UNIVERSITY OF SWAZILAND
FACULTY OF EDUCATION
DEPARTMENT OF CURRICULUM AND TEACHING
FINAL EXAMINATION QUESTION PAPER, MAY 2007

TITLE OF PAPER	:	**CURRICULUM STUDIES IN BIOLOGY I**
COURSE CODE	:	**EDC 278**
STUDENTS	:	**BEd. II, PGCE**
TIME ALLOWED	:	**THREE (3) HOURS**

INSTRUCTIONS:

1.This examination paper has six (6) questions. Answer any four (4) questions

2. Each question has a total of 25 points. The number of points for each sub-question, where it exists, is indicated in parentheses

3. There is an attachment (Mackean, D. G., 2001) for one question only

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1. Scientific knowledge is distinct from any other type of knowledge because it meets the criterion of testability and verifiability. In addition, it should meet the requirements of description, explanation, prediction and understanding. Explain. [25]

2 Medawar suggests that the scientific paper may be a fraud. Discuss. [25]

3. Select a topic in Biology. Illustrate how the topic can be used in an inquiry based discussion in a Form IV biology class. [25]

4. The National Science Education Standards suggests several inquiry skills that high school graduates should have mastered and be able to demonstrate in a new experiment. Discuss any five inquiry skills and for each one give an illustration from any biology topic. [25]

5. You are preparing to teach an inquiry lesson on fertilization in flowering plants to a Form IV Biology class. You may refer to the attachment (Mackean, D. G. 2001).

   i) Explain how the lesson could be taught using the following instructional strategies:
   a) Questioning, and
   b) Group work and cooperative learning
   [9, 9]

   ii) For each technique in i) identify the science process skills you would aim to develop. [7]

6. Research findings indicate that the impact formative assessment has on learning surpasses that of any documented type of educational intervention. Explain. [25]

QUESTIONS

4 Put the following events in the correct order for pollination in a wallflower plant: **a** bee gets dusted with pollen, **b** pollen is deposited on stigma, **c** bee visits older flower, **d** bee visits young flower, **e** anthers split open.
5 Which of the following trees would you expect to be pollinated by insects: apple, hazel, oak, cherry, horse-chestnut, sycamore?
6 In what ways do you think **a** an antirrhinum flower, **b** a nasturtium flower are adapted to insect pollination?
7 In the course of evolution, some flowers may have become adapted to pollination by certain insect species. Discuss whether the insects are likely to have become adapted to the flowers. What sort of adaptation might you expect?
8 Draw up a table to contrast the features of a typical insect-pollinated flower with those of a typical wind-pollinated flower. Include features such as petals (or their equivalent), structure and position of anthers and stigmas, pollen and nectar.

Fertilization and fruit formation

Pollination is complete when pollen from an anther has landed on a stigma. If the flower is to produce seeds, pollination has to be followed by a process called **fertilization**. In all living organisms, fertilization happens when a male sex cell and a female sex cell meet and join together (they are said to **fuse** together). The cell which is formed by this fusion is called a **zygote** and develops into an embryo of an animal or a plant (Fig. 10). The sex cells of all living organisms are called **gametes**.

In animals, the male gamete is the sperm and the female gamete is the egg or ovum (p. 150).

In flowering plants, the male gamete is in the pollen grain; the female gamete, called the **egg cell**, is in the ovule. For fertilization to occur, the nucleus of the male cell from the pollen grain has to reach the female nucleus of the egg cell in the ovule, and fuse with it. The following account explains how this happens.

Fertilization

The pollen grain absorbs liquid from the stigma and a microscopic **pollen tube** grows out of the grain. This tube grows down the style and into the ovary where it enters a small hole, the **micropyle**, in an ovule (Fig. 11). The nucleus of the pollen grain travels down the pollen tube and enters the ovule. Here it combines with the nucleus of the egg cell. Each ovule in an ovary needs to be fertilized by a separate pollen grain.

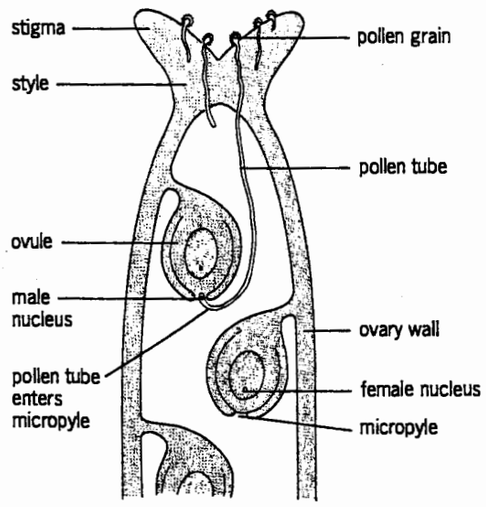


Figure 11 Diagram of fertilization, e.g. wallflower

Although pollination must occur before the ovule can be fertilized, pollination does not necessarily result in fertilization. A bee may visit many flowers on a Bramley apple tree, transferring pollen from one flower to the other. The Bramley, however, is 'self-sterile'; pollination with its own pollen will not result in fertilization. Pollination with pollen from a different variety of apple tree, for example a Worcester, can result in successful fertilization and fruit formation.

Fruit and seed formation

After the pollen nucleus has fused with the egg nucleus, the egg cell divides many times and produces a miniature plant called an **embryo**. The embryo consists of a tiny root and shoot with two special leaves called **cotyledons**. In dicot plants (p. 294) food made in the leaves of the parent plant is carried in the phloem to

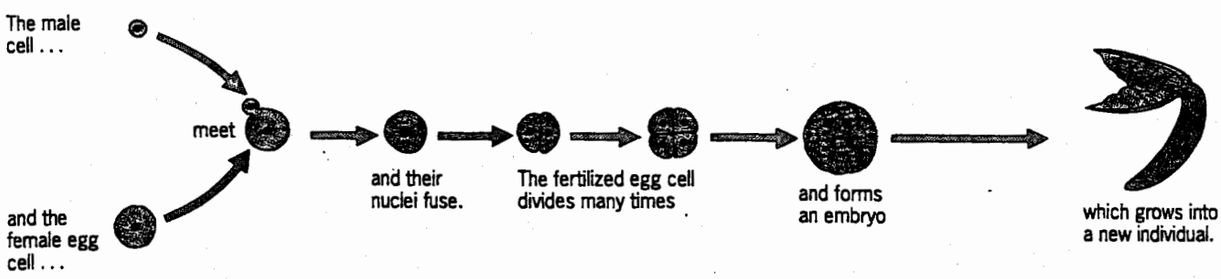
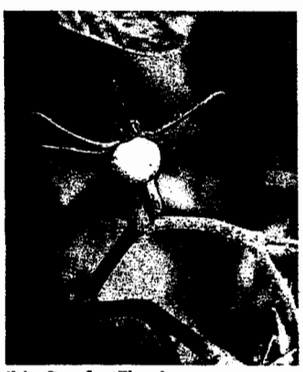


Figure 10 Fertilization. (a) The male cell and the female egg cell meet and their nuclei fuse (b). (c) The fertilized egg cell divides many times and forms an embryo which grows into a new individual (d).

the cotyledons. The cotyledons grow so large with this stored food that they completely enclose the embryo (Fig. 1, p. 83). In monocot plants (p. 294) the food store is laid down in a special tissue called endosperm (p. 85) which is outside the cotyledons. In both cases the outer wall of the ovule becomes thicker and harder, and forms the seed coat or **testa** (see p. 83).

(a) tomato flowers
The petals of the older flowers are shrivelling.



(b) after fertilisation
The petals have dropped and the ovary is growing.

(c) ripe fruit
The ovary has grown and ripened. The green sepals remain and the dried stigma is still attached.

Figure 12 Tomato; fruit formation

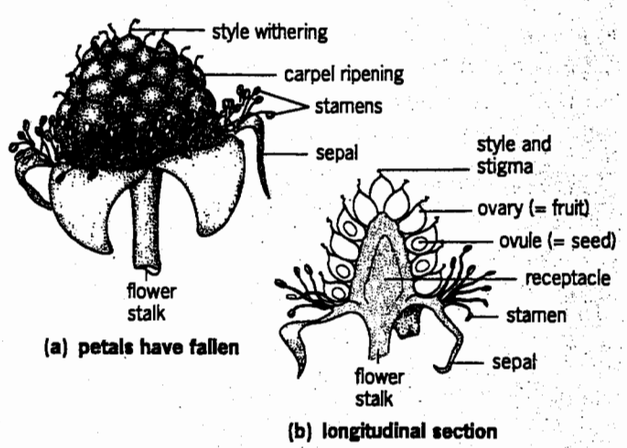


Figure 14 Blackberry; fruit formation

As the seeds grow, the ovary also becomes much larger and th petals and stamens shrivel and fall off (Figs 12(b) and 13). Th ovary is now called a **fruit**. The biological definition of a fruit is fertilized ovary; it is not necessarily edible. The wallflower ova forms a dry capsule.

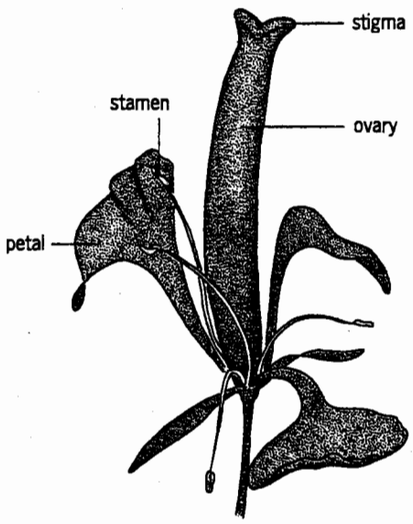


Figure 13 Wallflower. As the ovary grows, the petals, sepals ar stamens shrivel and fall off.

Figure 15 Blackberry flowers and fruits. Most of the flowers have been pollinated and fertilized. The petals have dropped and the carpels are growing to form fruits.

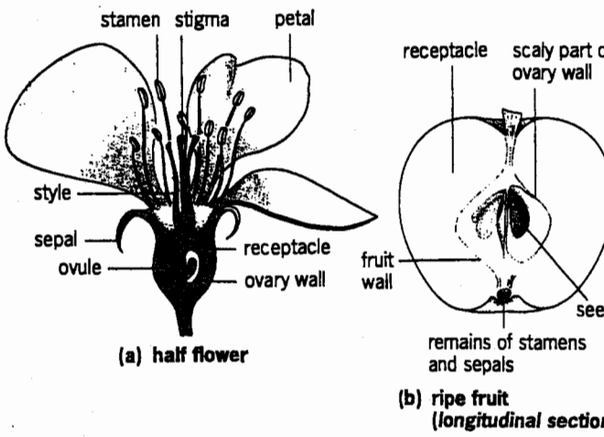


Figure 16 Apple; fruit formation

A plum is a good example of a fleshy, edible fruit. Tomatoes (Fig. 12) and cucumbers are also fruits although they are classed as vegetables in the shops. Blackberries (Figs 14 and 15) and raspberries are formed by many small fruits clustered together. In the apple (Fig. 16) and pear the edible part consists of the swollen receptacle surrounding and fused to the ovary wall.

QUESTIONS

9 Which structures in a flower produce **a** the male gametes, **b** the female gametes?

10 In not more than two sentences, show that you understand the difference between pollination and fertilization.

11 In flowering plants, **a** can pollination occur without fertilization, **b** can fertilization occur without pollination?

12 Which parts of a tomato flower **a** grow to form the fruit, **b** fall off after fertilization, **c** remain attached to the fruit?

13 Which of the following edible plant products do you think are, biologically, **a** fruits, **b** seeds, **c** neither: runner beans, peas, grapes, baked beans, marrow, rhubarb, tomatoes?

Dispersal of fruits and seeds

When the seeds are mature, the whole fruit or the individual seeds fall from the parent plant to the ground and the seeds may then germinate (p. 84). In many plants, the fruits or seeds are adapted in such a way that they are carried a long distance from the parent plant. This reduces competition for light and water between members of the same species. It may also result in plants growing in new places. The main adaptations are for dispersal by the wind and by animals but some plants have 'explosive' pods that scatter the seeds.

In the wallflower, the fruit splits open from the bottom (Fig. 17(b)), exposing the seeds, which remain attached to a central septum. When the wind shakes the plant, the seeds become detached from the septum and are scattered, though not very far, away from the parent plant.

Wind dispersal

'Parachute' fruits and seeds

Clematis, thistles, willow herb and dandelion have seeds or fruits of this kind. Feathery hairs project from the fruit or seed and so increase its surface area. As a result, the seed 'floats' over long distances before sinking to the ground. It is, therefore, likely to be carried a long way from the parent plant by slight air currents.

'Winged' fruits

Fruits of the sycamore (Fig. 17(e)) and ash trees have wing-like outgrowths from the ovary wall, or leaf-like structures on the flower stalk. These 'wings' cause the fruit to spin as it falls from the tree and so slow down its fall. This delay increases the chances of the fruit being carried away in air currents.

'Explosive' fruits

The pods of flowers in the pea family, e.g. gorse, broom, lupin and vetches, dry in the sun and shrivel. The tough fibres in the fruit wall shrink and set up a tension. When the fruit splits in half down two lines of weakness, the two halves curl back suddenly and flick out the seeds (Fig. 17(c)).

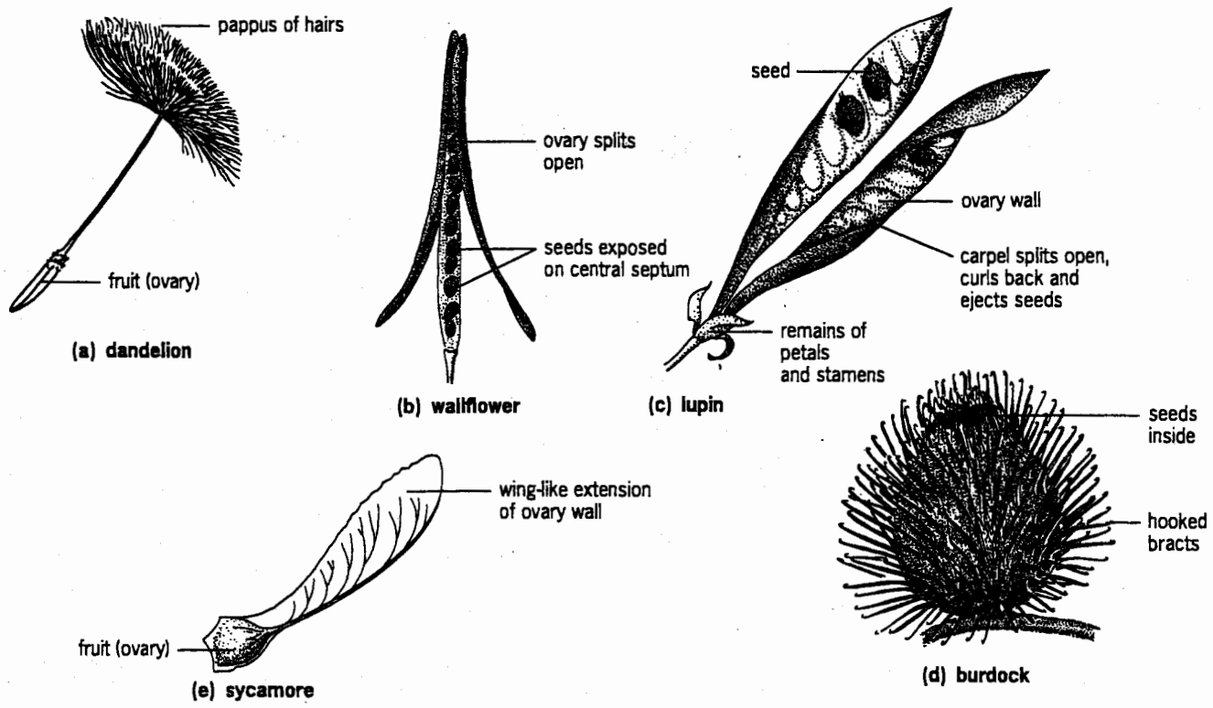


Figure 17 Fruit and seed dispersal