SCIENCE 704
MOLECULAR GENETICS

CONTENTS

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I. REPRODUCTION

In the following section you will study the parts of a flower. This study will give you a better understanding of flowers in relation to **reproduction** in plants. It will also help you to understand some of the experiments conducted by Gregor Mendel, the father of **genetics**. You will also study male-female reproduction, which is accomplished by means of special cells called sperm and egg.

Without reproduction, life would soon end. Life continues from generation to generation only as living things give rise to other living things that will replace their parents.

SECTION OBJECTIVES

□ **Read these objectives.** When you have completed this section, you should be able:

1. To describe the reproductive structures of flowers in relation to inheritance in plants.
2. To describe male-female reproduction and how the reproductive cells undergo reduction division.

□ **Restudy these words.**

anther	genes	pistil	sperm cell
chromosome	genetics	pollen	stamen
cross-pollination	germination	receptacle	stigma
egg cell	mitosis	reduction division	style
embryo	nucleus	reproduction	trait
fertilization	ovary	self-pollination	
filament	ovule	sepal	

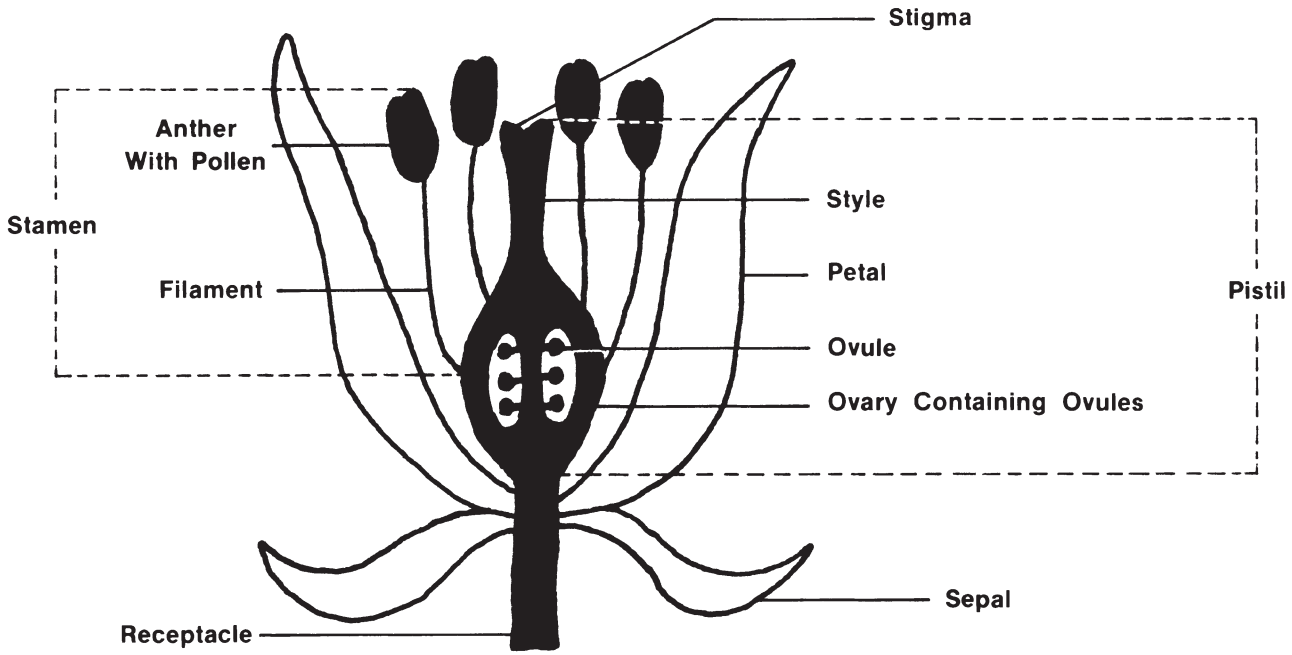
REPRODUCTION IN FLOWERS

Flowers form seeds which will reproduce the plant. The seed carries all of the information about the plant within the tiny plant **embryo**. When the tiny plant begins to **germinate**, it will carry the characteristics of its plant parents. This information is all coded and directed within its cells.

Study the drawing of the structure of the flower. Refer to the vocabulary list. Be sure you can define and locate each part of the flower. This knowledge of flower parts will help you understand **reproduction** in plants.

Explanation. Some plants are **self-pollinated**. That is, the **stigma** receives the **pollen** produced within its own flower. In some cases plants receive pollen from other plants; this process is called **cross-pollination**.

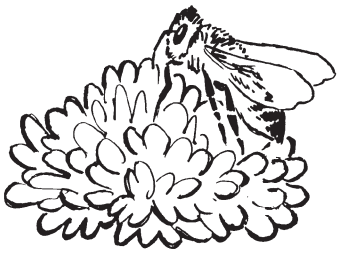
The narrow **filaments** topped by **anthers** form the **stamens** of the flower. When the pollen grain from an anther lands on the stigma, it usually sticks to it because of the sweet plant juices. The presence of sugar makes the pollen grains grow pollen tubes. Some kinds of pollen require weak sugar to make them grow, others require strong sugar before they will grow tubes. This requirement varies from one kind of plant to another.



When the pollen grain lands on the stigma and begins to grow a tube, the pollen tube grows down the **style** to the **ovary**. Each pollen grain contains a reproductive cell known as a **sperm cell**. The sperm cell will go down the tube and unite with an **egg cell** in the ovary. When the egg cell and sperm cell unite, this union is called **fertilization**. This fertilized egg will make many new cells and will grow into a tiny plant embryo. The embryo is located in the **ovule** (note drawing of flower). After fertilization, the ovule grows into a seed. The plant embryo usually remains in the seed until it is planted in the soil. The stigma, style, ovule, and ovary all make up the part of the flower called the **pistil**.

After fertilization, the ovary surrounding the ovule continues to grow and develop into a fruit that includes the seeds. For example, we eat the part of the apple that develops from the ovary and surrounds the seeds.

Examination. Grains of pollen can be scraped off the flower and examined with a magnifying glass. The magnifying glass will also enable you to examine the stigma, the **sepals**, the **receptacle**, the anther, the style, and the ovary. When the ovary is sliced open, the magnifying glass will enable you to count the ovules inside the ovary.



POLLINATION AND HONEYBEES

Most fruits and vegetables and many field crops are formed only as pollen is carried from plant to plant. The most important pollen carriers are the honeybees. As the bees dart from one flower to another in search of nectar and pollen, some pollen clings to their bodies and is thus scattered from one plant to another.

The honeybee is even more important as a pollinator than as a honey producer. For indeed, without pollination, carried on primarily by the honeybee, there would be no fruit, no seed, and no food for the future.

Complete this investigation.

These supplies are needed:

magnifying glass	toothpick
black paper or very dark material	fresh flower
sharp knife (scalpel)	

Perform the following examinations and answer the questions. Refer to the diagram of the structure of the flower as you work.

1. Use the toothpick to scrape off some pollen.
2. Examine it with a hand lens. Place the pollen on black paper for better viewing.

△1.1 What is the shape of the pollen? _____

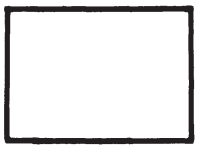
△1.2 What color is the pollen? _____

△1.3 Does the pollen have any markings, creases, folds, etc.? _____

○1.4 How many sepals does the flower have? Check the drawing for location. _____

○1.5 How many petals are there? _____

1.6 Sketch the shape of the top of the stigma.



1.7 Locate the stalk of the flower. The stalk which holds the flower is called the _____ (compare diagram of flower).

○1.8 Locate the filament (the stalklike structure which holds the anther). Does the filament with the anther rise above the stigma? _____

○1.9 If the pollen is located above the stigma, the flower is generally self-pollinated. If the pollen is below the stigma, the flower is generally cross-pollinated. Based on this information, is your flower self-pollinated or cross-pollinated? _____

○1.10 The style is a structure which extends from the ovary to the stigma. Is the style long or short? _____

○1.11 The ovary is located at the base of the flower. Use a knife to slice open the ovary. Slice off small pieces at a time. Feel and taste the sticky substance on the stigma as you cut the flower apart.

a. Do you find ovules inside the ovary? _____

b. How many? _____

MALE-FEMALE REPRODUCTION

Most multicellular plants and animals reproduce themselves by a process called male-female reproduction. In male-female reproduction there are special cells called sperm and egg. The sperm cell from a male parent and an egg cell from the female parent join together. This process begins a new life. In the previous discussion on plants, the uniting of a sperm cell from the pollen grain with the egg cell of the ovule is an example of male-female reproduction in plants. The little plant embryo will develop within the seed and will receive **traits** from both the male parent and the female parent.

Mitosis. Cells reproduce themselves by splitting apart to form two new cells. This splitting apart to form new cells is called **mitosis**. You began life as one cell. You now have many more cells than when you were a baby. By the process of mitosis you may have about 100 trillion cells by the time you are an adult. This type of cell division occurs when organisms grow larger and when worn out cells are replaced. The process of mitosis also replaces cells when plant, animal, or human cells are damaged in any way. The two new cells formed by mitosis are smaller than the one big cell from which they came. Yet they are exactly like it.

The **nucleus** of the cell controls cell activity, especially cell division. The nucleus contains the **chromosomes**. Located on the chromosomes are **genes** that carry information about traits. When new cells are made by mitosis, they receive the same number of chromosomes (with genes) as the original cell. Since the new little cells have the same number of chromosomes and genes, all of the traits are carried into the new cells that are made by mitosis.

Reduction division. In addition to mitosis, there is another kind of cell division known as **reduction division**. Reduction division is a special type of cell division that occurs in reproductive cells. Reduction division occurs in the reproductive cells of plants and animals which reproduce themselves by male-female reproduction. When new reproductive cells are formed by this special reduction division, the chromosome material is reduced to half. Chromosomes normally occur in pairs. Thus, they are reduced so that the reproductive cell gets only one of each pair. When the sperm and egg are joined together, the new individual that results from the joining will be restored to the original number.

In this illustration you will find out how reduction division works. The garden pea has fourteen chromosomes. When the pollen is being formed, special reproductive cells become the sperm cells. The sperm cell will undergo reduction division and will have only seven chromosomes. Likewise, the egg will undergo reduction division and will have only seven chromosomes. When the sperm from the pollen unites with the egg, it will be restored to the original fourteen chromosomes which are characteristic of the garden pea. The little embryo which will develop within the seed will have this constant number of chromosomes. The genes which are carried on the chromosomes are partially from the male parent and partially from the female parent.

Other plants may have more or less than 14 chromosomes. But regardless of a plant's chromosome number, the number of chromosomes will be reduced to half of the original number during reduction division in the reproductive cells.

Read Genesis 1:11, 12, 21, 24 and 25.

a. How many times does "after his kind" or "after their kind" appear in these verses? _____

b. Memorize Genesis 1:12 and write it from memory. _____

_____

_____

_____

Say this verse to someone.

Try this experiment. EXAMINATION OF THE PLANT EMBRYO

These materials are needed:

lima beans soaked overnight in water

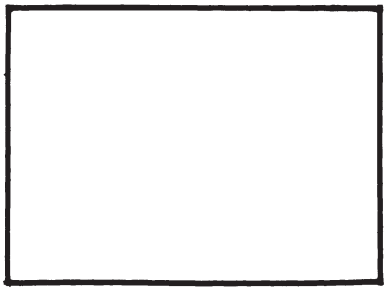
hand lens

Follow these directions.

1. First locate the point where the bean was attached to the pod. You will find the embryo on the same side that the bean was attached. DO NOT OPEN THIS SIDE OF THE SEED.
2. Take your thumbnail and open the opposite side from where the bean has been attached to the pod. You can slip your thumbnail between the two halves. The bean opens readily if it has been soaked.
3. Observe with a magnifying glass. Note the tiny embryo.

1.13 Can you see very small leaves on the embryo? _____ Notice also where the root will form.

1.14 In the space provided sketch the opened halves of a bean with the embryo. Label the drawing.



○1.15 On the basis of reduction division in male-female reproduction, explain in your own words how the little embryo was formed. _____

_____

_____

_____