Plant Developmental Biology

The roles of light in the life of plants

ENERGY

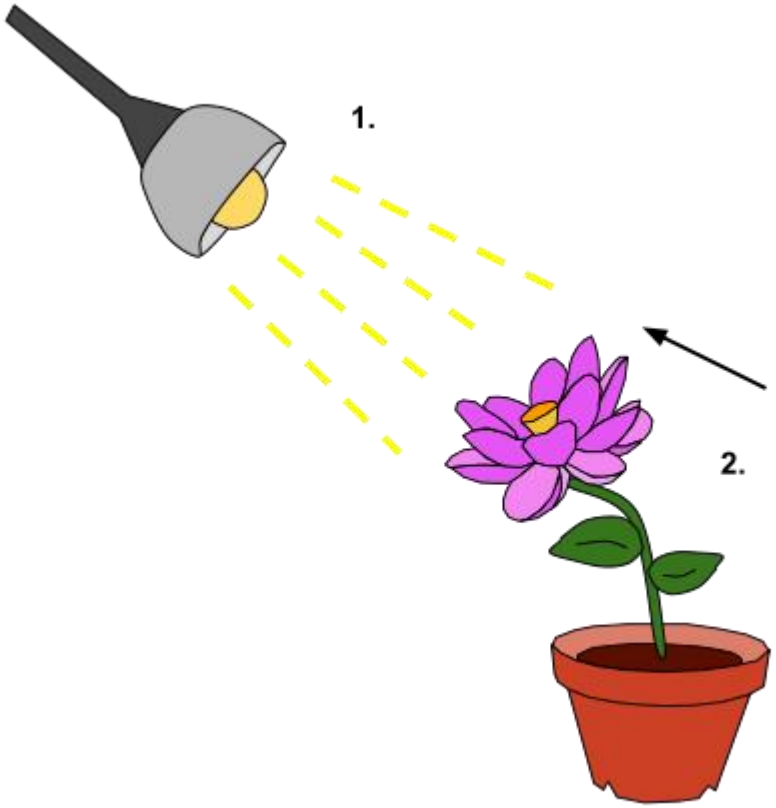
Photosynthesis

INFORMATION

Quantity Quality Direction Periodicity

Photomorphogenesis

Plants bend towards light, called phototropism

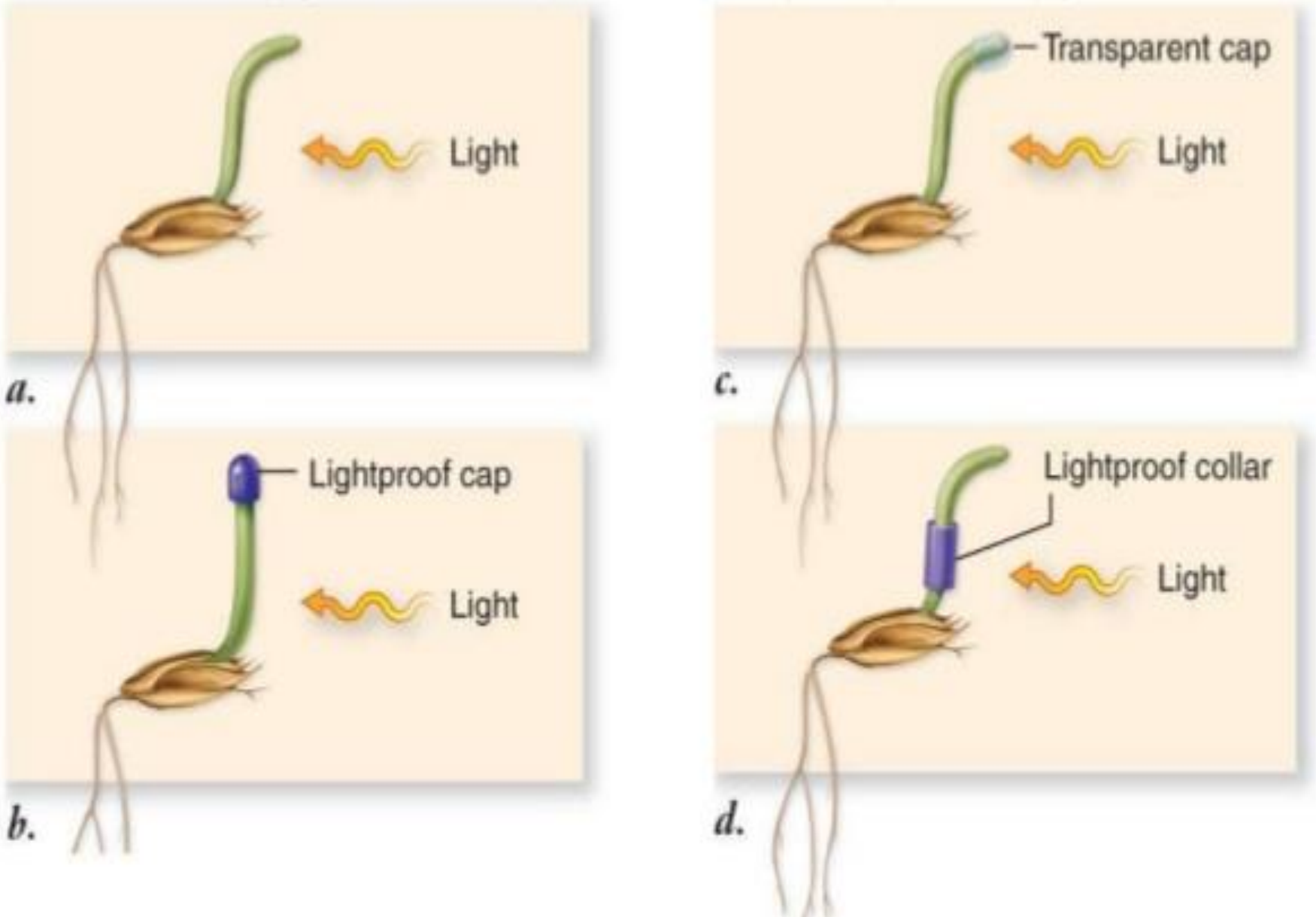


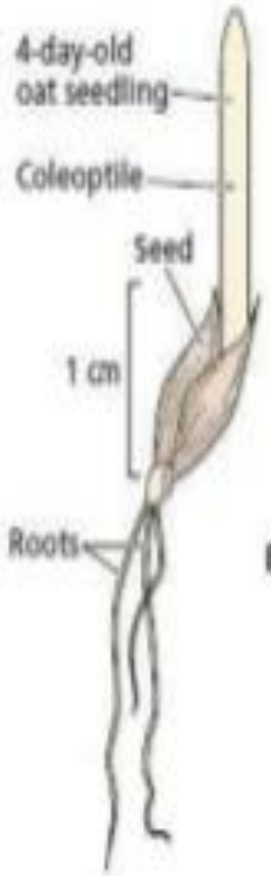
In addition to growth by cell division, a plant may grow through **cell elongation**. This occurs when individual cells or groups of cells grow longer.

Not all plant cells grow to the same length.

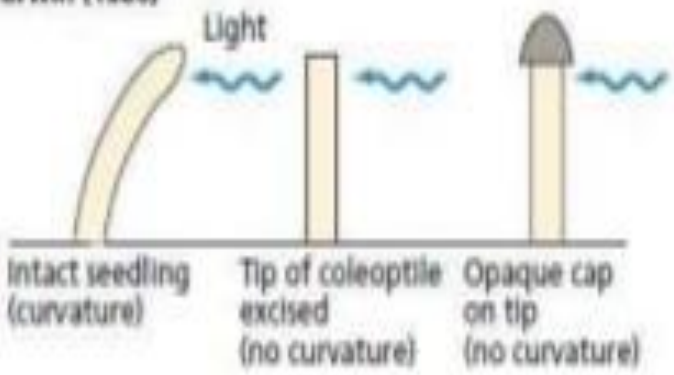
When cells on one side of a stem grow longer and faster than cells on the other side, the stem bends to the side of the slower growing cells as a result.

This directional growth can occur via a plant's response to a particular stimulus, such as light (phototropism), gravity (gravitropism), water, (hydrotropism).



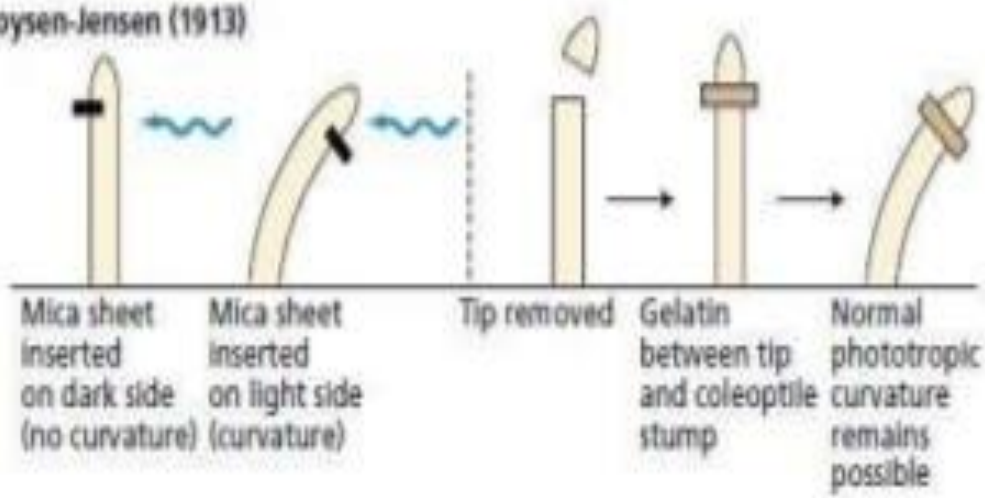


Darwin (1880)



From experiments on coleoptile phototropism, Darwin concluded in 1880 that a growth stimulus is produced in the coleoptile tip and is transmitted to the growth zone.

Boysen-Jensen (1913)



In 1913, P. Boysen-Jensen discovered that the growth stimulus passes through gelatin but not through water-impermeable barriers such as mica.

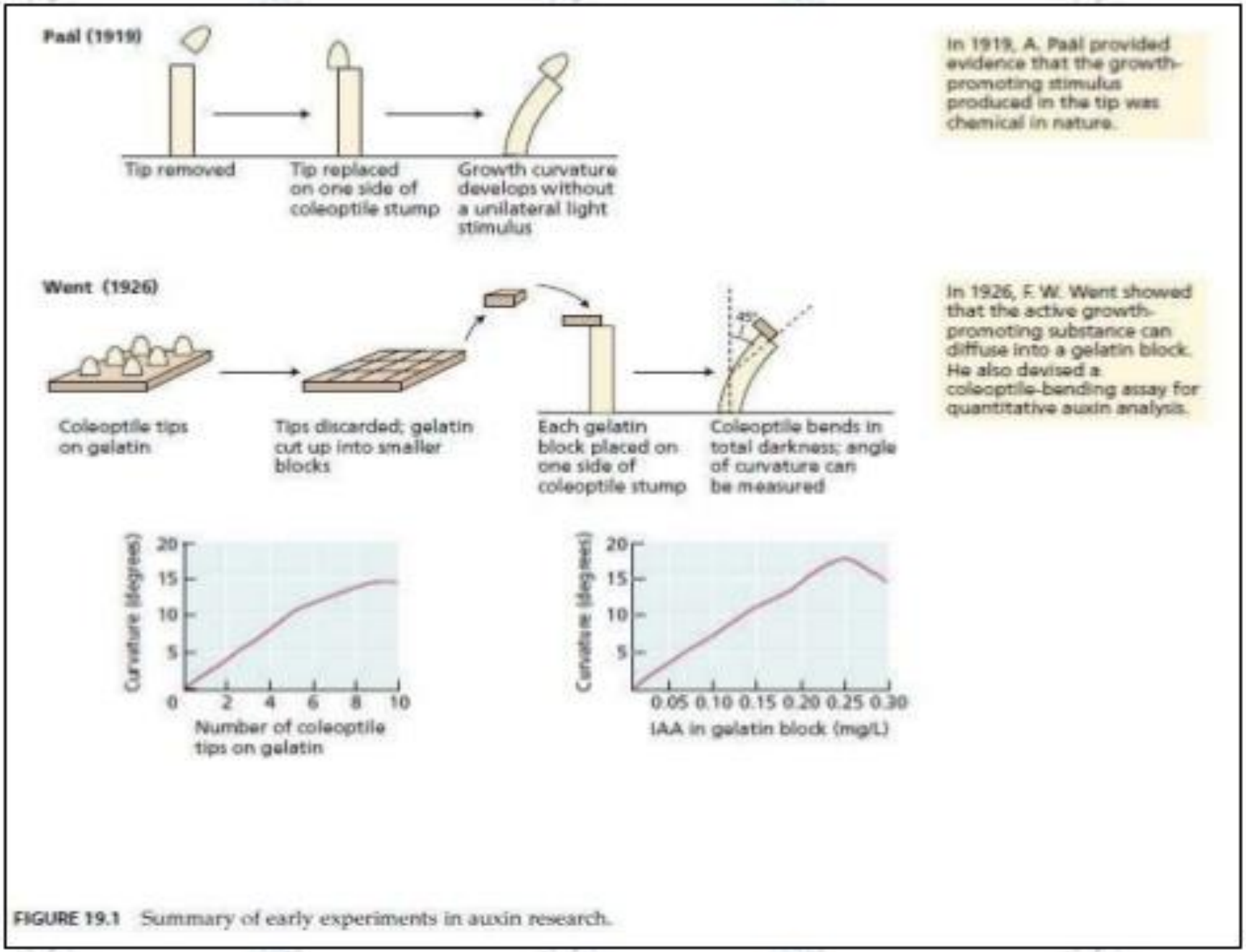
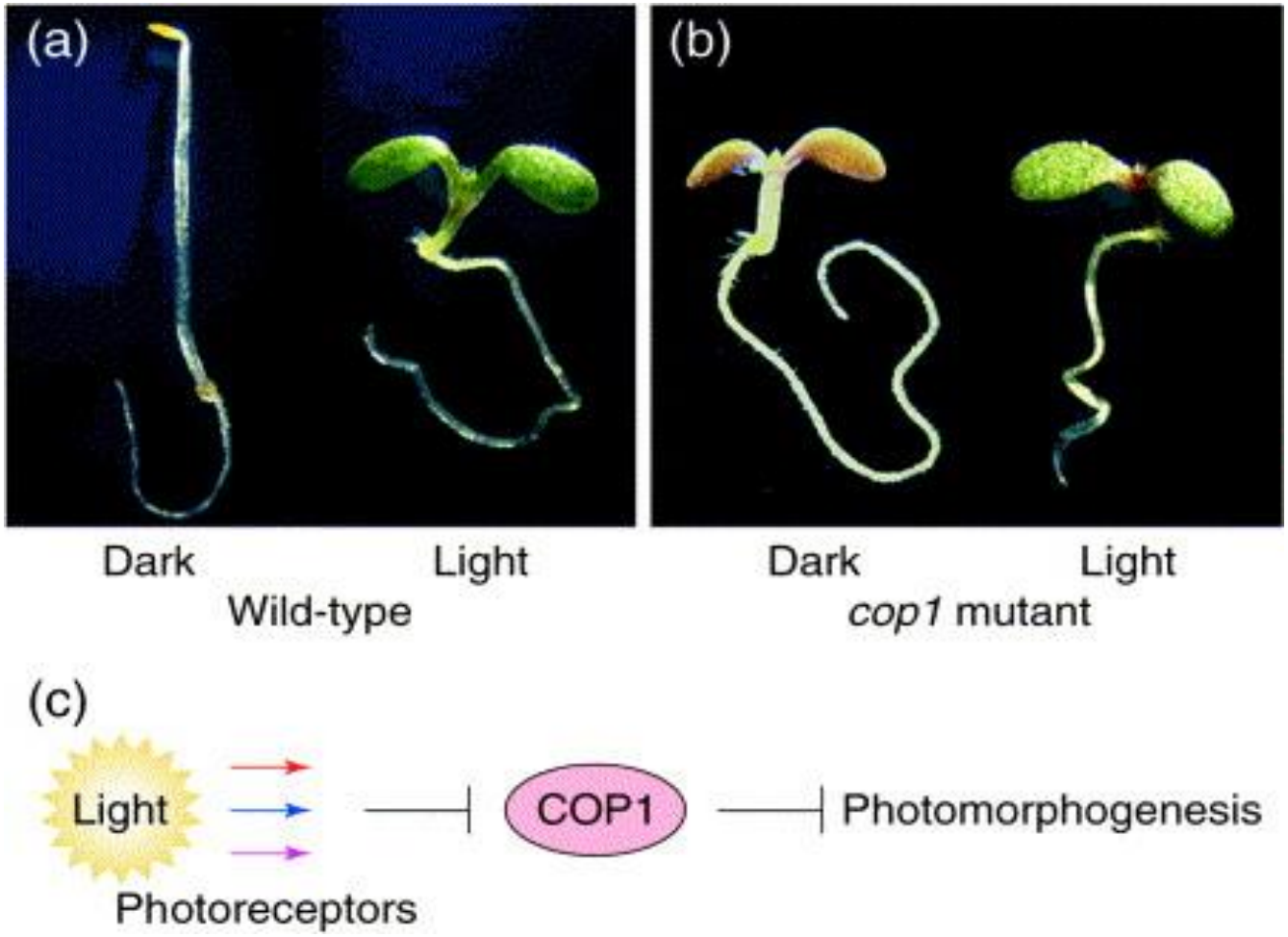


FIGURE 19.1 Summary of early experiments in auxin research.

A dicot seedling emerging from the ground displays an apical hook (in the hypocotyl in this case), a response to dark conditions

Photomorphogenesis in Plants



In developmental biology, **photomorphogenesis** is light-mediated development, where plant growth patterns respond to the light spectrum. This is a completely separate process from photosynthesis where light is used as a source of energy. Phytochromes, cryptochromes, and phototropins are photochromic sensory receptors that restrict the photomorphogenic effect of light to the UV-A, UV-B, blue, red and far red portions of the electromagnetic spectrum.

Seedling development

In the absence of light, plants develop an etiolated growth pattern. Etiolation of the seedling causes it to become elongated, which may facilitate it emerging from the soil.

A seedling that emerges in darkness follows a developmental program known as skotomorphogenesis (dark development), which is characterized by etiolation. Upon exposure to light, the seedling switches rapidly to photomorphogenesis (light development).[5]

There are differences when comparing dark-grown (etiolated) and light-grown (de-etiolated) seedlings.

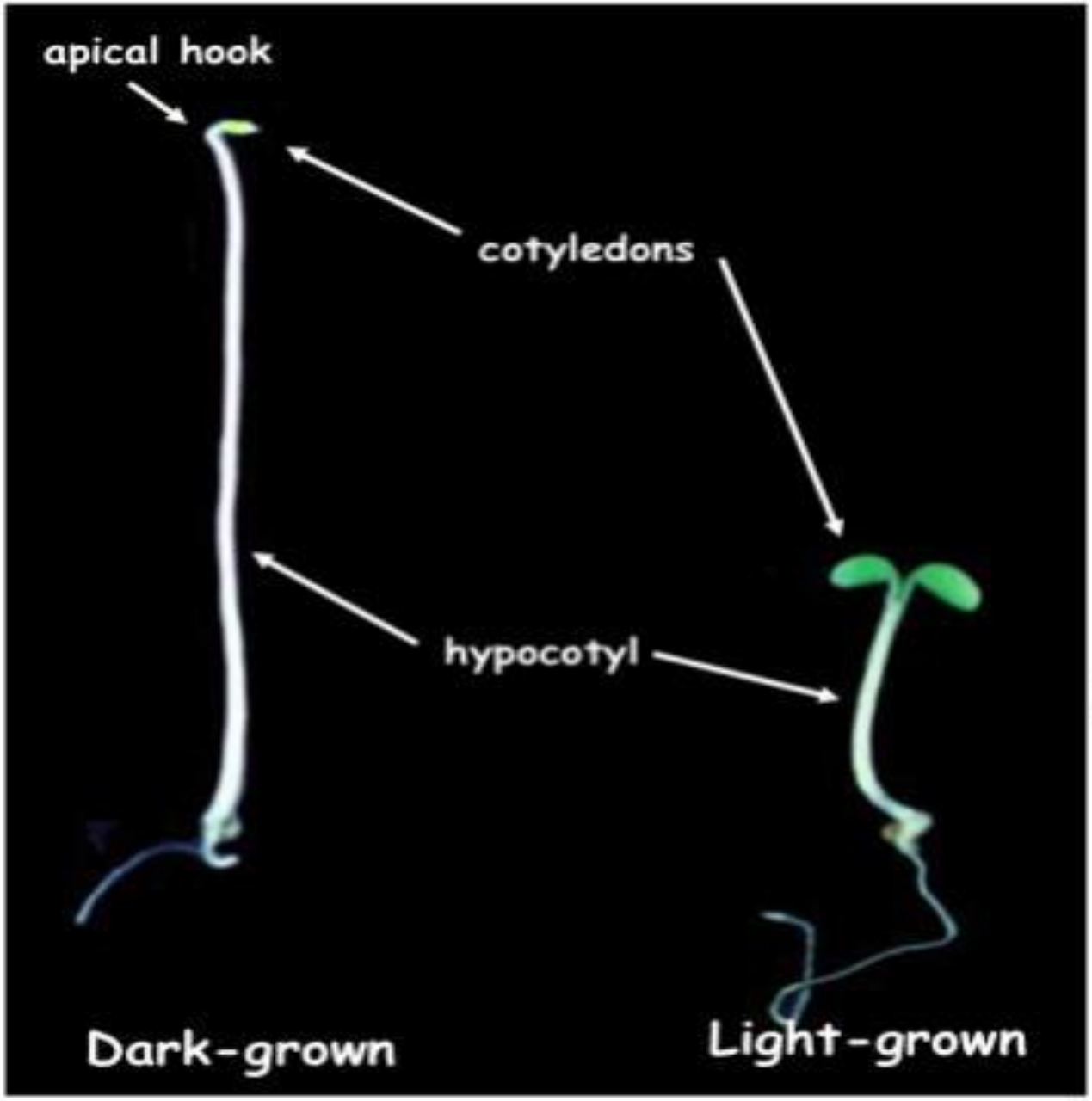
Etiolated characteristics:

- Distinct apical hook (dicot) or coleoptile (monocot)
- No leaf growth
- No chlorophyll
- Rapid stem elongation
- Limited radial expansion of stem
- Limited root elongation
- Limited production of lateral roots

The developmental changes characteristic of photomorphogenesis shown by de-etiolated seedlings, are induced by light.

De-etiolated characteristics:

- Apical hook (dicot) opens or coleoptile (monocot) splits open
- Leaf growth promoted
- Chlorophyll produced
- Stem elongation suppressed
- Radial expansion of stem
- Root elongation promoted
- Lateral root development accelerated



Arabidopsis seedlings