PowerLecture:
Chapter 31
Plant Reproduction
Section 31.0: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 31.0: Pollinator Declines

Section 31.0: American Museum of Natural History—No More Chocolate?

Section 31.0: *Insect Pollination of Flowering Crop Plants* Online Book

- Section 31.0: The Chocolate Bug. Robb Walsh. *Natural History,* May 1997.

Section 31.0: In Search of a Bee Tree. Jack Hope. *Natural History,* Nov. 1998.

Section 31.0: Bees for Hire. Garry Hamilton. *Canadian Geographic,* July 2000.

How Would You Vote?

The following is the question for this chapter. See national results below.

Should we ban the use of pesticides that harm pollinators?

Impacts, Issues: Imperiled Sexual Partners

- Approximately 75% of all crop plants set more fruit and complete the life cycle with the help of pollinators, particularly bees, butterflies, flies, moths and beetles

- Dwindling populations of pollinators are a global problem

Impacts, Issues: Imperiled Sexual Partners

- Different bees are essential to the pollination of different plants

- Reducing pollinator populations causes flowering plants that rely on them to make less seeds

Section 31.1: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 31.1: The Secret Garden

Section 31.1: Flower Dissection & Lab Manual

Section 31.1: Flowers Are a Mine for a Spice More Precious than Gold (saffron). Diane Ward. *Smithsonian,* Aug. 1988.

Plants and Pollinators

- Pollen had evolved by 390 million years ago
  - Sperm packed inside a nutritious package
  - Transferred first by wind currents
  - Later transferred by insects
- Plants that attracted insect pollinators with flowers had a reproductive advantage

Angiosperm Life Cycles

Flower Structure

- Nonfertile parts
  - Sepals
  - Receptacle
- Fertile parts
  - Male stamens
  - Female carpel (ovary)

Kinds of Flowers

- Perfect flowers
  - Have both male and female parts
- Imperfect flowers
  - Are either male or female
  - Same plant may have both male and female flowers
  - Sexes may be on separate plants

Pollen Allergies

- Millions of people are genetically predisposed to overreact to certain kinds of pollen
- Symptoms include a runny nose, reddened and itchy eyelids, and sneezing

Section 31.2: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 31.2: Insect Pollinators

Section 31.2: Photographic Plant/Pollinator Database

Section 31.2: Pollination Adaptations

Section 31.2: On the Trail of a Scent. Annette Heist. *Natural History,* May 1999.

Section 31.2: Diversity Pays in Crop Pollination. C. Westerkamp et al. *Crop Science,* Sept. 2000.

Pollination

- Transfer of pollen grains to a receptive stigma
- Pollen can be transferred by a variety of agents
- When a pollen grain lands on the stigma it germinates

Pollinators

- Pollination vectors
  - Winds
  - Insects
  - Birds
  - Other animals

- Coevolution with pollinators

Pollinators
Pollinators

- Visual cues
  - Size, shape, color, pattern

- Olfactory cues
  - Odors from fruit or flowers
  - Pollinators follow concentration gradient of volatile chemicals to their sources

- Reinforcements
  - Nectar

Pollinators
Long Floral Tubes and the Hawkmoths
Section 31.3: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 31.3: Palynology Links & Education

Section 31.3: Laboratory of Pollen Biology

Section 31.3: Microscopic Views of Sexual Reproduction in a Lily

- Section 31.3: A "Shotgun Wedding" Finally Produces Test-Tube Plants. Billy Goodman. *Science,* July 23, 1993.

- Section 31.3: Pollen Germination as a Model System for Teaching. Robert Evans. *Bulletin of the New Jersey Academy of Science,* Spring 2003.

Pollen Formation

- Each anther has four pollen sacs
- Inside the pollen sacs, cells undergo meiosis and cytoplasmic division to form microspores
- Microspores undergo mitosis to form pollen grains

Pollen Formation

Egg Formation

- Meiosis in ovule produces megaspores
- All megaspores but one disintegrate
- It undergoes mitosis three times without cytoplasmic division
- Result is a cell with eight nuclei
- Division produces seven-celled female gametophyte
- One cell is egg, another will form endosperm

Double Fertilization

- A pollen tube grows down through the ovary tissue
- It carries two sperm nuclei
- When pollen tube reaches an ovule, it penetrates embryo sac and deposits two sperm
- One fertilizes the egg, other fuses with both nuclei of endosperm mother cell

Events inside Ovule

Endosperm Formation

- Occurs only in angiosperms
- Fusion of a sperm nucleus with the two nuclei of the endosperm mother cell produces a triploid (3*n*) cell
- This cell will give rise to the endosperm, the nutritive tissue of the seed

Stepped Art

Section 31.4: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 31.4: Fruit Identification Guide

- Section 31.4: Investigating Fruit (classroom activities). Danny McKenzie et al. *Science Activities,* Spring 1995.

Seeds and Fruits

- The seed is the mature ovule
- The fruit is the mature ovary

Seed Formation

- Fertilization of the egg produces a diploid sporophyte zygote
- The zygote undergoes mitotic divisions to become an embryo sporophyte
- Seed: A mature ovule, which encases an embryo sporophyte and food reserves inside a protective coat

Structure of a Seed

- Protective seed coat is derived from integuments that enclosed the ovule
- Nutritious endosperm is food reserve
- Embryo has one or two cotyledons
  - Monocot has one
  - Dicot has two

Nourishing the Embryo

- Dicot embryo
  - Absorbs nutrients from endosperm
  - Stores them in its two cotyledons
- Monocot embryo
  - Digestive enzymes are stockpiled in the single cotyledon
  - Enzymes do not tap into the endosperm until the seed germinates

Fruit: A Mature Ovary

- Simple fruit
  - Derived from ovary of one flower
- Aggregate fruit
  - Derived from many ovaries of one flower
- Multiple fruit
  - Derived from ovaries of many flowers
- Accessory fruit
  - Most tissues are not derived from ovary

Aggregate Fruits

- Formed from the many carpels of a single flower
- Made up of many simple fruits attached to a fleshy receptacle
- Blackberries and raspberries are examples

Multiple Fruits

- Formed from individual ovaries of many flowers that grew clumped together
- Examples:

- Pineapple
- Fig

Accessory Fruits
Accessory Fruits
Accessory Fruits
Accessory Fruits

Section 31.5: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 31.5: PBS—The Seedy Side of Plants
- Seed Dispersal by Water, Wind, Explosion, Animals …

- Section 31.5: Beyond Walden (excerpt from "The Dispersion of Seeds") Henry Thoreau. *The Sciences,* May–June 1993.

Section 31.5: Floaters (tropical seeds can cross oceans). Wayne Armstrong. *Sea Frontiers,* May–June 1994.

Seed Dispersal

- Fruit structure is adapted to mode of dispersal
- Some modes of seed dispersal:
  - Wind currents
  - Water currents
  - Animals

Section 31.6: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 31.6: Saguaro National Park—The Life Cycle of the Saguaro Cactus

- Section 31.6: Pollination of Cacti in the Sonoran Desert. Theodore Fleming. *American Scientist,* Sept. 2000.

Many Seeds, Few Fruits

- Saguaro plants produce many flowers with a low percentage of them giving rise to fruit. Why make this investment?

- One possibility is that the "excess" flowers are produced exclusively for pollen export

Saguaro

Saguaro

Saguaro

Section 31.7: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 31.7: Arizona Master Gardener Manual

Section 31.7: Plant Propagation Forum

Section 31.7: Plant Tissue Culture Information Exchange

- Section 31.7: Multiplying the Elite. C.B. Christie et al. *Agribusiness Worldwide,* Jan.–Feb. 1994.

Section 31.7: Learn How to Graft! Scott Meyer. *Organic Gardening,* Dec. 1993.

Section 31.7: Plant Roots as Chemical Factories ("hairy root" cultures). Hector Flores. *Chemistry and Industry,* May 18, 1992.

Asexual Reproduction

- New roots or shoots grow from extensions or fragments of existing plants
- Proceeds by way of mitosis
- All offspring are genetically identical (unless mutation occurs)

Natural Clones

- Forest of quaking aspen in Utah
  - 47,000 trees are genetically identical shoots
  - Roots are all interconnected
- Oldest known clone
  - Ring of creosote bushes in Mojave desert is 11,700 years old

Artificial Propagation

- New plant develops from cuttings or fragments of shoot systems
  - African violets and jade plants can be propagated from leaf cuttings
- Tissue-culture propagation
  - Tiny plant bits are grown in rotating flasks containing a liquid growth medium

Tissue Culture Propagation

Tissue Culture Propagation

Tissue Culture Propagation