Examining Sexual Reproduction of Flowering Plants

FLOWERING plants have come to dominate all other plants on Earth. One reason for their domination is their unique method of reproducing sexually. This unit will explore the sexual reproductive processes of flowering plants and what makes them special.

Objective:

Analyze sexual reproduction of flowering plants.

Key Terms:

cotyledons	gametes	pollination
cross-pollination	germination	polyploid
diploid	haploid	radicle
double fertilization	hybridization	seed
embryo	hybrids	seed coat
endosperm	hypocotyl	self-pollination
epicotyl	incompatibility	sexual reproduction
fertilization	plumule	zygote

Sexual Reproduction of Flowering Plants

Sexual reproduction of flowering plants is the result of the male sperm in the pollen uniting with the female egg in a flower. Most flowering plants reproduce in nature by sexual reproduction.

POLLINATION

The reproductive process begins with pollination. **Pollination** is the transfer of the male sperm carried in the pollen to the female part of a flower, the stigma. Plants rely on wind and water to transfer the pollen. In addition, plants depend on animals to help with pollination. Birds, insects, bats, and other animals are attracted to scented or brightly colored flowers. These animals transfer pollen from the anthers of the flowers they visit to the stigmas of other flowers.

FIGURE 1. Birds, insects, bats, and other animals are attracted to scented or brightly colored flowers.

When the pollen of a plant pollinates a flower on the same plant, the process is called **self-pollination**. Many plants can self-pollinate. A plant with genetic mechanisms that prevent its pollen from growing a pollen tube on a style of the same plant has a condition called **incompatibility**. When the pollen of a plant pollinates the flower on another plant of the same species, the process is called **cross-pollination.** Most floral crops today are the result of cross-pollination by plant breeders.

Once the pollen lands on the stigma, it grows a thin pollen tube down the style to the ovary. The cell within the grain of pollen divides to form two sperm nuclei. The sperm cells, or male **gametes**, travel down the pollen tube to an ovule that holds the egg. The female sex cell (the egg) is also a gamete.

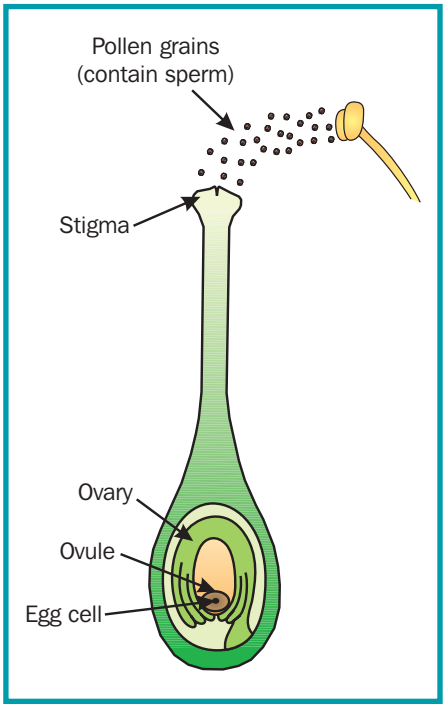

FIGURE 2. Pollination of a flower.

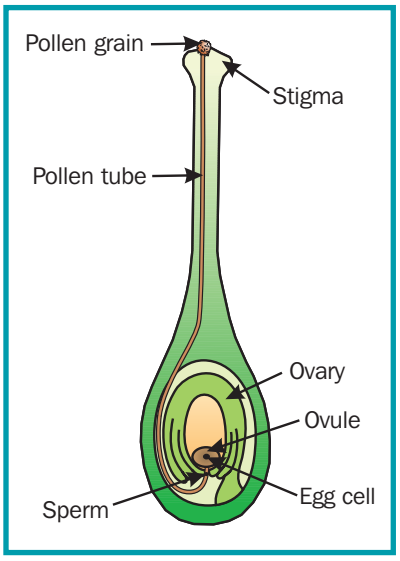

FIGURE 3. Fertilization of a flower.

FERTILIZATION

Fertilization is the fusion of a sperm with an egg. Both the sperm and the egg are **haploid**, meaning they contain a single set of chromosomes. Fertilization unites the single set of chromosomes in the sperm nucleus with the single set of chromosomes in the egg nucleus. This enables the fertilized egg, or zygote, to have a complete pair of chromosomes. A cell with two sets of chromosomes is termed **diploid**.

Many grasses and flowering plants have three or more sets of chromosomes. They are called **polyploid**. Plants with extra sets of chromosomes are typically larger and more vigorous than diploid members of the same species.

Double Fertilization

In flowering plants, fertilization is unlike that of any other living organism. Pollen of a flowering plant contains two sperm nuclei. Both sperm nuclei from the pollen grain are involved in fertilization. This fertilization process is actually a **double fertilization**.

The first fertilization occurs when one of the sperm fuses with the egg. The resulting **zygote** contains genetic material from both the male and female parts of a flower. Through cellular division, the zygote becomes the **embryo**, or immature plant.

In the second fertilization, the other sperm nucleus fuses with two polar nuclei in the ovule. The combination of the three nuclei makes a triploid cell that multiples by mitosis. It eventually develops into the endosperm. The **endosperm** is food storage tissue in the seed, which is used by the embryo.

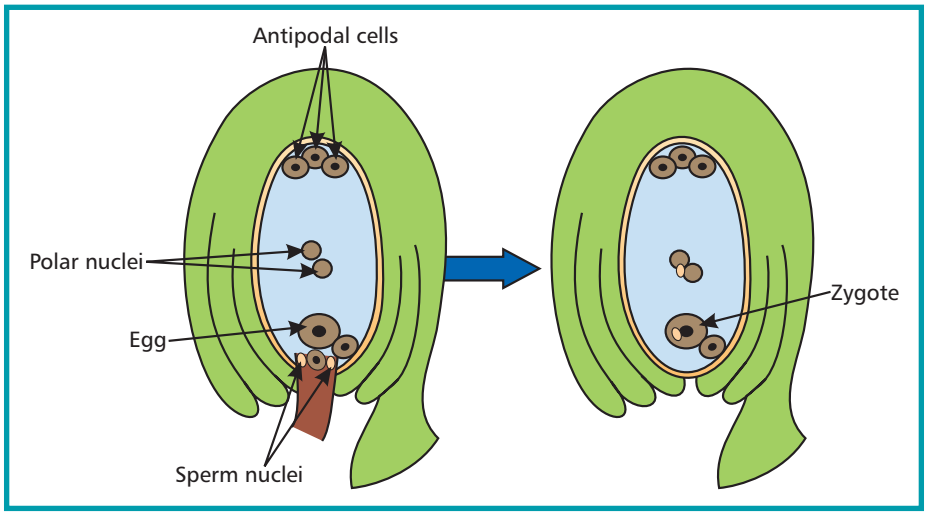

FIGURE 4. One sperm nucleus fertilizes the egg, and the other sperm nucleus fuses with the polar nuclei.

Following fertilization, the ovule develops into a **seed**. The seed contains the embryo plant and stored food. The ovary ripens and becomes the fruit. Fruit serves the purpose of protecting seeds from drying. It also aids in the dispersal of seeds.

Hybridization

Together the sperm and the egg contribute genetic information to the new embryo plant. The union of sperm and egg results in new combinations of genetic information. These combinations produce new traits that add to the vigor of the offspring. The offspring that result from the new combinations of genes are known as **hybrids**.

People have greatly improved horticultural crops through **hybridization**. Most flower and plant varieties used in the floriculture industry today are the result of cross-pollination by plant

breeders. Plant breeders select plants for outstanding characteristics, such as flower color and disease resistance. Then, they collect pollen from one plant and transfer it to the flower of another. Their desire is to have the outstanding characteristics expressed in the offspring.

THE SEED

A seed is a living entity that serves as a bridge between generations of a plant. The seed is formed in the pistil of the flower and develops from the ovule following fertilization. It consists of an embryo, stored food, and a seed coat.

As the fertilized egg, or zygote, grows and develops, it becomes the embryo of the seed. The embryo is an immature plant held in a dormant, or resting, phase inside the seed. It has a stem, a root, and one or two seed leaves called **cotyledons**. Dicot plants, such as soybean, pea, and oak, have two cotyledons, or seed leaves, in their seed. Monocot plants, such as corn, Kentucky bluegrass, and lilies, have one cotyledon in their seed.

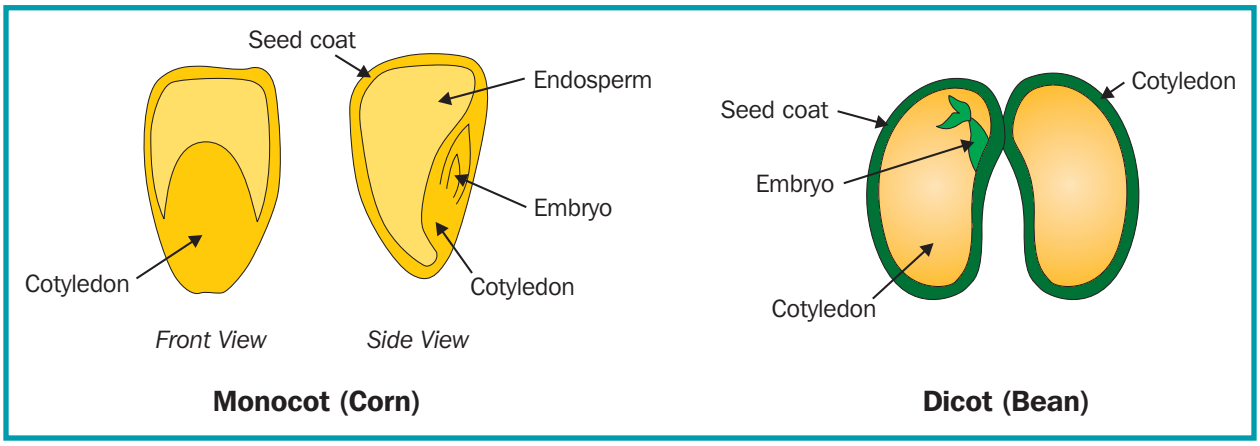

FIGURE 5. The major parts of seeds are common to dicots and monocots.

The embryonic root is called the **radicle**. It forms the first root of the plant and is the first structure to emerge as germination begins. The portion of the embryonic stem below the attachment of the cotyledon(s) is the **hypocotyl**. It develops into the true stem. The portion of the embryonic stem above the attachment of the cotyledon(s) is the **epicotyl**. The epicotyl develops into a pair of small leaves. The tip of the epicotyl may also be known as the plumule. The **plumule** is the terminal bud of the first shoot to emerge from the seed.

The seed contains stored food to support the development and growth of the embryo. This food is stored in the area of the seed known as either the endosperm or the cotyledons. A monocot plant stores the bulk of its energy in the endosperm. A dicot plant stores its food in the two cotyledons. When germination begins, the embryo draws energy from the stored food to emerge from the soil and to develop leaves. Once the leaves have developed, the seedling can manufacture its own food.

The seed has a protective shell called a **seed coat**. It protects the embryo and the endosperm from drying and from physical injury. The seed coat also plays an important role in determining when outside conditions are right for **germination**, the beginning of growth.

Summary:

Sexual reproduction of flowering plants is the result of the male sperm in the pollen uniting with the female egg in a flower. Pollination is the transfer of the male sperm carried in the pollen to the female part of a flower, the stigma. Fertilization is the fusion of a sperm with an egg. The fertilization process of flowering plants is a double fertilization.

A seed consists of an embryo, stored food, and a seed coat. The embryo is an immature plant held in a dormant, or resting, phase inside the seed. It has a stem, a root, and one or two seed leaves called cotyledons. The embryonic root is called the radicle. The portion of the embryonic stem below the attachment of the cotyledon(s) is the hypocotyl. The portion of the embryonic stem above the attachment of the cotyledon(s) is the epicotyl. The seed contains stored food to support the development and growth of the embryo. This food is stored in the area of the seed known as either the endosperm or the cotyledon. The seed has a protective shell called a seed coat.

Checking Your Knowledge:

1. What is sexual reproduction of flowering plants?
2. What is pollination?
3. What is double fertilization?
4. What are the major parts of a seed?
5. How do monocot and dicot seeds differ?

Expanding Your Knowledge:

Gather different types of fruit, such as an apple, a pear, a pumpkin, and a tomato. Examine the fruit and determine where the flower petals were located. Slice each fruit in half and note the location of the seed(s). Carefully, slice open a seed and look for the embryo and cotyledon(s).

Web Links:

Double Fertilization
http://bcs.whfreeman.com/thelifewire/content/chp39/3902001.html

Parts of a Seed
http://www.theseedsite.co.uk/seedparts.html

What Is Pollination?
http://www.pollinatorparadise.com/what_is_pollination.htm

Agricultural Career Profiles
http://www.mycaert.com/career-profiles