

Homeostasis in Plants

26.1 Plants develop in response to the environment

- Photodormancy: some seeds require a period of light or dark to germinate.
- Thermodormancy: some seeds require a period of high or low temperature to germinate.

Hormones - chemical signals that act at very low concentrations at sites often **far** from where they are produced.

- Each hormone plays multiple roles and interactions can be complex.

Photoreceptors - proteins with associated pigments that absorb light.

Gravitropism by Auxin

- Plants may detect gravity by the settling of statoliths
 - Specialized plastids containing dense starch grains
 - Auxin is released in the area where the most pressure is placed.

Auxin and Cell Expansion

Acid growth hypothesis: H^+ is pumped into cell wall; lower pH activates expansins, which catalyze changes that loosen the cell wall.

- Auxin increases synthesis of proton pumps and guides their insertion into the plasma membrane.

Thought gibberellins are different from auxins, they have a similar mechanism of action. Gibberellins are sprayed on seedless grapes to get larger fruit.

Gibberellins or auxins can do one thing when they have nuclear receptors. The repressors hold on to the transcription factors. When gibberellin binds to the receptor, the receptor can then enter the cytoplasm.

Cytokinins

Cytokinins have several effects, often interacting with auxin:

- Induce proliferation of cultured plant cells.
- In cell cultures, high cytokinin-to-auxin ratio promotes formation of roots.
- Cause some light-requiring seeds to germinate even if kept in darkness. Cytokinins can delay the senescence of leaves.

The cytokinin signaling pathway includes proteins similar to those in two-component systems in bacteria.

- Receptor - acts as a protein kinase, phosphorylating itself and a target protein.
- Target protein - acts as a transcription factor to regulate the response.

Photoreceptors Initiate Developmental Responses to Light

Cryptochromes: blue-light receptors located in the nucleus; affect seedling development and flowering.

Mechanism of action is unknown.

Phytochromes: red light (650-680 nm) receptors

Lettuce seedlings germinate only in response to red light.

Red light responses are reversible by far-red light (710-740 nm)

Mechanism of Action of Phytochrome

Phytochrome exists in two interconvertible isoforms: Red light & far-red light -
-> both can lead to:

- Chlorophyll synthesis
- Apical hook unfolding
- Leaf expansion

Phytochrome and Shade-tolerance (avoidance)

Ratio of red to far-red light determines phytochrome-mediated responses. During daylight, ratio is about 1.2:1 - the P_{fr} isoform predominates. In shade, ratio may be as low as 0.13:1 - P_r isoform predominates. Shade-intolerant species respond by stimulating stem cell elongation, thus growing taller to escape the shade.