Chapter 36

Overview of plant behavioral responses

- Behavior is a response of an organism to an internal or external stimulus
- types of plant behavior
  - movement
    - bending,twisting, or rotating
      - nutation
    - rapid movement as in sensitive plants
      - response to touch
  - growth
  - seed germination
  - seasonal production of reproductive structures
  - defensive responses to attacks
    - thorns, spines, chemicals

Responses to internal and external stimuli

Internal

- Internal biological clock
  - circadium rhythms
- chemical signals
  - transcriptions factors and other proteins or hormones
  - often interact with each other and external signals

External

- light atmospheric gases (CO_2 and water vapor) temperature, touch, wind, gravity, water, rocks, and soil minerals
- Herbivors, pathogens, organic chemicals from neighboring plants, and beneficial or harmful organisms

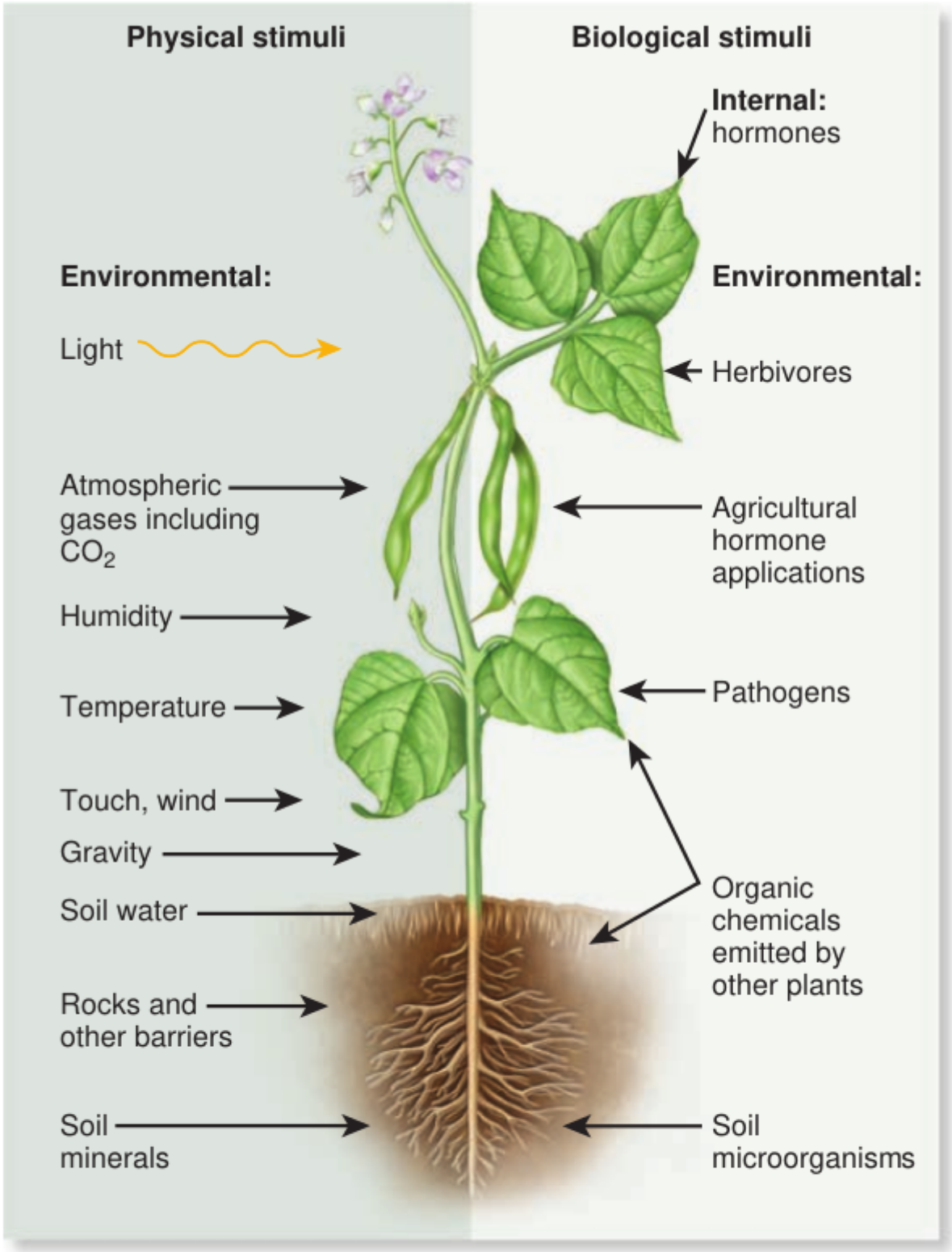


Figure 36.2 **Types of plant stimuli.** Plants respond to both physical and biological stimuli. Stimuli may be internal to the plant or come from the environment.

Plant Behavior

Involves internal and external stimuli

- tropism
  - growth response that is dependent on a stimuli that occurs in a particular direction
- Reception molecules
  - located in plant cells
  - sense stimuli and cause response

Phototropism

- Growth response to light
- light causes movement of hormone auxin away from said light
- result in unequal distribution of auxin
  - causing unequal cell elongation
- positive tropism

Gravitropism

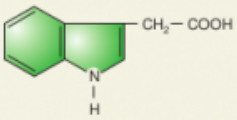
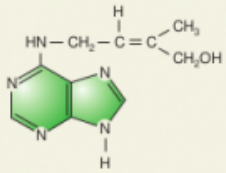
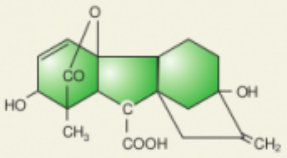
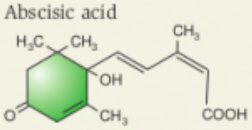
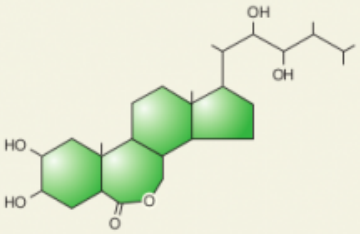
- growth response to gravity
- positive tropism
  - roots
- negative tropism
  - shoots
- columella cells in root cap/tip region sense gravity

Thigmotropism

- Growth response to touch
- roots
  - columella cells cause roots to grow around obstacles

Regulation of plant growth

Table 36.1 The Major Types of Plant Hormones

Type of plant hormone	Chemical structure of an example	Functions (Note: this is a partial, not complete list)
Auxins	Indoleacetic acid (IAA) 	Establish apical-basal polarity, induce vascular tissue development, mediate phototropism, promote formation of adventitious roots, inhibit leaf and fruit drop, and stimulate fruit development
Cytokinins	Zeatin 	Promote cell division, influence cell specialization and plant aging, activate secondary meristem development, promote adventitious root growth, and promote shoot development on callus
Gibberellins	Gibberellic acid 	Stimulate cell division and cell elongation, stimulate stem elongation and flowering, and promote seed germination
Ethylene	Ethylene 	Promotes seedling growth, induces fruit ripening, plays a role in leaf and petal aging and drop, coordinates defenses against osmotic stress and pathogen attack
Abscisic acid	Abscisic acid 	Slows or stops metabolism during environmental stress, induces bud and seed dormancy, prevents seed germination in unfavorable conditions, and promotes stomatal closing
Brassinosteroids	Brassinolide 	Promote cell expansion, stimulate shoot elongation, retard leaf drop, stimulate xylem development, and promote stress responses

Hormones

- chemical messengers that regulate plant growth
  - most transported in phloem tissue
  - all require an expenditure of energy on part of the plant (ATP) for transport
- interact with external environmental stimuli

Hormones control

- growth
- seed germination
- flowering
- fruiting
- shedding of leaves
- color change of leaves

Hormones of two broad categories

- growth inhibiting
  - mostly fall/winter
  - certain times of the year growth is not good
- growth promoting
  - mostly spring/summer

Auxins

- first group of plants hormones to be described
- growth promoting
- produced in
  - shoot tips, seeds, fruits, leaves, stem
  - NOT in the roots

Effects of auxin

Promotes

- cell elongation
- shoot elongation
- production of wood
- fruit development

Inhibits

- lateral bud development
- absission (falling off) of leaves, flowers, fruits

Cytokinins

- Originally detected in coconut "milk"
- growth promoting
- prodiced in
  - seed, fruits, roots

Effects of Cytokinins

Promotes

- cellular division

- named derived from Cytokenesis

Inhibits

- senesence
  - change of color due to breakdown of pigments

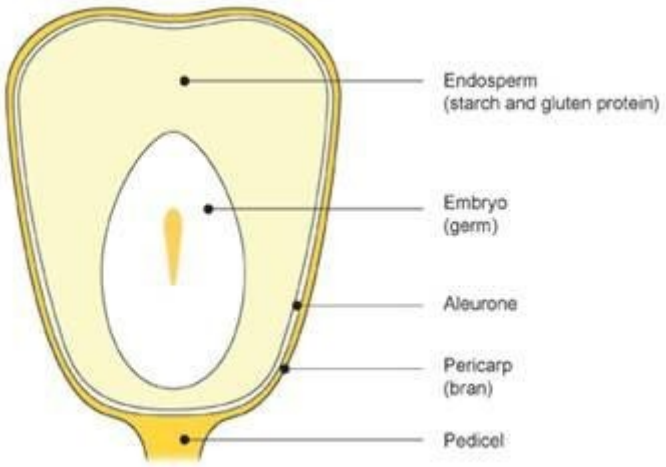
Gibberellins (giberellic acids)

- many types
  - >200
  - more than any other group
- growth promoting
- found throughout the plant but concentrated in seeds

Effects of Gibberellins

Promotes

- stem elongation by cell division and cell elongation



- intake of water causes swelling and embryo hydration
- embryo secretes gibberellins
- gibberellins transported to cells of aleurone layer to secrete enzyme
- (alpha-amaylase) for breakdown of endosperm (starchy stored food) to glucose
- embryo will respire glucose to produce ATP
- embryo is directing the timing of plant germination
- Advantage seed plants

Brassinosteriods

- growth promoting

Effects of Brassinosteriods

Promotes

- cell expansion
- shoot elongation
- xylem tissue development
- stress response

Inhibits

- leaf abscission

Abscisic Acids (ABA)

- Growth inhibiting
- found in large quantities in seeds. mature leaves, and dormant buds

Effects of ABA

Promotes

- senesence
- production of storage molecules in seeds

Inhibits

- cell elongation
- alpha-amaylase production

Ethylene

- growth inhibiting
- actually a gas produced by incomplete metabolism
- interacts with the 4 growth promoting hormones to determine cell size and shape

Effects of Ethylene

Promotes

- fruit ripening
- abscission of leaves, fruits, flowers

Seed germination

- requires breaking of dormancy
  - combination of internal and external factors

Internal

- hormones
- stored food
- H2O absorption
- embryo swelling

External

- sunlight
- temperature
- longer day light
- soil moisture

Generalized Seed

- Seed coat(s)
- as seed coat cracks
- Radical comes out first
  - then then shoot

Seedling

- result of cellular reproduction and increase size
- internal development
  - cells>tissues>organs>organism

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