Plant growth hormones

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-:CONTENTS:-

INTRODUCTION:-

- Plant hormones are also known as phytohormones.
- Plant hormones are chemicals that regulate plant growth.
- Hormones also determine the formation of flowers,stems,leaves,the shedding of leaves, and the development and ripening of fruit.
- Hormones are vital to plant growth, and lacking them, palnts would be mostly a mass of undifferentiated cells.so they are also known as growth factors or growth hormones.
- The term “PHYTOHORMONES” was coined by ‘THIMANN’ in 1948.

CHARACTERISTICS:-

- The word hormone is derived from Greek , meaning set in motion. plant hormones affect gene expression and transcription levels , cellular division and growth.
- They are naturally produced within plants , though very similar chemicals are produced by fungi and bacteria , that can also affect plant growth.
- Plant hormones are not nutrients , but chemicals that in small amount promote and influence the growth, development , and differentiation of cells and tissues.

CLASSES OF PLANT HORMONES:-

- In general , it is accepted there are five major classes of plants hormones , some of which are made up of many different chemicals that can vary in structure from one plant to the next.
- The five major classes are :-

a)AUXIN

b)GIBBERELLIN c)CYTOKININ

d)ETHYLINE e)ABSISIC ACID

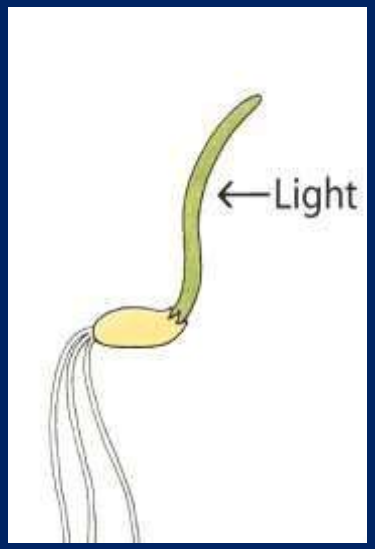
Auxin :-

- Discovered in 1881 by CHARLES AND FRANCIS DARWIN.
- They reported experiments on the response of growing plants to light.
- ➢ Grass seedlings do not bend if the tip is covered with a light proof cap.
- ➢ They do not bend when a collar is placed below the tip.
- ➢ 30 year later, PETER BOYSEN JENSEN AND ARPAD PAAL demonstrated that the influence was actually a chemical.

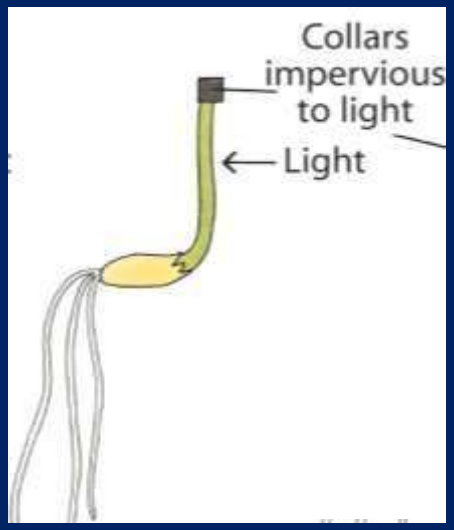
AUXIN:-

- **PRODUCTION**
  - Shoot tips
  - Developing seeds
- **SOME KNOWN ACTION**
  - Establish of polarity of root –shoot axis during embryogenesis.
  - Cell elongation.
  - Cell differentiation.
  - Apical dominance.
  - Lateral root formation & adventitious root formation.
  - Fruit formation

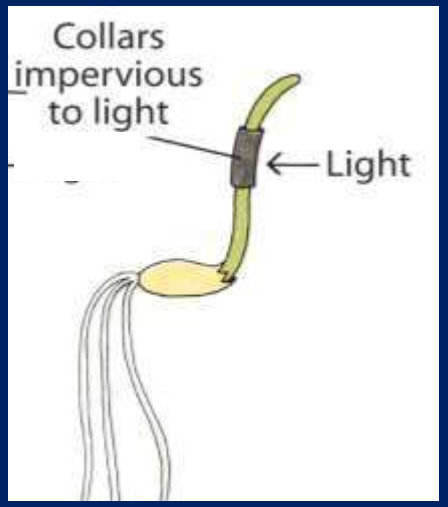
Darwins' (Charles and son) experiment



Under normal conditions, shoot tips bend towards the light



Without light on the tip, no bending



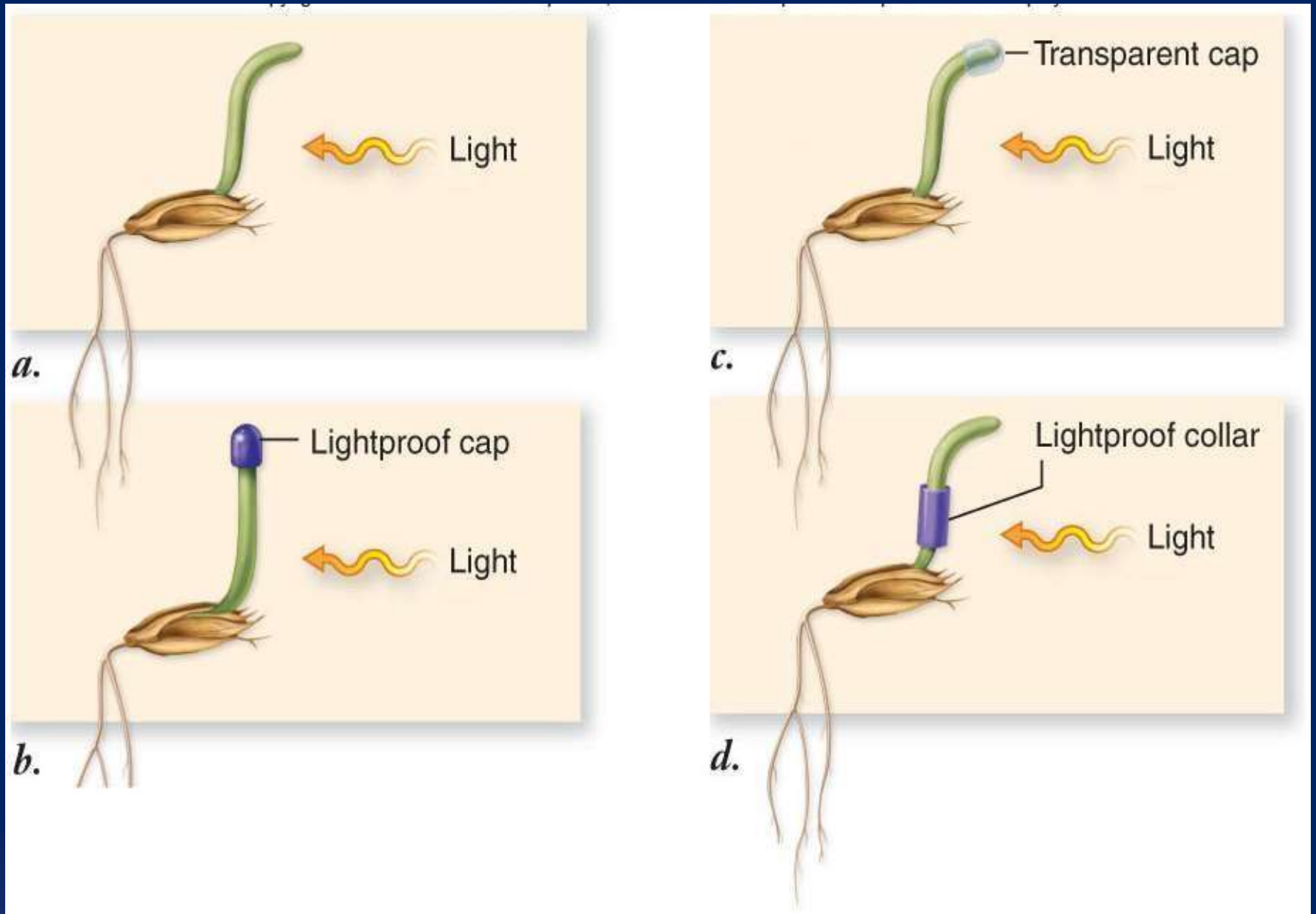
When not at tip, collar doesn't prevent bending

Conclusion: Light is sensed at the tip, but response not at tip

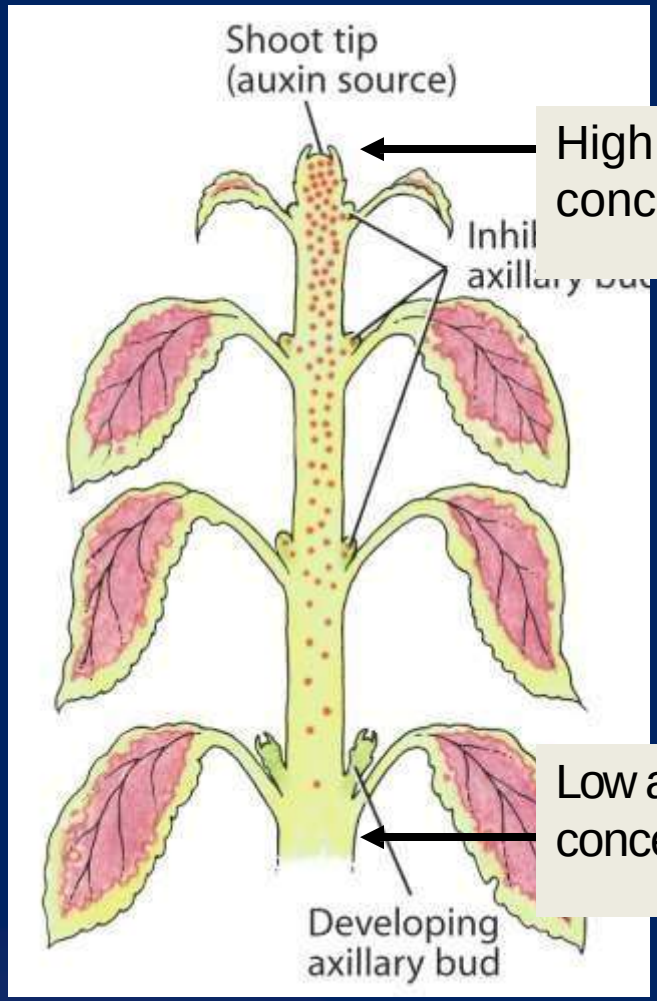
New hypothesis: A substance or chemical is transported

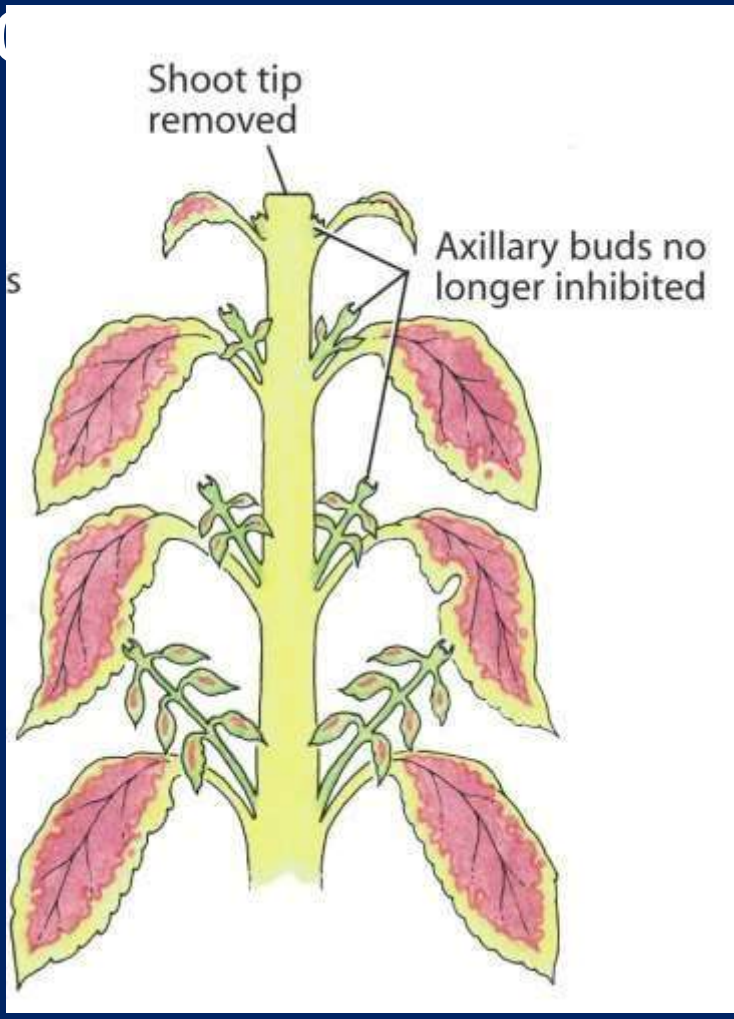
Auxin later isolated from shoot tips and established to be involved in cell elongation

Drawings depicting seedlings of *Zea* (Gramineae family)


Light
a.
Transparent cap
Light
c.
Lightproof cap
Light
b.
Lightproof collar
Light
d.

Evidence for the role of auxin in apical dominanc

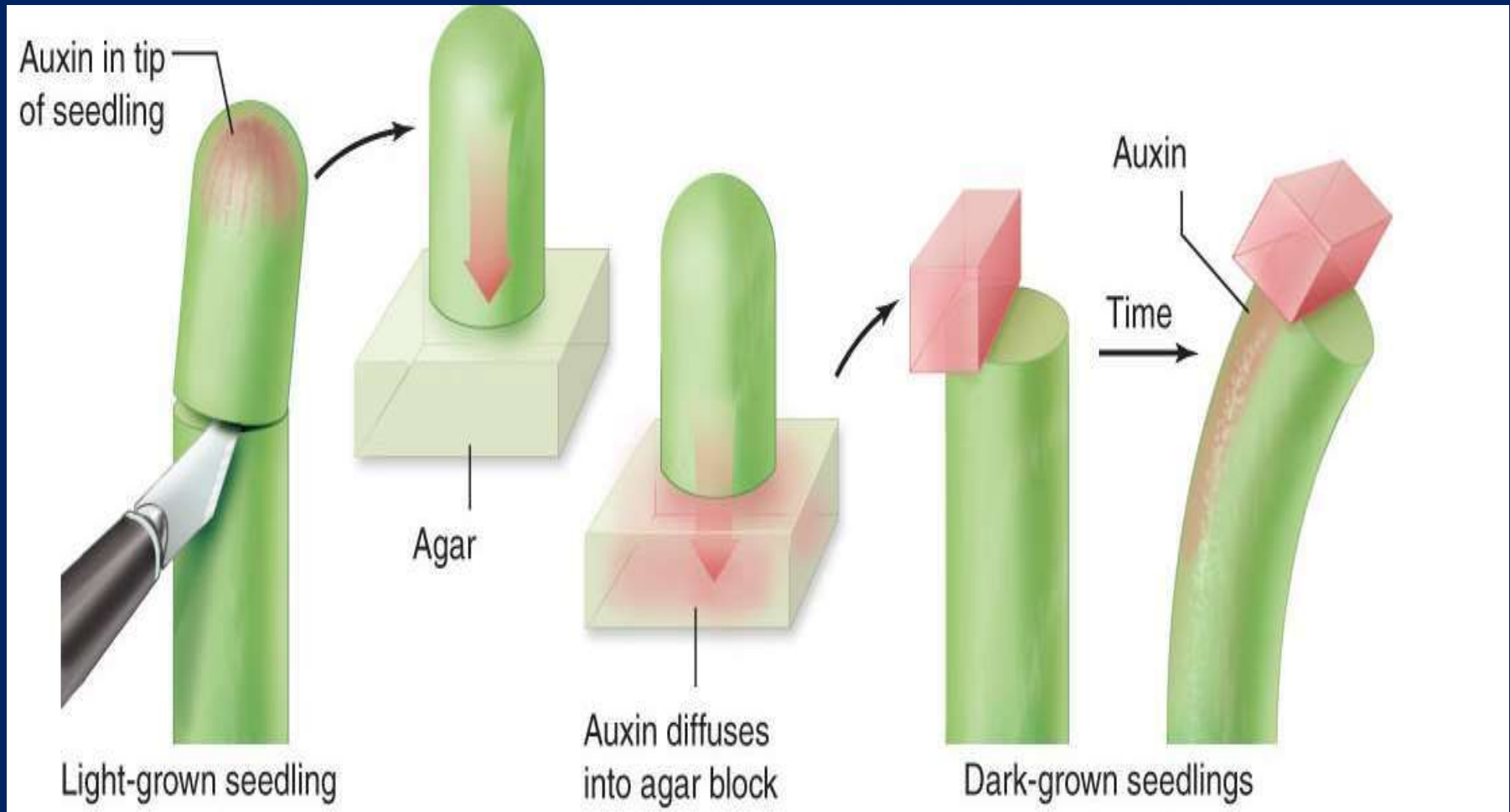




Drawings depicting *Coleus* (Lamiaceae family)

Auxin

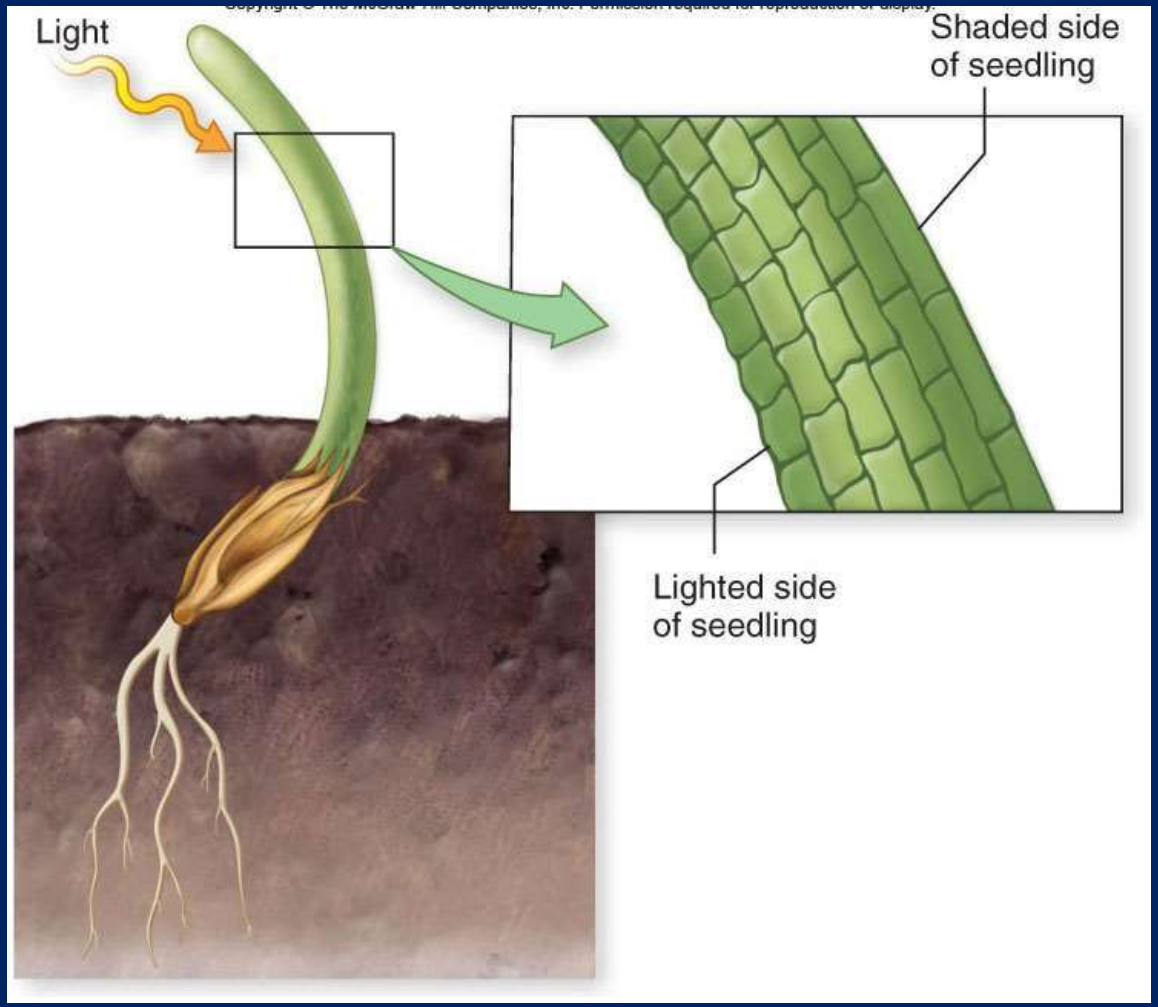
- In 1926, Frits Went performed an experiment that explained all of the previous results
- He named the chemical messenger auxin
- It accumulated on the side of an oat seedling away from light
- Promoted these cells to grow faster than those on the lighted side
- Cell elongation causes the plant to bend towards light



1. Went removed the tips of oat seedlings and put them on agar, an inert, gelatinous substance.

2. Blocks of agar were then placed off-center on the ends of other oat seedlings from which the tips had been removed.

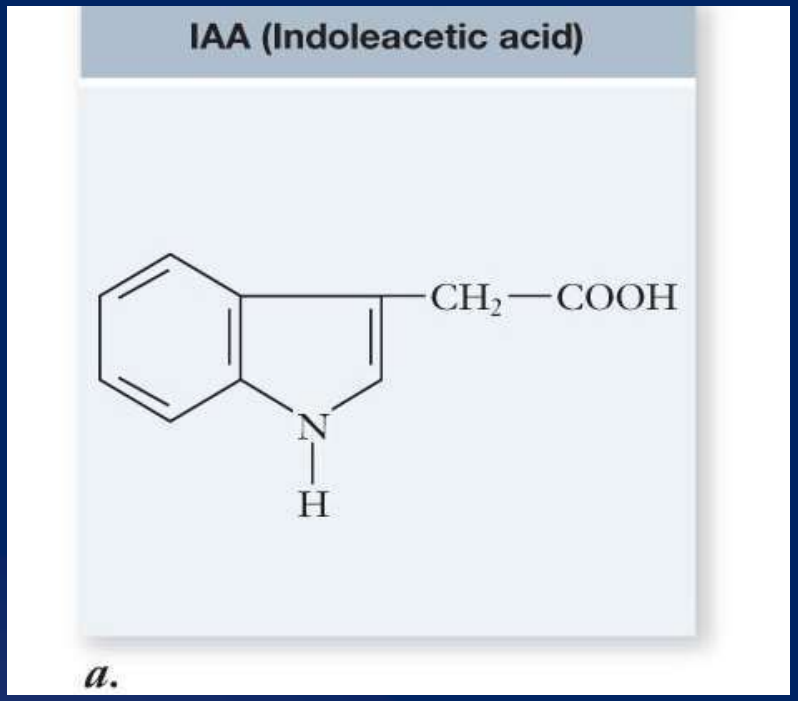
3. The seedlings bent away from the side on which the agar block was placed.

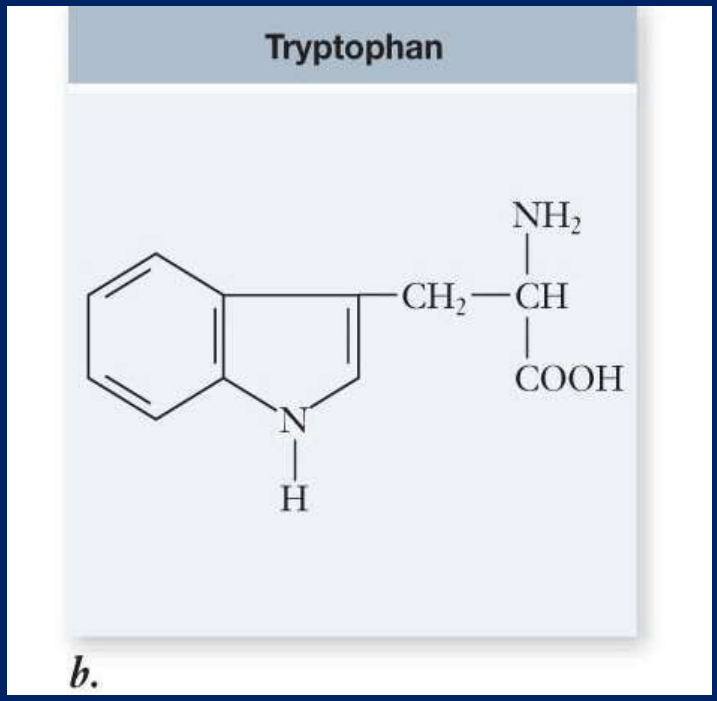


- Chemical enhanced rather than retarded cell elongation
- Frits Went named the substance that he had discovered auxin

How Auxin Works

- Indoleacetic acid (IAA) is the most common natural auxin
- Probably synthesized from tryptophan





Synthetic Auxins

- Naphthalene acetic acid (NAA) and indolebutyric acid (IBA) have many uses in agriculture and horticulture
- Prevent abscission in apples and berries
- Promote flowering and fruiting in pineapples
- 2,4-dichlorophenoxyacetic acid (2,4-D) is a herbicide commonly used to kill weeds

Gibberellins

- Named after the fungus *Gibberella fujikuroi*

which causes rice plants to grow very tall

- Gibberellins belong to a large class of over 100 naturally occurring plant hormones
  - All are acidic and abbreviated GA
  - Have important effects on stem elongation
    - Enhanced if auxin present

- Adding gibberellins to certain dwarf mutants restores normal growth and de

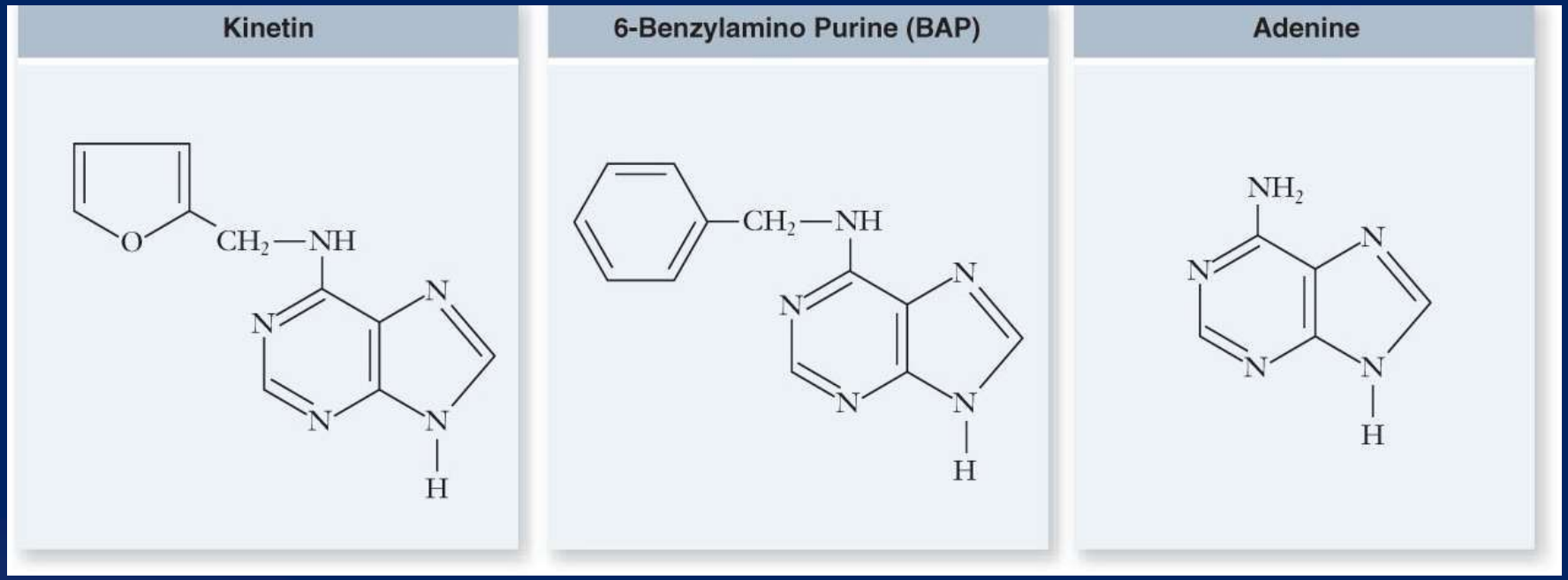
- GA is used as a signal from the embryo that turns on transcription of genes encoding hydrolytic enzymes in the aleurone layer
- When GA binds to its receptor, it frees GA- dependent transcription factors from a repressor
- These transcription factors can now directly affect gene expression

Gibberellins

- Hasten seed germination
- Used commercially to extend internode length in grapes
  - Result is larger grapes

Cytokinins

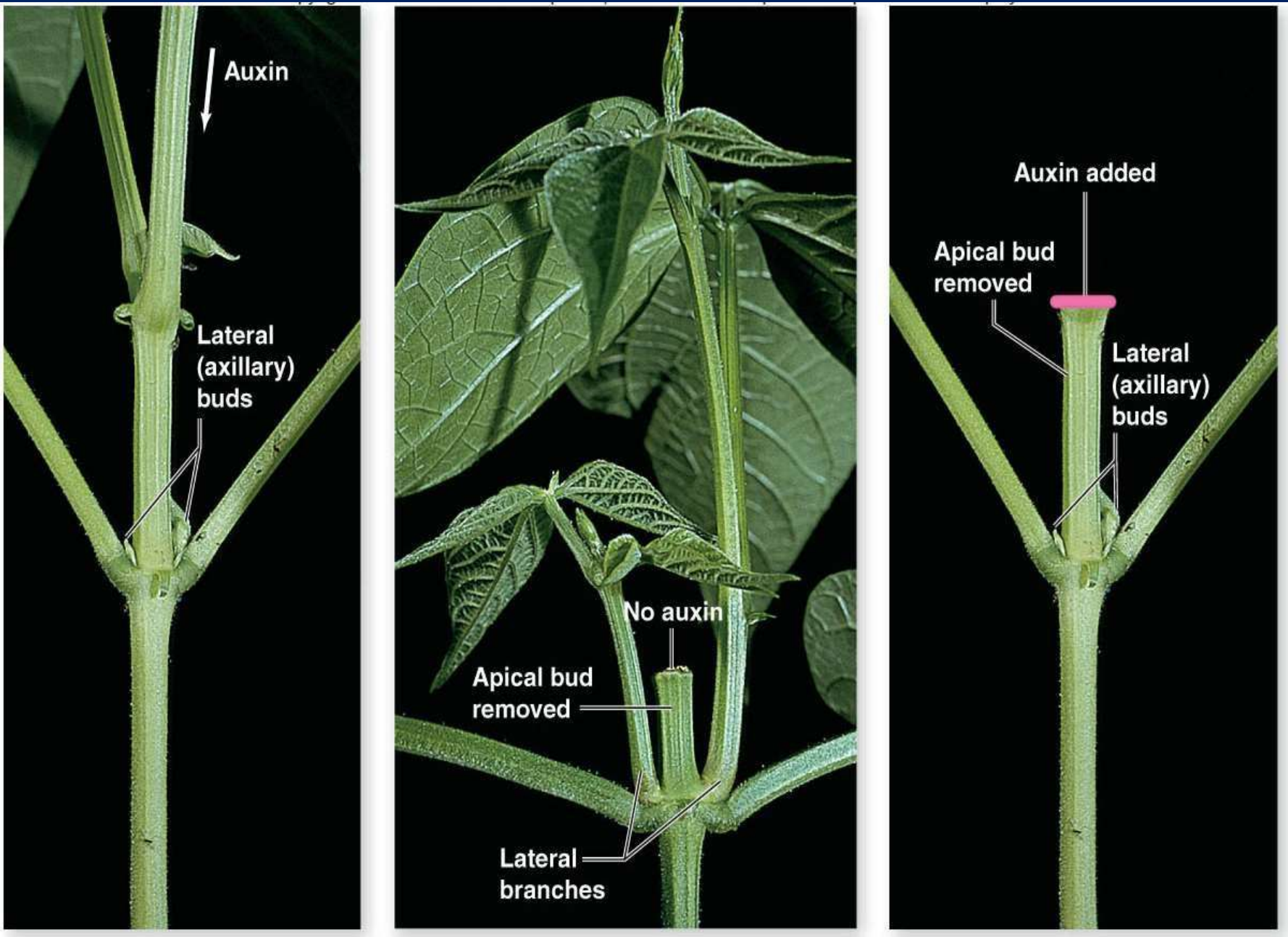
- Plant hormone that, in combination with auxin, stimulates cell division and differentiation



Synthetic cytokinins

- Produced in the root apical meristems and developing fruits
- In all plants, cytokinins, working with other hormones, seem to regulate growth patterns
- Promote the growth of lateral buds into branches
- Inhibit the formation of lateral roots

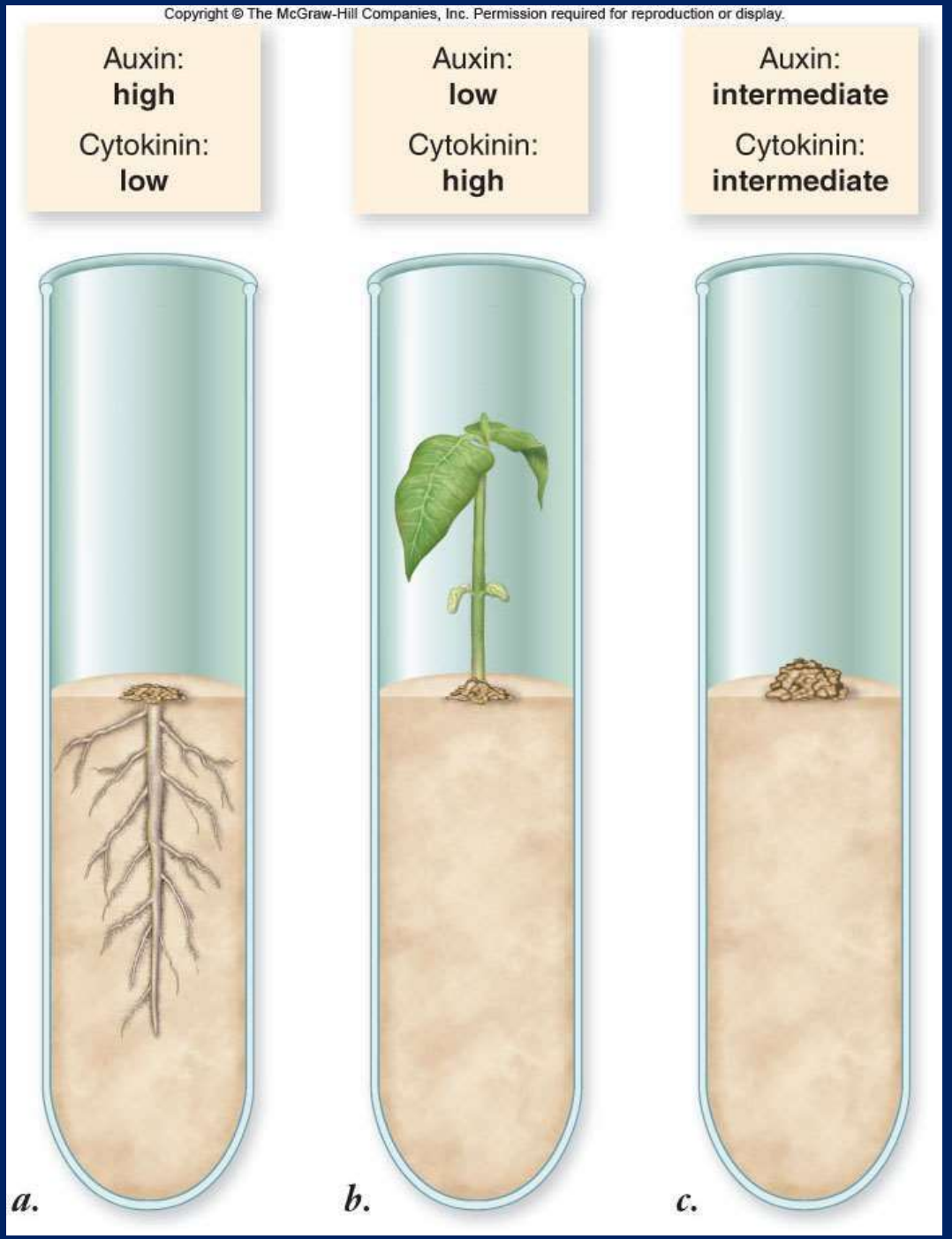
– Auxin promotes their formation


Auxin
Lateral (axillary) buds
No auxin
Apical bud removed
Lateral branches
Auxin added
Apical bud removed
Lateral (axillary) buds

Cytokinins

- Promote the synthesis or activation of cytokinesis proteins
- Also function as antiaging hormones
- *Agrobacterium* inserts genes that increase rate of cytokinin and auxin production
  - Causes massive cell division
  - Formation of crown gall tumor

- Plant tissue can form shoots, roots, or an undifferentiated mass depending on the relative amounts of auxin and cytokinin



Ethylene

- Gaseous hydrocarbon ($H_2C—CH_2$)
- Auxin stimulates ethylene production in the tissues around the lateral bud and thus retards their growth
- Ethylene also suppresses stem and root elongation
- Major role in fruit development – hastens ripening
  - Transgenic tomato plant can’t make ethylene
  - Shipped without ripening and rotting

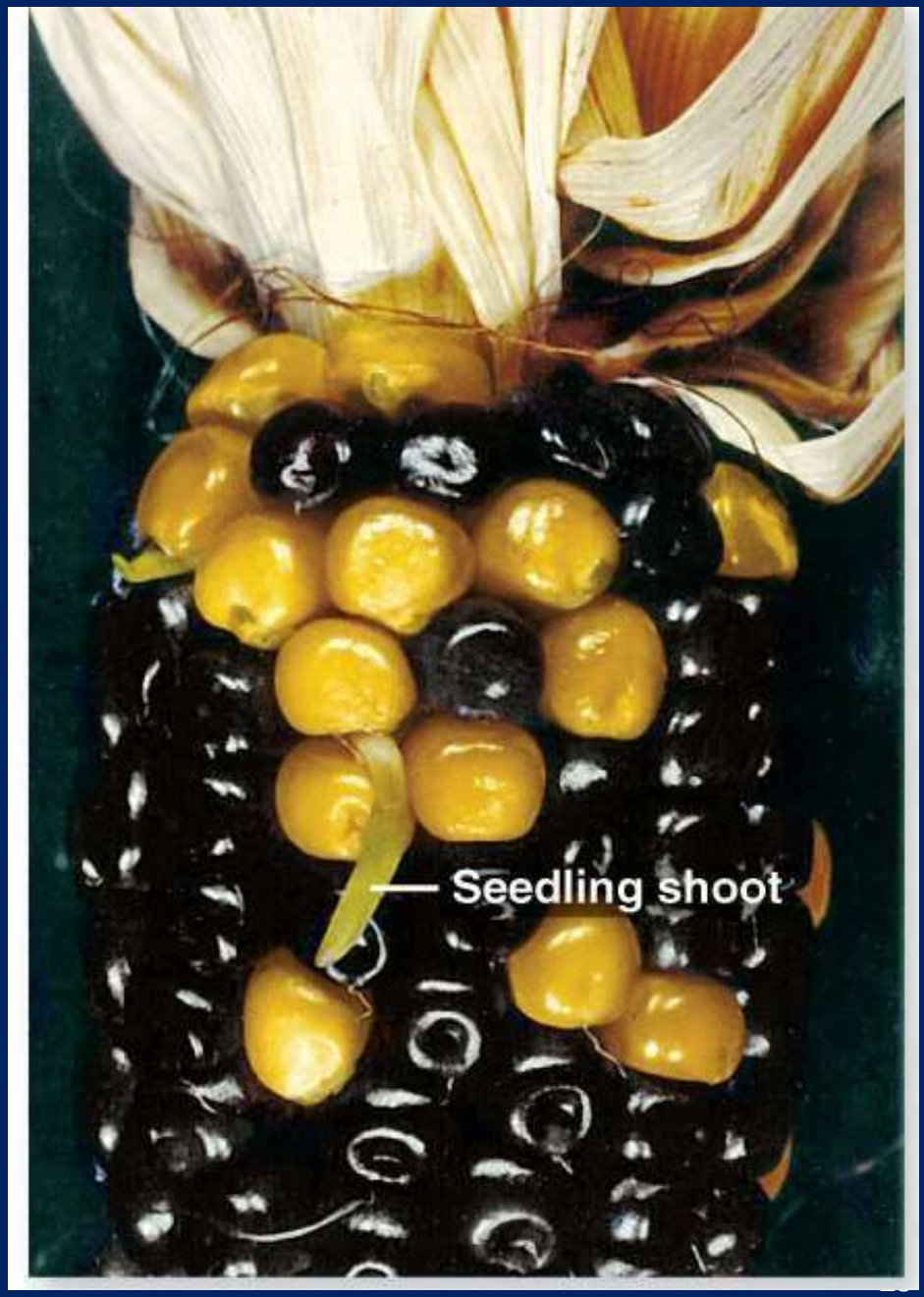
Abscisic Acid

- Synthesized mainly in mature green leaves, fruits, and root caps
- Little evidence that this hormone plays a role in abscission
- Induces formation of dormant winter buds
- Counteracts gibberellins by suppressing bud growth and elongation
- Counteracts auxin by promoting senescence

Abscisic Acid

- Necessary for dormancy in seeds
  - Prevents precocious germination called vivipary
- Important in the opening and closing of stomata


Dormant bud

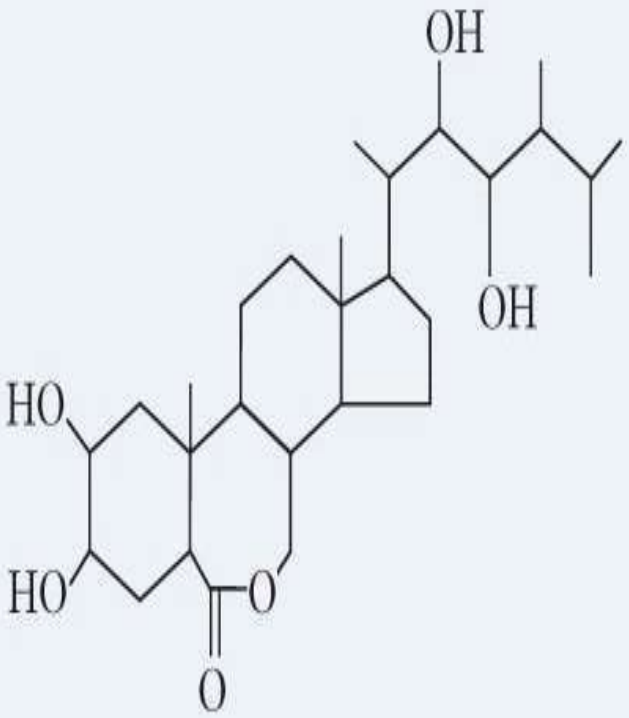
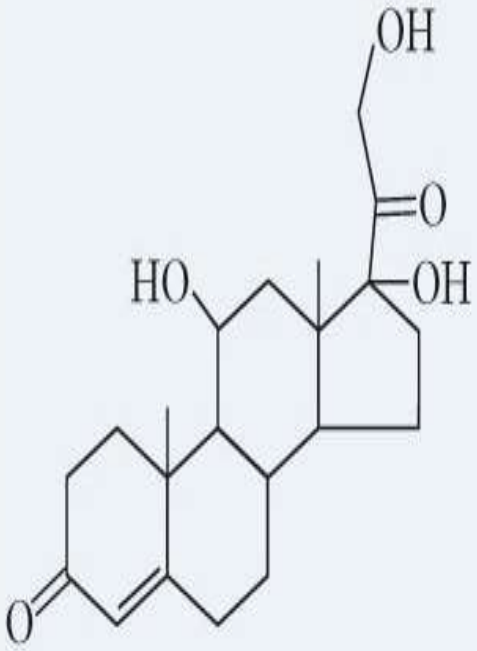
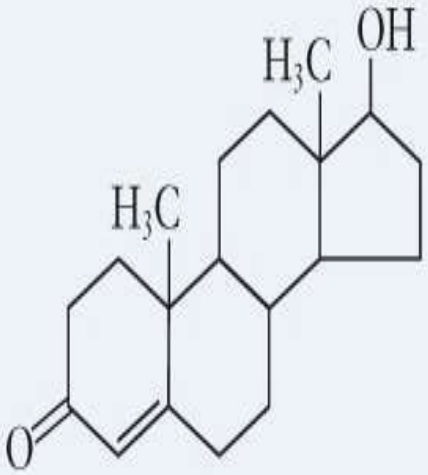

Seedling shoot

Other known hormones:-

- Other identified plant growth regulators include-

a)BRASSINOSTEROID:-

- First discovered in the pollen of brassica spp.
- Are structurally simillar to steroid hormones.

Plant	Animal	
Brassinolide	Cortisol	Testosterone
		

Brassinosteroids

- Functional overlap with other plant hormones, especially auxins and gibberellins
- Broad spectrum of physiological effects

– Elongation, cell division, stem bending, vascular tissue development, delayed senescence, membrane polarization and reproductive development

Salicylic acid:-

- Activate genes in some plants that produce chemicals that aid in the defense against pathogenic invader.

Jasmonates :-

- Are produced from fatty acids & seems to promote the production of defense proteins that are used to fend off invading organisms.
- Also have a role in seed germination.

plant peptide hormones:-

- Involved in cell to cell signaling.
- Roles in plant growth &development , including defense mechanism.

Polyamines:-

- Are strongly basic molecule with low molecular weight that

have been found in all organism studied thus far.

Nitric oxide:-

- Serves as signals in hormonal &defense response.
- E.G-nitrogen fixation , stomata closure , germination , cell

death.

Karrikins :-

- Not plant hormones because they are not made by plants, but are a group of plant growth regulator found in the smoke of burning plant materials that have the ability to stimulates the germination of seeds.

Strigolactones :-

- Implicated in the inhibition of shoot branching.

Triacontanol :-

- A fatty alcohol that acts as a growth stimulant, especially initiating new basal breaks in the rose family.
- It is found in ALFALFA (Lucerne),BEE'S WAX.

POTENTIAL MEDICAL APPLICATION:-

- Plant stress hormones activate cellular response, including cell death to diverse stress situation in plants.
- Researchers have found that some plant stress hormone share the ability to adversely affect human cancer cells.
- E.G:-sodium salicylate has been found to suppress proliferation of LYMPHOBLASTIC LEUKEMIA,PROSTATE &MELANOMA human cancer cells.
- Methyl jasmonate has been found to induce cell death in a number of cancer cell lines.

conclusion

- There exists a certain elegance by which the hormones counteract each other, regulate each other, and create completely unique and unexpected effects in tandem.
- The balance of auxin and cytokinin, not either hormone in isolation, allow for calluses to differentiate, while abscisic acid and gibberelins struggle against each other in regulation of seed dormancy.


thank you so much