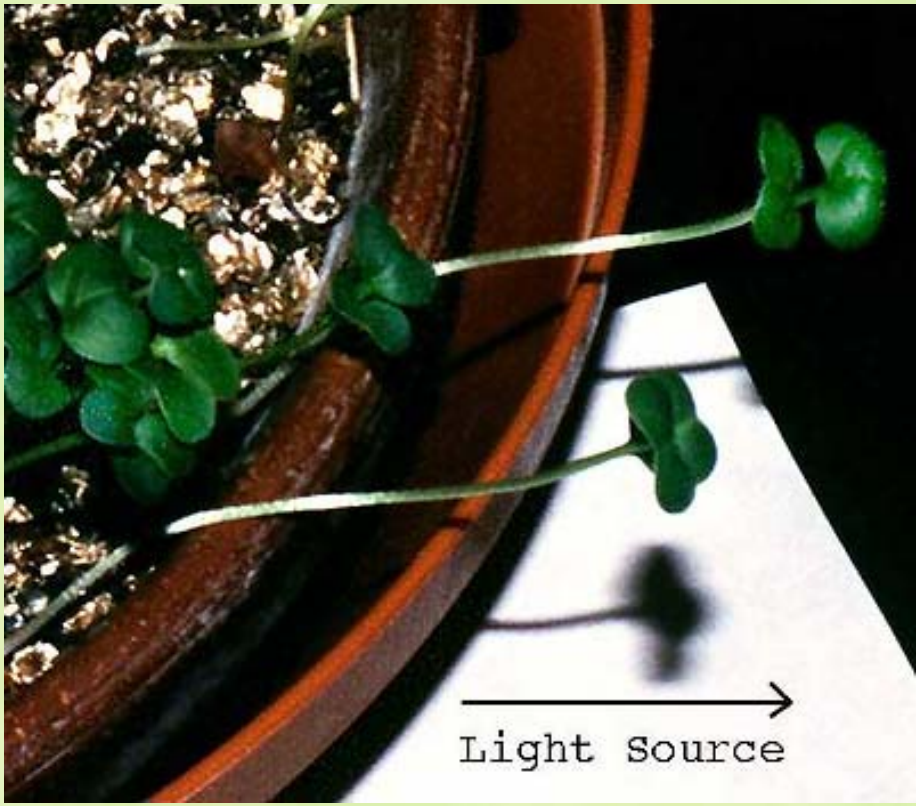


Loosening of cell wall



Phototropism – ability to bend towards light

- Auxins - responsible for plants bending towards light.
- Auxins - move down shaded side of the stem and cause cells to elongate



Gravitropism (geotropism) – plant response to gravity

- Auxins – responsible for plant response to gravity

- Auxins – move to lowest side and cause stem tissue to elongate – stem curves upwards

Auxin

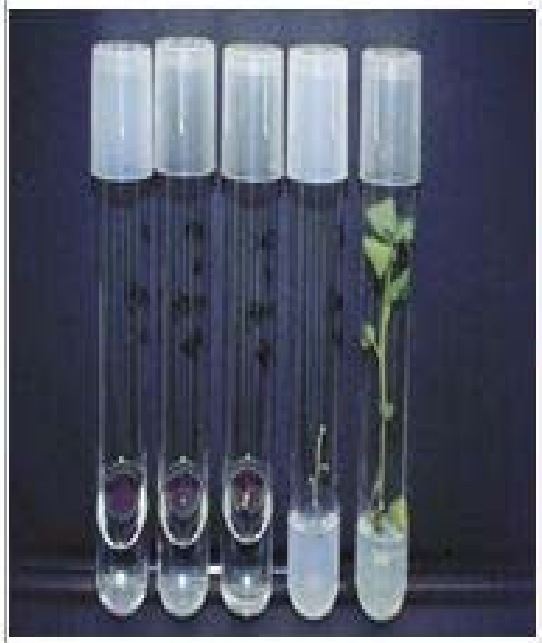
- Synthetic auxins
  - ❖widely used in agriculture and horticulture
    - ❖prevent leaf abscission
    - ❖prevent fruit drop
    - ❖promote flowering and fruiting
    - ❖control weeds
  - ❖ Agent Orange - 1:1 ratio of 2,4-D and 2,4,5-T used to defoliate trees in Vietnam War.
    - ❖Dioxin usually contaminates 2,4,5-T, which is linked to miscarriages, birth defects,leukemia, and other types of cancer.

Additional responses to auxin

- abscission - loss of leaves
- Callus tissue production
- flower initiation
- fruit development
- apical dominance

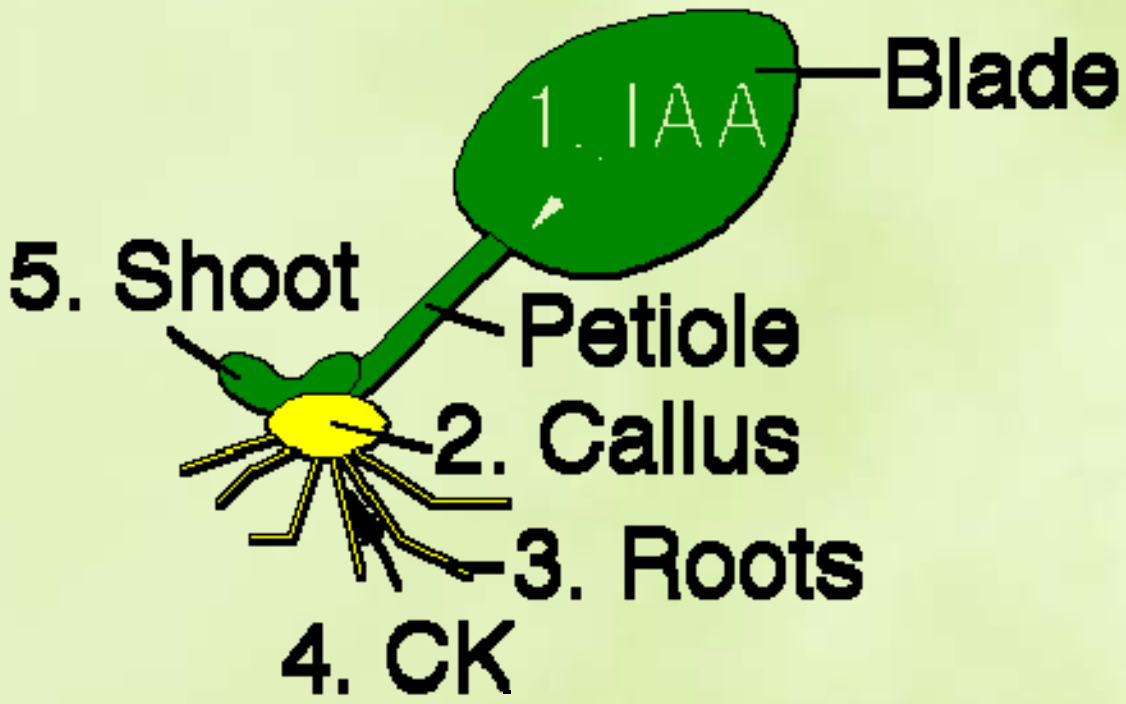
1	Cell divisions and enlargement Eg. cambial growth in diameter	.IAA + GA
2	Tissue culture	Shoot multiplications (IBA and BAP),callus Growth (2,4,-D), root multiplication IAA and IBA (1-2 mg)
3	Breaking dormancy and Apical dominance	NAA
4	Shortening internode	Apple trees (NAA) (dwarf branch-fruit)
5	Rooting of cuttings	(10-1000 ppm - NAA, IAA, phenyl acetic acid)
6	Prevent lodging	NAA- develop woody and erect stem
7	Prevent abscission	Premature leaf, fruit, flower fall (NAA, IAA and 2,4-D)
8	Parthenocarpic fruit	Grapes, banana, orange - (IAA)
9	Flower initiations	Pine apple -uniform flowering - fruit ripening (NAA). Delay flowering (2,4-D)
10	Weed eradications	2,4,D and auxin compounds

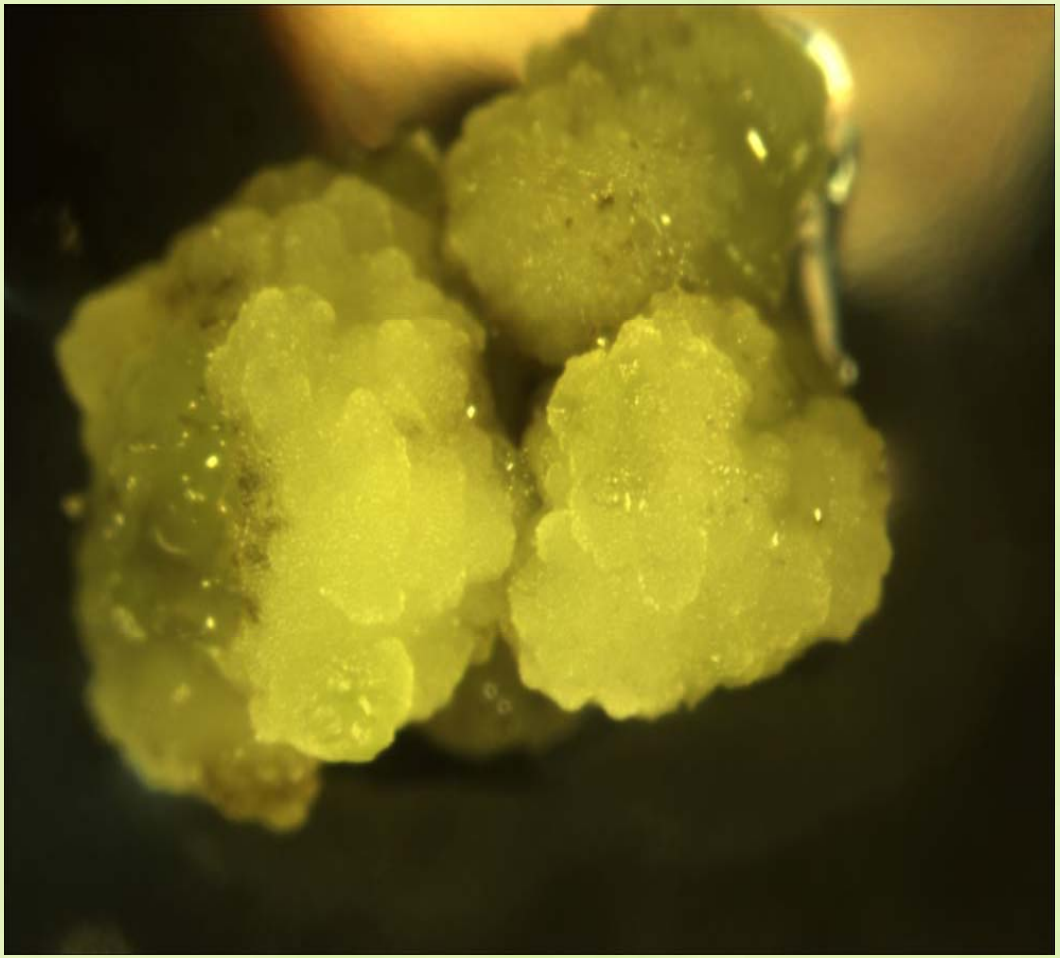
Preventing fruit abscission



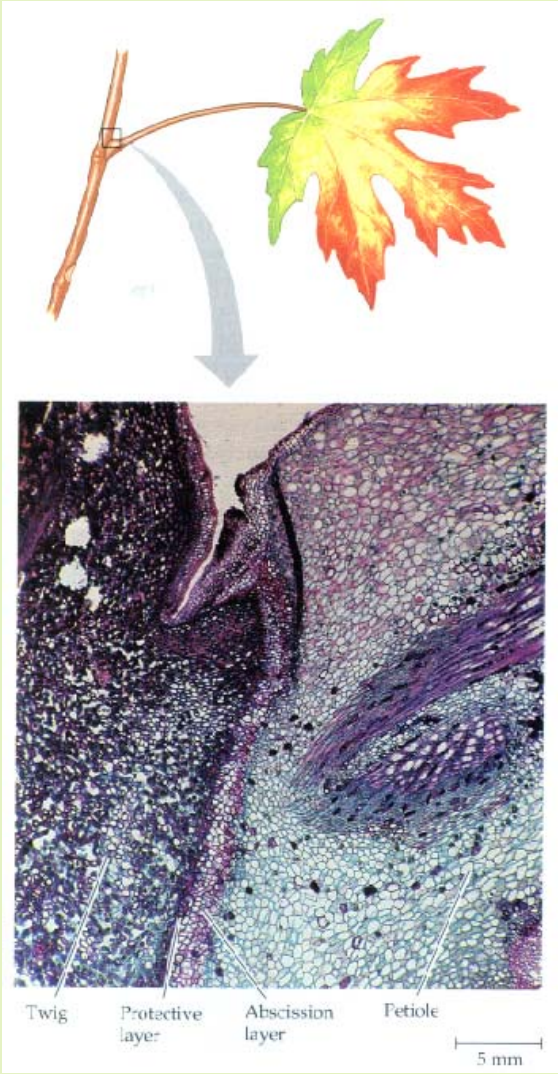
Tissue culture: Callus growth and Shoot multiplication

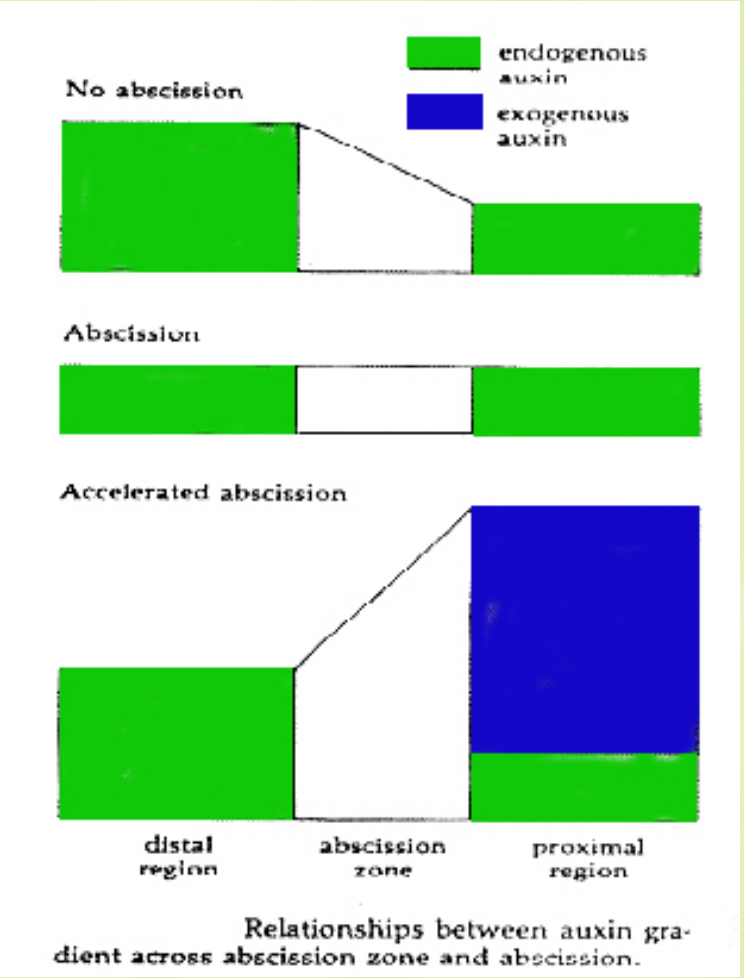
Callus tissue production





Control of abscission by auxin

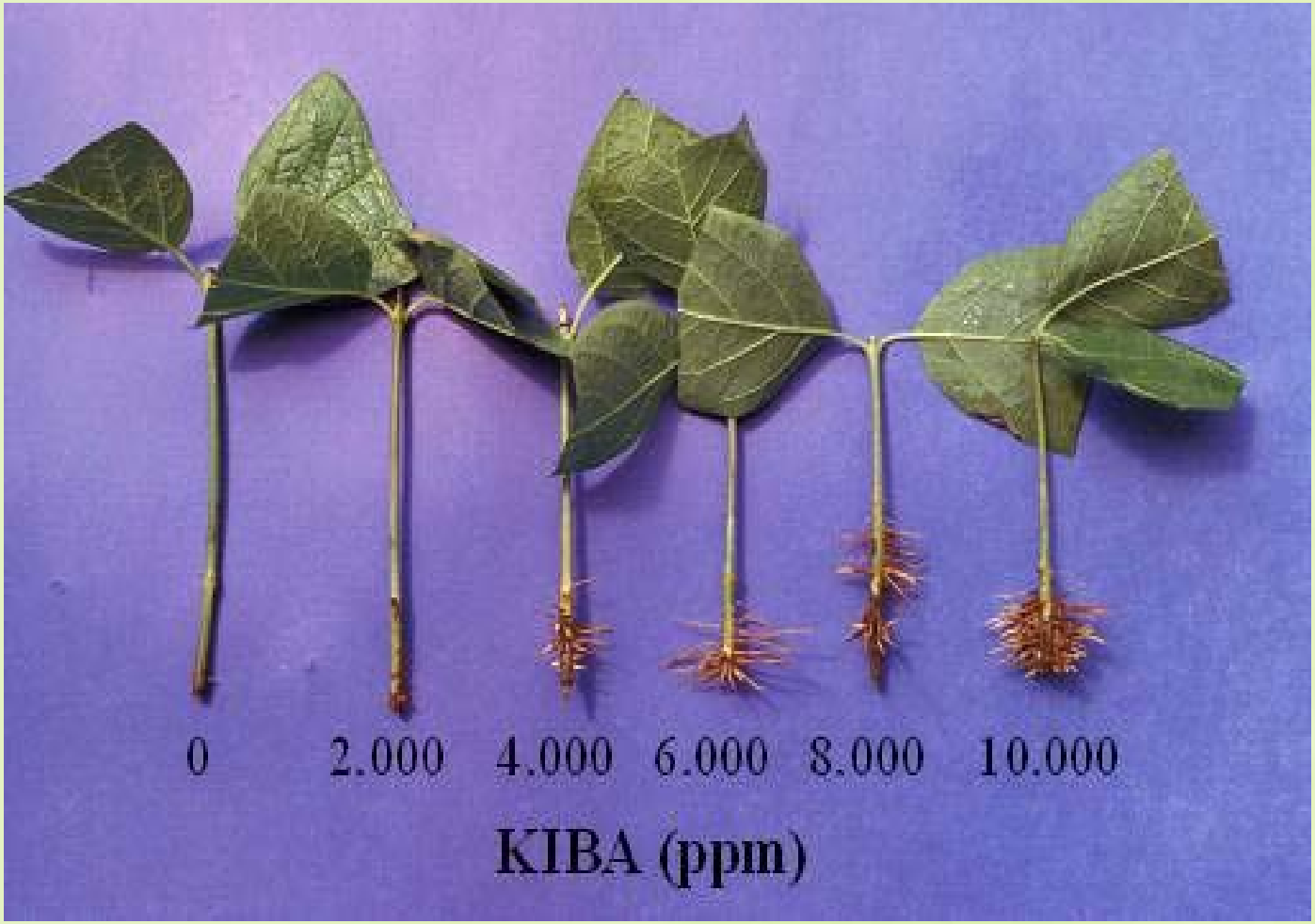




Relationships between auxin gradient across abscission zone and abscission.

Root development

- Auxins encourage root development in cuttings
- Some plants produce plenty of auxins to make rooting cuttings easy
- Other plants need synthetic auxins such as IBA

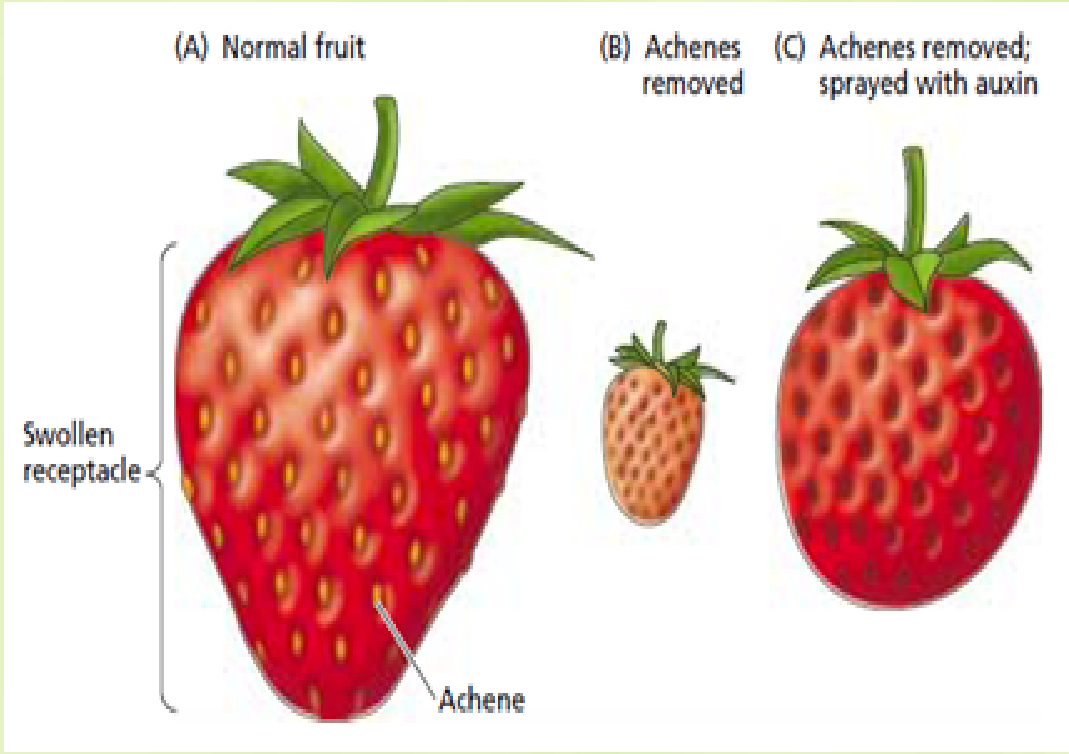

0
2.000
4.000
6.000
8.000
10.000
KIBA (ppm)

Apical Dominance

- Lateral branch growth are inhibited near the shoot apex, but less so farther from the tip.
- Apical dominance is disrupted in some plants by removing the shoot tip, causing the plant to become bushy.

Pinching

- Pinching = removing the terminal bud
- Pinching - stops flow of auxins down the stem and allows side shoots to develop
- Produces bushy, well-branched crops



- Above describes the effect of auxin on strawberry development. The achenes produce auxin. When removed the strawberry does not develop (Raven, 1992).