# Post-Fertilisation : Structures & Events

## 1 Mark Questions

**1.Banana is a true fruit but is also a parthenocarpic fruit. Give reason.[Foreign 2010]**

**Ans.**The fruit of banana is formed from the ovary, so it is a true fruit. It is a parthenocarpic fruit because the ovary develops into fruit without fertilisation and is thus, seedless.

**2.Why is apple referred to as a false fruit? [HOTS; All India 2010 C]**

**Ans.**In apple, the thalamus also contributes to fruit formation. So, apples are called false fruits.

**3.Name the mechanism responsible for the formation of seed without fertilisation in angiosperms. Give an example of a species of flowering plants with such seed formation. [Delhi 2010]**

**Ans.**Apomixis is the mechanism responsible for the formation of seeds without fertilisation in angiosperms, e.g. grasses.

**4.Name the part of flower that contributes to fruit formation in strawberry and guava respectively.[All India 2009 C]**

**Ans.**(i)In strawberry, the fruit develops from the ovary, other floral parts degenerate and fall off. Thalamus also contributes to fruit formation.

(ii)In guava, the wall of ovary develops into the wall of fruit called pericarp.

## 2 Marks Questions

**5.List the post-fertilisation events in angiosperms.[Delhi 2014]**

**Ans**.The post-fertilisation events in angiosperms include:

(i)Endosperm and embryo development.

(ii)Maturation of ovule into seed.

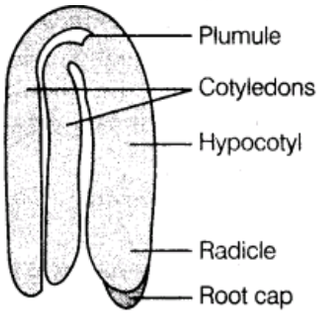
(iii)Maturation of ovary into fruit

**6.Some angiosperm seeds are said to be 'albuminous', whereas few others are said to have a perisperm, Explain each with the help of an example. [Foreign 2012]**

**Ans**.Some angiospermic seeds are albuminous as they retain endosperm even after embryo development, i.e. not completely consumed by embryo, e.g. wheat, maize, castor.While in some angiospermic seeds remnants of nucellus are persistent which is referred to as perisperm, e.g. black pepper and beet.

**7.Draw a labelled diagram of a matured embryo of a dicotyledonous plant.[All India 2014 C]**

**Ans.**The labelled diagram of a mature embryo of a dicotyledonous plant is as given below.



A typical dicot embryo

**8.Differentiate between albuminous and non-albuminous seeds, giving one example of each. [Delhi 2011]**

**Ans.** Difference between albuminous and non-albuminous seeds are:

| Albuminous seed | Non-albuminous seed |
|---|---|
| Endosperm is not completely used by the developing embryo, so a portion of it remains in the seed. | Endosperm is completely used by the developing embryo before the maturation of seed, so there is no endosperm left in the seed. |
| Examples coconut, castor and maize. | Examples pea, bean and mustard. |

**9.Banana is a parthenocarpic fruit, whereas oranges show polyembryony. How are they different from each other with respect to seeds? [hots; Delhi 2009]**

**Ans.**Since, banana is a parthenocarpic fruit, it is seedless, whereas oranges show polyembryony that leads to formation of many seeds

**10.Name the cell from which the endosperm of coconut develops. Give the characteristic features of endosperm of coconut. [Delhi 2009]**

**Ans.**In cpconut, cell formation occurs and the endosperm becomes cellular. The number of free nuclei formed before cellularisation varies greatly. The coconut water is free nuclear endosperm. It is made up of thousands of nuclei and the surrounding white kernel is the cellular endosperm.

**11.Name the blank spaces A, B, C and D from the table given below.**

| Item | What it represents in the plant |
|---|---|
| Pericarp | *A* |
| *B* | Cotyledon in seeds of grass family |
| Embryonal axis | *C* |
| *D* | Remains of nucellus in a seed |

**Ans.**A — Fruit wall, B — Scutellum
C — Plumule and radicle, D — Perisperm

## 3 Marks Questions

**12.Describe endosperm development in angiosperm. [Foreign 2014]**

**Ans.**(i)Embryo development occurs after endosperm development in angiosperms.
(ii) The three methods of endosperm development are:
(a)nuclear type (b) cellular type
(c)helobial type
(iii) Nuclear type is the common method in which triploid Primary Endosperm Nucleus (PEN) undergoes repeated mitotic division without cytokinesis. This stage is called free-nuclear endosperm.
(iv)Cell wall formation starts from the periphery and the endosperm becomes completely cellular, e.g. coconut, rice, etc.
(v)Cells of the endosperm store food materials.
(vi)Endosperm may be completely utilised by the developing embryo before the maturation of seeds as in pea, bean, mustard, etc. These seeds are called non-albuminous or endospermic seeds.
(vii) In seeds like castor, maize, coconut, rice, etc., a portion of it may remain in the mature seeds, such seeds are called albuminous or endospermic seeds

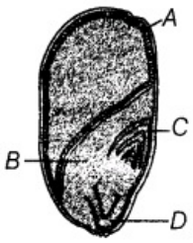
**13.(i) How is apomixis different from parthenocarpy?**
**(ii) Describe any two modes by which apomictic seeds can be produced.[Delhi 2014 C]**
**Ans**.(i)Parthenocarpy is development and production of seedless fruits in the absence of fertilisation, whereas apomixis refers to development of seeds and fruits, without fertilisation. So, the main difference between apomixis and parthenocarpy is that seeds are formed in former, while absent in later.
(ii) The two modes by which apomictic seeds can be produced are:
(a)**Agamospermy** In which the seed or embryo is derived from diploid egg ceil, formed without meiosis and syngamy. This diploid egg cell develops into embryo without undergoing fertilisation, e.g. apple,
(b)**Adventive embryony** The method in which diploid cells surrounding the embryo sac, e.g nucellus and integument protrude into the sac and develops into embryo. This may also lead to formation of more than one embryos in an embryo sac or ovule, leading to condition called polyembryony, e.g. Citrus,Opuntia.

**14.(i) Describe the endosperm development in coconut.**
**(ii)Why is tender coconut considered as healthy source of nutrition?**
**(iii)How are pea seeds different from castor seeds with respect to endosperm? [All India 2013]**
**Ans**.(i)Coconut endosperm formation is nuclear type. The primary endosperm nucleus undergoes nuclear division without cell wall formation.
(ii) Soft coconut is an endosperm. It is rich in nutrients like fats, proteins, carbohydrates, minerals, vitamins, etc. Hence, it is considered as a healthy source of nutrition.
(iii)The seeds of pea are non-endospermic, while castor seeds are endospermic. The endosperm in pea seeds is consumed completely during embryo development, but endosperm is not utilised in castor seeds.

15.Differentiate between perisperm and endosperm giving one example of each. [All India 2012]
**Ans.**

| Perisperm | Endosperm |
|---|---|
| It represents persistent remains of nucellus (of ovule) in the seed. | It develops from Primary Endosperm Nucleus (PEN). |
| It is a part that belongs to seed. | It contains reserve food materials. |
| It is usually dry. | It is usually in fluid form or soft. |
| Example black pepper. | Example water of coconut, pea, beans. |

**16.LS of a maize grain is given below. Label the parts A, B, C and D in it. [All India 2012]**




**Ans**.A — Pericarp
B — Scutellum (cotyledon)

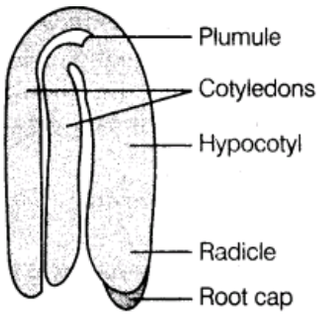
C — Coleoptile
D — Coleorhiza

**17.With the help of an example of each explain the following Apomixis, parthenocarpy, polyembryony. [All India 2012 c]**
**Ans.Apomixis** The phenomenon in which seeds are produced without fertilisation is called apomixis or agamospermy, e.g. grass.
**Parthenocarpy** It is a commercially important process in which seedless fruit is formed without fertilisation, e.g. banana.
**Polyembryony** The occurrence of more than one embryo in a seed is known as polyembryony, e.g. orange.

**18.Fertilisation is essential for the production of seed, but in some angiosperms seeds develop without fertilisation.**
**(i)Give an example of an angiosperm that produces seeds without fertilisation. Name the process.**
**(ii)Explain the two ways by which seeds develop without fertilisation.[All India 2009]**
**Ans.**(i)The members of Asteraceae like sunflower produce seeds without fertilisation. The process is called apomixis.
(ii) The two ways by which cells develop without fertilisations are:
(a)A diploid egg cell is formed without meiosis and it develops without fertilisation into an embryo in some cases.
(b)In some cases, some of the cells of nucellus around the embryo sac develop into embryo, e.g. mango and citrus.

## 5 Marks Questions

**19.(i) Explain the different ways apomictic seeds can develop. Give an example of each.**
**(ii)Mention one advantage of apomictic seeds to farmers.**
**(iii)Draw a labelled mature stage of a dicotyledonous embryo.[All India 2014]**
**Ans.**(i) The two modes by which apomictic seeds can be produced are:
(a)**Agamospermy** In which the seed or embryo is derived from diploid egg ceil, formed without meiosis and syngamy. This diploid egg cell develops into embryo without undergoing fertilisation, e.g. apple,
(b)**Adventive embryony** The method in which diploid cells surrounding the embryo sac, e.g nucellus and integument protrude into the sac and develops into embryo. This may also lead to formation of more than one embryos in an embryo sac or ovule, leading to condition called polyembryony, e.g. Citrus,Opuntia.
(ii)The introduction of apomixis genes into hybrid seeds results in apomictic seeds, which results in asexual reproduction or production of cloned seed. But the main advantage by which these apomictic seeds are advantageous to farmers as they lower the cost of production and increase the yield. Also unlike hybrid seeds they don't have to be produced every year and can be stored, thus saving time and money.
(iii)The labelled diagram of a mature embryo of a dicotyledonous plant is as given below.

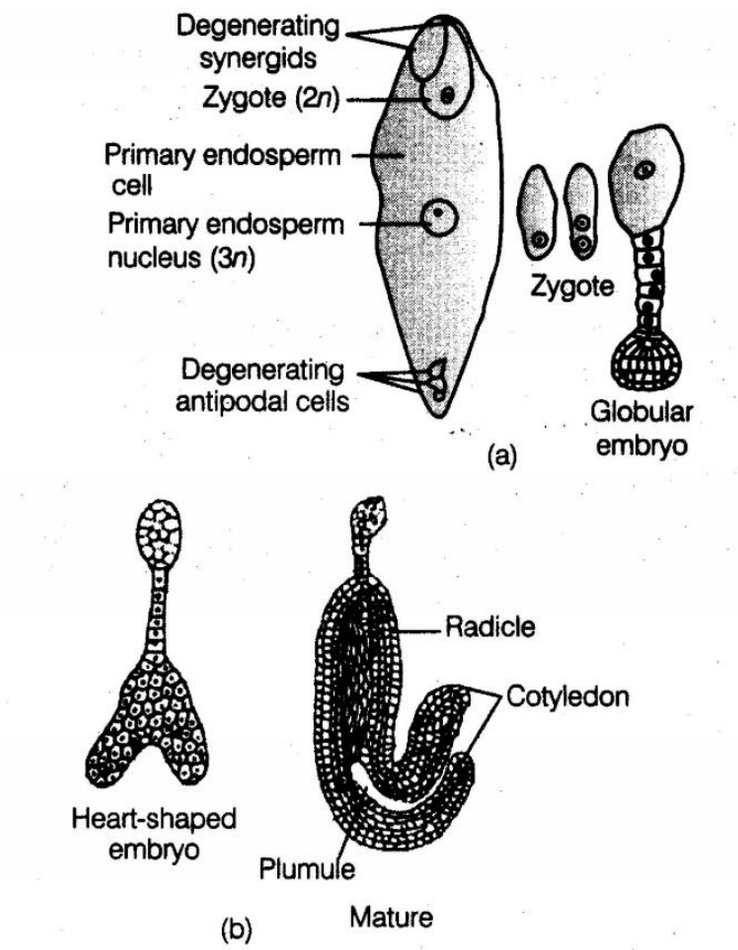


A typical dicot embryo

**20.(i) Why does endosperm development precede embryo development in angiosperm seeds? State the role of endosperm in mature albuminous seeds.**
**(ii) Describe with the help of three labelled diagrams the different embryonic stages that include mature embryo of dicot plants.[Delhi 2014]**

**Ans.**(i)The embryo development starts only after a certain amount of endosperm is formed. It is an adaptation for assured nutrition of the developing embryo. Therefore, endosperm development precedes embryo development. The role of endosperm in mature albuminous seeds is storage of reserve food for growing embryo.

(ii)The embryonic stages during the development of mature embryo sac are:



**(a) Fertilised embryo sac showing zygote and Primary Endosperm Nucleus (PEN)**
**(b) Stages in embryo development in a dicot (3)**

**21.(i) Mature seeds of legumes are non-albuminous. Then, can it be assumed that double fertilisation does not occur in legumes? Explain your answer,**
**(ii) List the differences between the embryos of dicot (pea) and monocot (grass family).**
**[Delhi 2014 C]**

**Ans.**(i)Seeds of legumes are non-albuminous that implies that endosperm in such seeds is

completely used up in providing nutrition to developing embryo. The endosperm is formed as a result of triploid fusion, i.e. between a male gamete and two polar nuclei. This making it obvious that it cannot be formed in the absence of double fertilisation.Therefore, though the seeds of legumes are non-albuminous, it clearly states the occurrence of double fertilisation in them.

(ii) The differences between the embryos of pea and grass can be summarised as:

| **Dicot embryo** (Pea) | **Monocot embryo** (Grass) |
|---|---|
| The basal cell forms a 6-10 celled suspension. | Basal cell produces a single-celled suspension. |
| Terminal cell produces embryo, except the radicle. | Forms the whole of embryo. |
| First division of terminal cell is longitudinal. | First division is transverse. |
| It possess two cotyledons. | It possess one cotyledon. |
| Plumule is terminal and is present between the elongated cotyledons. | Plumule is laterally present to excessive growth of single cotyledon. |

**22.(i) Why are seeds of some grasses called apomictic? Explain.**

**(ii) State two reasons to convince a farmer to use a apomictic crop.[Delhi 2014 C]**

**Ans.**(i)The seeds of some grasses develop seeds without fertilisation. It may be because a diploid egg cell develops into a embryo directly (without undergoing meiosis and syngamy) or some diploid cells of nucellus or integument surrounding the embryo sac, protrude inside and develop into embryos. This phenomenon of developing embryo and seeds without fertilisation is called apomixis and such seeds produced are referred to as apomictic.

(ii) The introduction of apomixis genes into hybrid seeds results in apomictic seeds, which results in asexual reproduction or production of cloned seed. But the main advantage by which these apomictic seeds are advantageous to farmers as they lower the cost of production and increase the yield. Also unlike hybrid seeds they don't have to be produced every year and can be stored, thus saving time and money.

**23.Give reasons why?**

**(i)Most zygotes in angiosperms divide only after certain amount of endosperm is formed.**

**(ii)Groundnut seeds are exalbuminous and castor seeds are albuminous.**

**(iii)Micropyle remains as a small pore in the seed coat of a seed.**

**(iv)Integuments of an ovule hardens and the water content is highly reduced as the seed matures.**

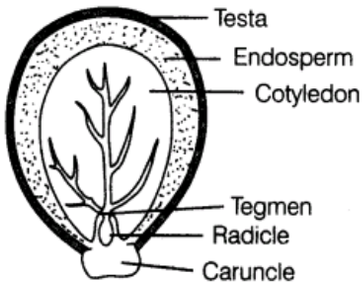
**(v)Apple and cashewnuts are not called true fruits.[All India 2011,2008]**

**Ans**.(i)Zygotes in angiosperms mostly divide only after a certain amount of endosperm is formed as an adaptation strategy to assure nutrition for the developing embryo.

(ii) (a) Groundnut seeds are exalbuminous because the developing embryo utilises the endosperm completely. So, there is no endosperm left in the seed.

(b)Castor seeds are albuminous because endosperm is not completely used up by the developing embryo. There is some amount of endosperm left in the seeds always.
(iii) Micropyle allows entry of water and oxygen during seed germination.
(iv) During unfavourable conditions, seeds become dormant. The loss of water reduces the metabolic activity of seeds and hardens the integuments.
(v)In these fruits, thalamus contributes in fruit formation. So, they are not called true fruits

**24.(i)Draw a labelled longitudinal view of an albuminous seed.**
**(ii) How are seeds advantageous to flowering plants?[All India 2010,2008]**
**Ans**.(i) LS of an albuminous seed is

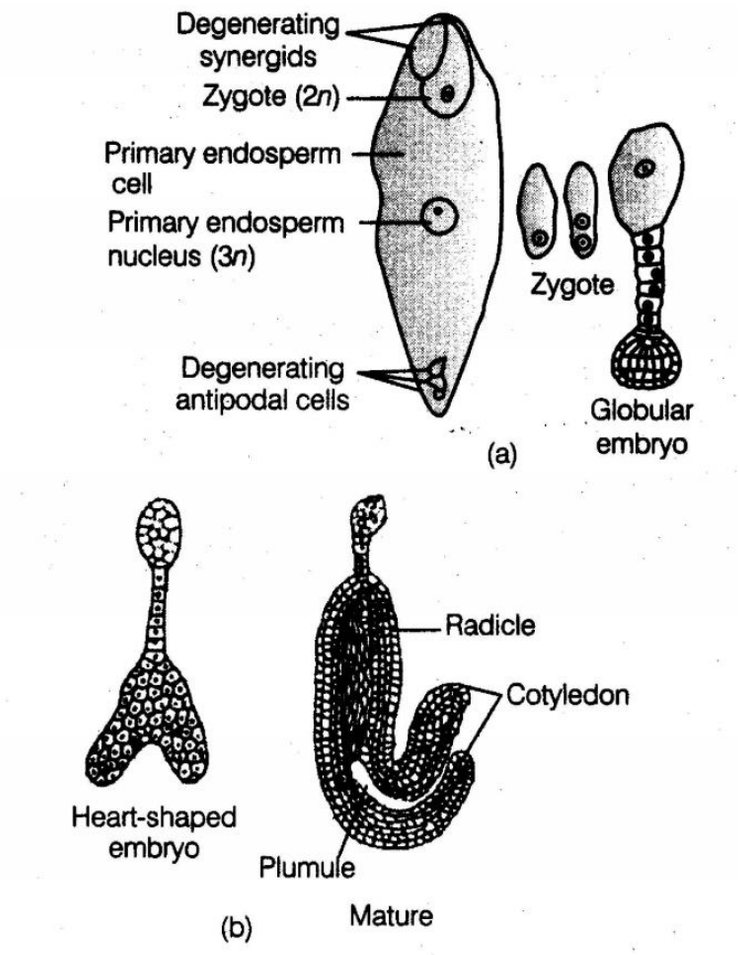



(ii)Advantages of seeds to flowering plants are:
(a)Provides protection to embryo in most delicate stage.
(b)Help in dispersal to spread in new habitats.
(c)Contain sufficient food reserves.
(d)Produce genetic variations.
(e)Seeds are related to pollination and fertilisation.

**25.Explain the development of the zygote into an embryo and of the primary endospermic nucleus into an endosperm in a fertilised embryo sac of a dicot plant. [All India 2010 c]**
**Ans**.**Development of endosperm**
(i)Embryo development occurs after endosperm development in angiosperms.
(ii) The three methods of endosperm development are:
(a)nuclear type (b) cellular type
(c)helobial type
(iii) Nuclear type is the common method in which triploid Primary Endosperm Nucleus (PEN) undergoes repeated mitotic division without cytokinesis. This stage is called free-nuclear endosperm.
(iv)Cell wall formation starts from the periphery and the endosperm becomes completely cellular, e.g. coconut, rice, etc.
(v)Cells of the endosperm store food materials.
(vi)Endosperm may be completely utilised by the developing embryo before the maturation of seeds as in pea, bean, mustard, etc. These seeds are called non-albuminous or endospermic seeds.
(vii) In seeds like castor, maize, coconut, rice, etc., a portion of it may remain in the mature seeds, such seeds are called albuminous or endospermic seeds
**Embryo development in dicot plant**
(i) Embryo formation starts after a certain amount of endosperm is formed.
(ii) Zygote divides by mitosis to form a proembryo.
(iii) Formation of globular and heart-shaped embryo occurs which finally becomes horse shoe-shaped mature embryo.
(iv) In dicot plant, embryo consists of two cotyledons and an embryonal axis between them.
(v)The portion of embryonal axis above the level of attachment of cotyledons is epicotyl and terminates in the plumule.
(vi)The portion of embryonal axis below the level of attachment of cotyledon is the hypocotyl,

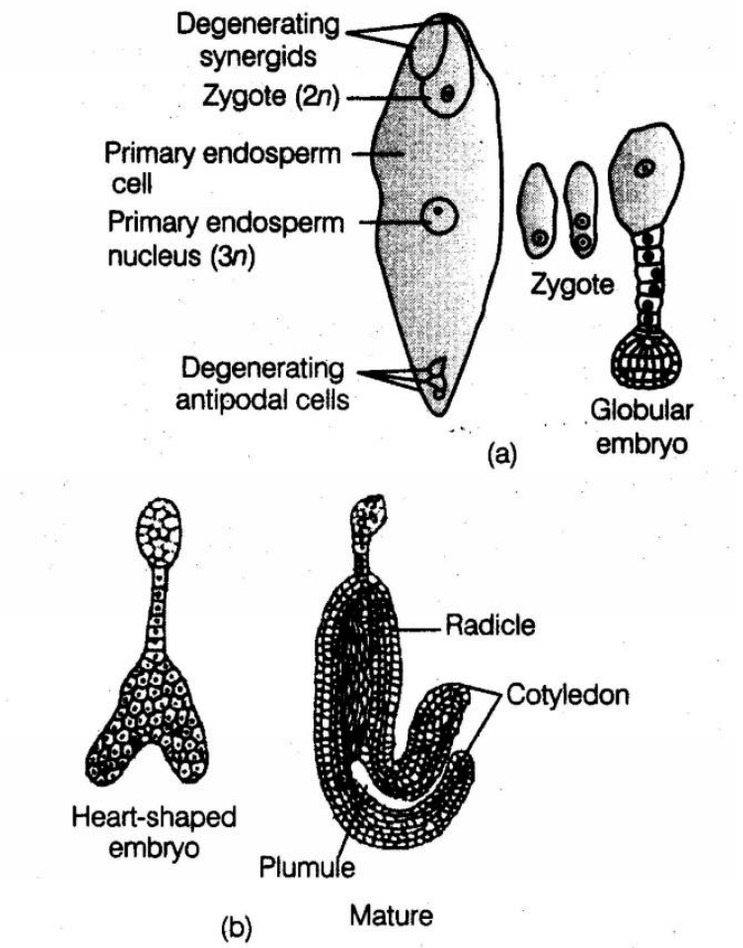
it becomes radicle (root tip).

**26.(i) Trace the development of embryo after syngamy in a dicot plant.**
**(ii)Endosperm development precedes embryo development. Explain.**
**(iii)Draw a diagram of a mature dicot embryo and label cotyledons, plumule, radicle and hypocotyl in it. [All India 2009,2008]**
**Ans.**(i) **Development of embryo after syngamy.**
(a)The embryo development starts only after a certain amount of endosperm is formed. It is an adaptation for assured nutrition of the developing embryo. Therefore, endosperm development precedes embryo development. The role of endosperm in mature albuminous seeds is storage of reserve food for growing embryo.
(b)The embryonic stages during the development of mature embryo sac are:




**(a) Fertilised embryo sac showing zygote and Primary Endosperm Nucleus (PEN)**
**(b) Stages in embryo development in a dicot (3)**

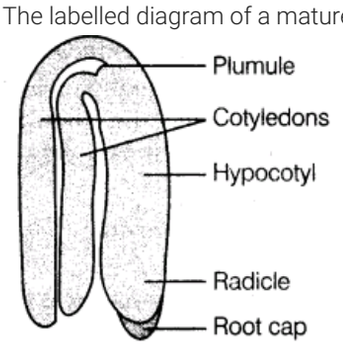
(ii) (a)The embryo development starts only after a certain amount of endosperm is formed. It is an adaptation for assured nutrition of the developing embryo. Therefore, endosperm development precedes embryo development. The role of endosperm in mature albuminous seeds is storage of reserve food for growing embryo.
(b)The embryonic stages during the development of mature embryo sac are:




**(a) Fertilised embryo sac showing zygote and Primary Endosperm Nucleus (PEN)**
**(b) Stages in embryo development in a dicot (3)**

(iii) **Mature dicot embryo.**

The labelled diagram of a mature embryo of a dicotyledonous plant is as given below.



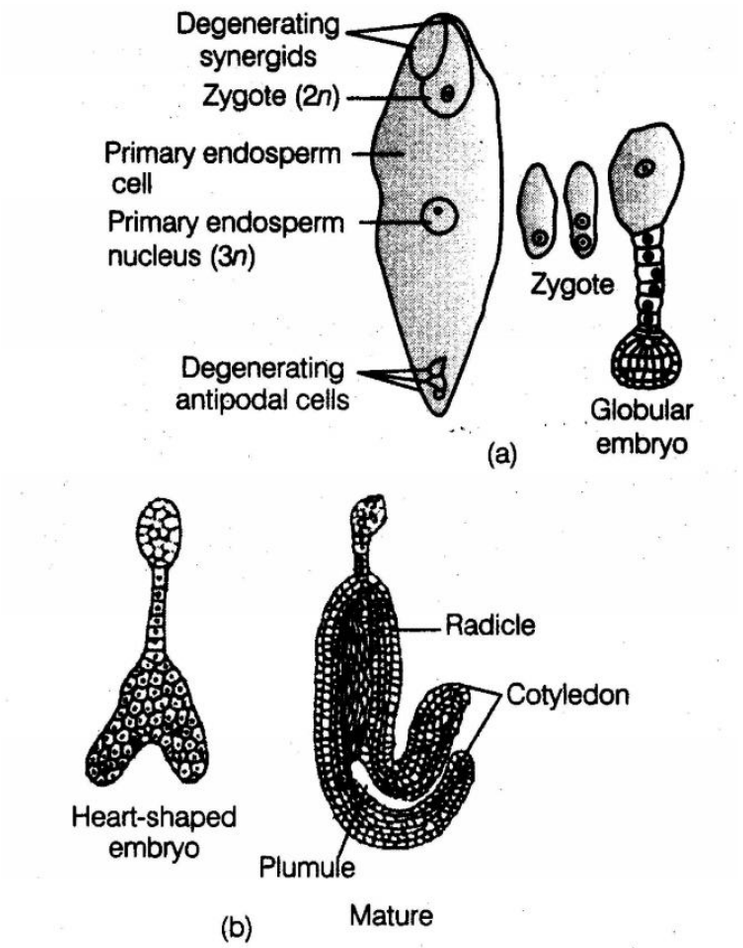

A typical dicot embryo

## Miscellaneous Questions

## 5 Marks Questions

**1.(i) Draw a LS of a pistil showing pollen tube entering the embryo sac in an angiosperm and label and six parts other than stigma, style and ovary.**
**(ii) Write the changes a fertilised ovule undergoes within the ovary in an angiosperm plant.**
**[All India 2013]**

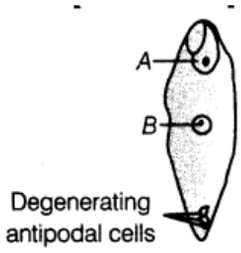
**Ans**.(i)The embryonic stages during the development of mature embryo sac are:




**(a) Fertilised embryo sac showing zygote and Primary Endosperm Nucleus (PEN)**
**(b) Stages in embryo development in a dicot (3)**

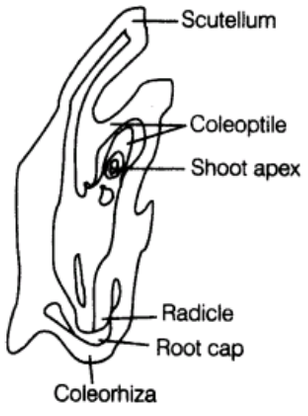
(ii)Changes taking place in a fertilised ovule within the ovary in an angiosperm plant are:
Unfertilised ovule —Seed
Funiculus —Present
Integument —Seed coat
(a)outer —Testa
(b)inner —Tegman
Polar nuclei —Endosperm
Nucellus —Utilised or remaining perisperm
Antipodal —Degenerate
Synergid —Degenerate
Egg —Embryo

**2.(i) Name the structures which the parts A and B shown in the diagram alongside respectively develop into.**
**(ii)Explain the process of development which B undergoes in albuminous and exalbuminous seeds. Give one example of each of these seeds. [Foreign 2011]**



**Ans.(i)** The part A develops into the embryo. The part B develops into the endosperm.
(ii) Endosperm formation
(a)Primary endosperm cell divides repeatedly and forms triploid endosperm nucleus.
(b)Primary endosperm nucleus undergoes successive free nuclear divisions to give rise to a number of free nuclei. At this stage, it is called free nuclear endosperm.
(c)Wall formation takes place from the periphery and proceeds towards the centre and the endosperm becomes cellular.
(d)In albuminous seeds, some amount of endosperm persists in the mature seed as the developing embryo does not consume it completely,
e.g. wheat /maize.
(e)In exalbuminous seeds, the endosperm is completely consumed by the developing embryo before seed maturation,
e.g. in pea/groundnut.

**3.(i) Draw a labelled diagram of LS of an embryo of grass (any six labels).**
**(ii) Give reason for each of the following:**
**(a)Anthers of angiosperm flowers are described as dithecous.**
**(b)Hybrid seeds have to be produced year after year. [All India 2011]**
**Ans**.(i) LS of grass embryo.




(ii) (a) A typical angiosperm anther is bilobed with each lobe having two thecae. So, anther is called dithecous.
(b) Hybrid seeds show segregation of traits and do not maintain the hybrid character in plants. So, they need to be produced every year and cannot be stored.

**4.Explain double fertilisation and trace the post fertilisation events in sequential order leading to seed formation in a typical dicotyledonous plant.[All India 2008 C; Foreign 2010]**
**Ans.**(i) Post-fertilisation events can be traced as:

- Development of endosperm, enlargement of seeds and fruit formation.
- Zygote develops into an embryo.
- Central cell becomes primary endosperm cell and the primary endosperm nucleus develops into the endosperm.
- Antipodals and synergids degenerate.
- Integuments develop into seed coat.
- Ovules ripen into seeds.
- Ovary ripens to form the fruit.

**Embryo development in dicot plant**
(i) Embryo formation starts after a certain amount of endosperm is formed.
(ii) Zygote divides by mitosis to form a proembryo.
(iii) Formation of globular and heart-shaped embryo occurs which finally becomes horse shoe-

shaped mature embryo.
(iv) In dicot plant, embryo consists of two cotyledons and an embryonal axis between them.
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(vi)The portion of embryonal axis below the level of attachment of cotyledon is the hypocotyl, it becomes radicle (root tip).