

Topic: Plant responses to the environment

Reading: Chapter 44

Main concepts:

- Many responses in plants are the result of plant hormones.
 - Each of the five types of plant hormones has multiple functions, depending on the tissue involved and the interactions with other hormones.
 - Types of hormones:
 - Growth promoting hormones: Auxins, gibberellins, cytokinins
 - Growth suppressing (or senescence) hormones: ethylene gas, abscisic acid
 - Auxins:
 - stimulate the elongation of cells.
 - control tropisms, in which plants grow directionally in response to a stimulus
 - Phototropism: growth toward or away from light
 - Geotropism: growth toward or away from gravity
 - Thigmotropism: growth in response to touch (such as tendrils winding around a twig)
 - cause apical dominance (growth of apical bud, suppression of lateral buds).
 - stimulate fruit development.
 - stimulate root growth and branching (in concert with cytokinins).
 - Gibberellins:
 - promote cell elongation in the internodes of plants.
 - stimulate germination of seeds.
 - stimulate fruit development.
 - stimulate flowering.
 - Cytokinins:
 - stimulate lateral buds to grow (in concert with auxins)
 - stimulate development of seeds and fruits.
 - promote cell division in meristems.
 - delay aging of plants.
 - Ethylene gas:
 - causes fruits to ripen.
 - causes abscission of leaves, flowers
 - inhibits cell elongation in stems.
 - Abscisic acid:
 - stimulates senescence.
 - inhibits gibberellins; maintains seed and bud dormancy during adverse weather.
 - Light-sensitive pigments also regulate plant life cycles
 - Phytochrome senses red and far-red light. Plants use phytochrome to sense daytime and nighttime.
 - Using phytochrome, plants can sense changing day length, and use this to determine the optimal time to flower.
 - Plants have other, faster forms of communication
 - Plants send chemical signals in response to attack by insects. Some signals attract predators of the insect pests.
 - Some chemicals are used to signal other plants to create tougher tissue, making them less palatable to insects.
 - Some plant movements are reversible (in other sources, these are called nastic movements.)
 - Specialized cells in parts of the plant may be able to pump ions, such as potassium ions, in and out of the cell. Water follows by osmosis, causing the cell to shrink or swell. This mechanism is used by the "sensitive plant" (*Mimosa pudica*) to cause its leaves to droop quickly in response to touch.
 - In the Venus Fly Trap, stimulation of hairs on the surface of the leaves sends electrical signals to cells in the "hinge" of the leaf. Cells on the outside of the leaf expand rapidly in response, making the "trap" close.
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Common misconceptions:

- Many students have an idea that plants are simple, “primitive,” and do very little. Study of plant hormones and other chemical signals shows us that plants are highly sophisticated and responsive to their environments.
- Some students have difficulty understanding plant responses because they do not distinguish between “growth” by cell division and “growth” by cell elongation. It’s important to distinguish between these two types of growth to understand the effects of plant hormones.

Reading notes:

- Make a table listing the five types of plant hormones and their primary functions.
- Describe the major findings of early studies by the Darwins, Boysen-Jensen, and Went that led to the discovery of auxins.
- Describe the role of auxins in plant tropisms (primarily phototropism and geotropism).
- Describe the interactions between auxins and cytokinins in the plant roots and shoots, particularly in terms of lateral shoot development.
- Define day-neutral, short-night, and long-night plants. Describe the role of phytochrome in controlling flowering in these plants.
- Describe how hormones such as gibberellin and ethylene gas are used commercially in the fruit growers industry.
- State why it is important for plants to undergo senescence, and the processes and hormones involved in senescence.
- Describe how plants use chemicals to signal one another and for defense in the event of an insect attack.
- Describe how the sensitive plant and the Venus fly trap move, and state why these movements are reversible while tropisms are not.

Useful websites:

- “Auxins” <http://www.kscience.co.uk/animations/auxin.htm> is an animated tutorial describing the role of auxins in plant growth.
 - “How do hormones affect plant growth and development?” <http://w3.dwm.ks.edu.tw/bio/activelearner/36/ch36intro.html> is a self-guided online tutorial to tropisms and other plant responses.
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