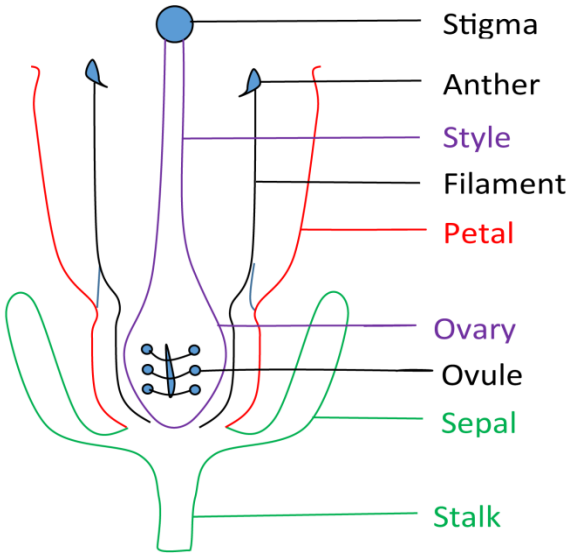
Sexual reproduction in plants

The flower

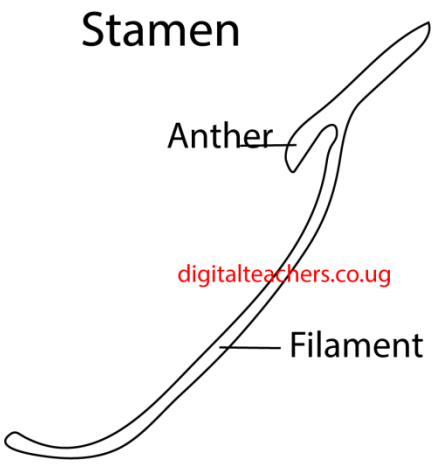
The flower is the sexual reproducing organ of the flowering plants.

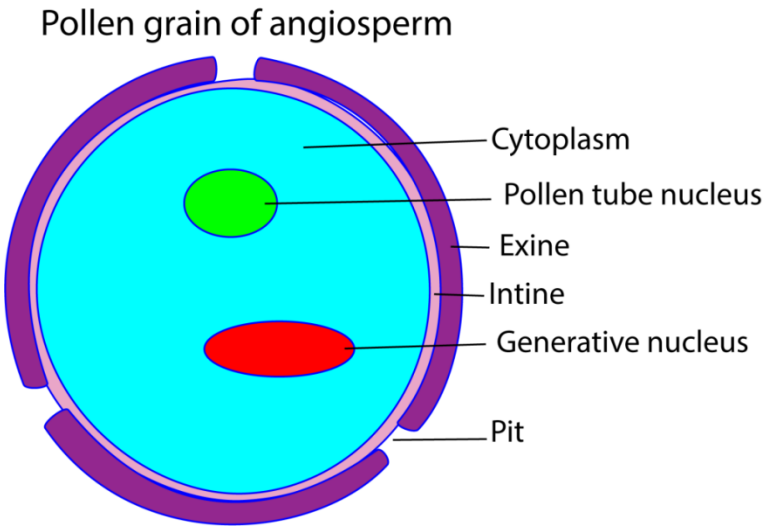
Diagram of a typical flower



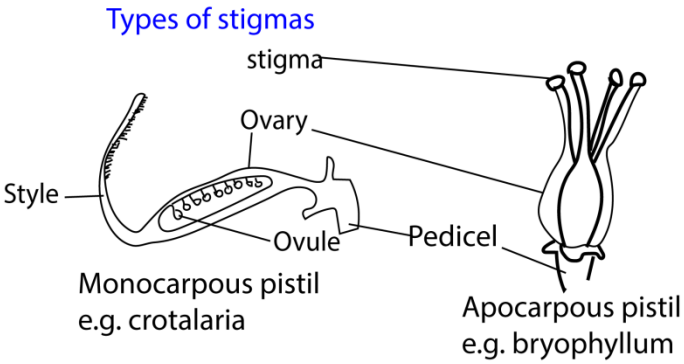
Parts of flowers

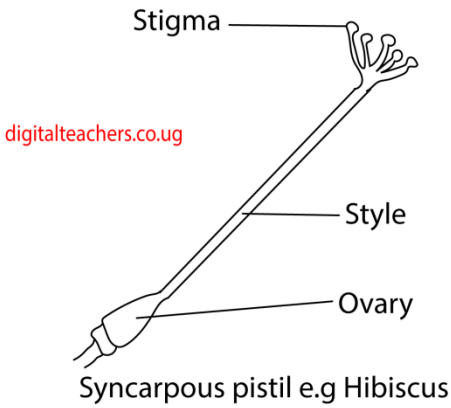
1. Stalk joins a flower to the plant.
2. Sepals (**calyx**) protect floral parts during the bud stage. They may fused (joined longitudinally) or free (not joined)
3. Petals (**corolla**)are brightly coloured to attract pollinators. They may fused (joined longitudinally) or free (not joined)
4. Stamen or androecium the male part of the flower. It is made of anther that produce pollen grains and filament that supports the anthers.



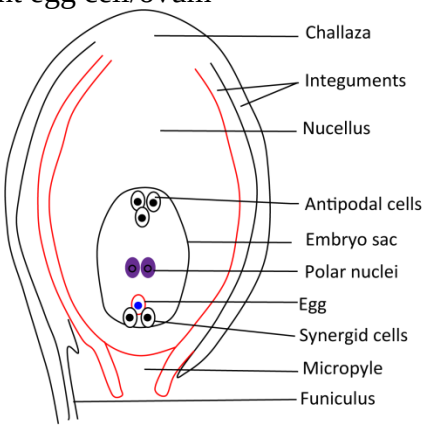


5. Pistil/gynoecium
   This is the female part the flower. It is made of
   (a) Ovary containing ovules
   (b) The style connecting the ovary to
   (c) Stigma which receives the pollen grain
   Types of pistil
   (i) **Monocarpous** pistil consist of only one carpel (e.g. Crotalaria)
   (ii) **Apocarpus** pistil has entirely separate carpels on the same receptacle e.g. bryophyllum.
   (iii) **Syncarpous pistil** has fused carpels e.g. hibiscus.





Plant egg cell/ovum

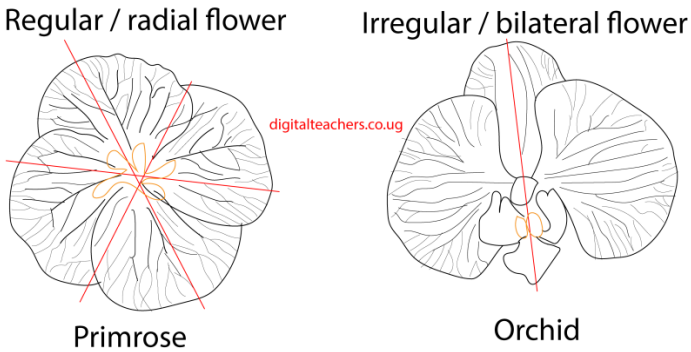


Functions of parts ovum

- Stalk/funiculus allows passage of food and water to the growing ovary
- Ovary wall protects the ovule
- Egg cell develop into seed
- Embryo sac protects the embryo
- Integument protect the embryo and develop into seed coat
- Micropyle allow entry of pollen nuclei.

Terms used to describe flowers

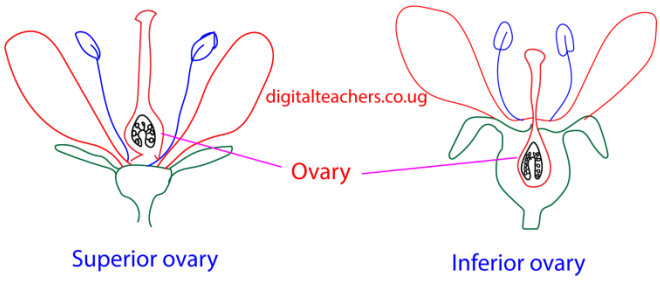
(a) A complete flower is a flower that sepals, petals, stamen and pistil.
(b) Incomplete flower lacks one or more of the following i.e. Sepals, petals, stamen and/or pistil
(c) Non-essential parts of flower are those not directly involved in sexual reproduction of a flower, i.e. sepals and corolla.
(d) Essential **parts** of the flower are those directly involved in sexual reproduction i.e. stigma, style, ovary, ovule, anthers.
(e) **A regular flower** has more than one line of symmetry e.g. hibiscus, sweet potato, promrose and morning glory flowers while **irregular flowers** have only one line of symmetry, e.g. bean and orchid flowers.



(f) Hermaphrodite flower has both male (androecium) and female (gynoecium) parts.
(g) Unisexual flower has either stamen or pistil. Plants that has stamen only is called **staminate**, while that that has pistil only is **pistillate**.

(h) Monoecious plant has both pistillate and staminate on the same plant, e.g. maize plant, palm plant.
(i) Dioecious **plant**, the pistillate and staminate are borne on separate plant, e.g. paw paw.
(j) Inferior **ovary** is one where the sepals, petals and anthers are borne on top of ovary, e.g. banana, canna lily and sun flower; while in **superior ovary**; stamen, petals and sepals are borne below the ovary, e.g. hibiscus, cassia and bean flower.

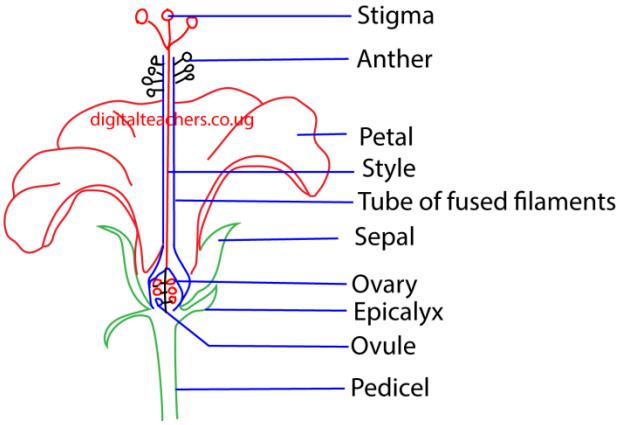
Superior and inferior ovaries



Common flowers

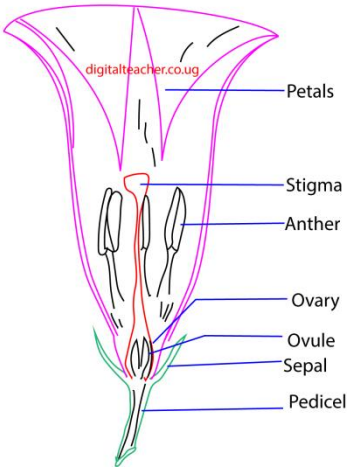
Parts of hibscus flower

Longitudinal section of hibscus flower

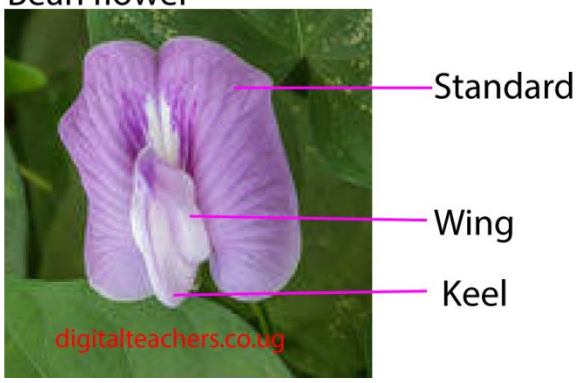


Sweet potato flower

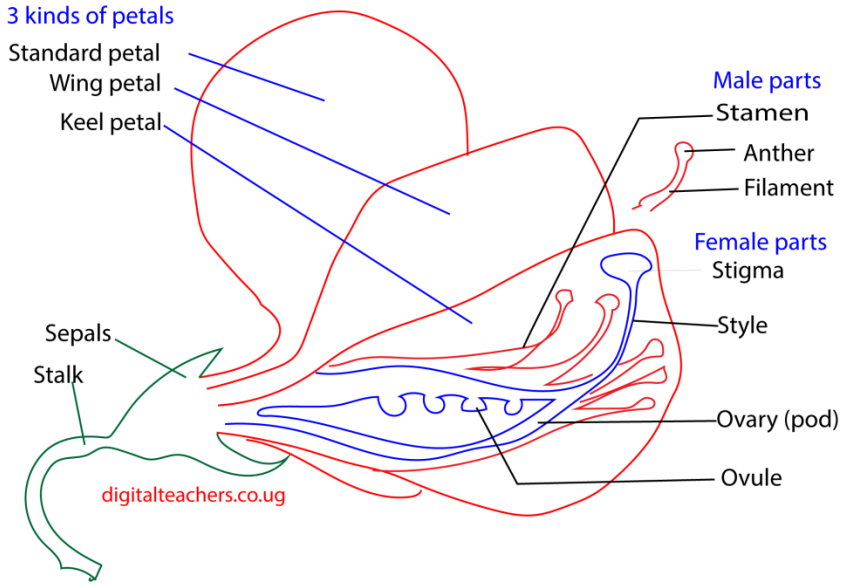
Cross s



Bean flower



Cross section of bean flower



Differences between hibiscus an potato flowers

	Hibiscus flower	**Potato flowers**
1.	Lobed stigma	fused stigmas
2.	Free petals	Fused petals
3.	Many anthers	Five anthers
4.	Has epicalyx	Has no epicalyx
5.	Fused sepals	Free sepals
6.	Fused filament	Free filamant

Differences between hibiscus and bean flower

	Hibiscus flower	Bean flower
1.	Lobed stigma	Single stigma
2.	All filaments fused	Nine of the filament are fused one free
3.	Many anthers	Ten anthers
4.	Regular flower	Irregular flower
5.	Fused carpel	One carpel
6.	Fused sepals	Free sepals
7.	Has epicalyx	Has no epicalyx
8.	All petals are free	Two of the five petals are fused
9.	All petals are similar	Petals dissimilar

Differences between bean and potato flowers

	Potato flower	Bean flower
1.	Fused carpel	One carpel
2.	Regular flower	Irregular flower
3.	Fused petals	Two of the five petals are fused
4.	Five anthers	Ten anthers
5.	Free filament	Nine of the ten filaments are fused

Pollination

This is the transfer of pollen grains from an anther to the stigma.

Self-pollination is the transfer of pollen grains from the anther to the stigma of the same flower or another flower of the same plant.

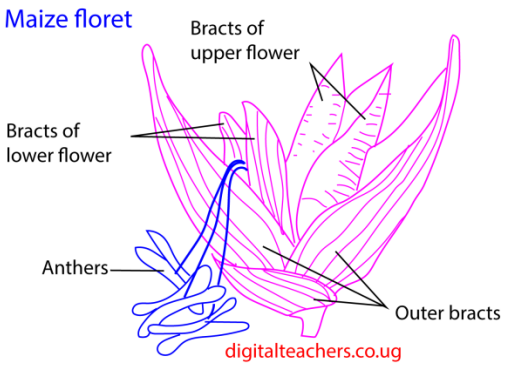
Cross pollination is the transfer of pollen grains from the anther of one flower to the stigma of another flower on a different plant of the same species.

Agents of pollination

1. Wind
2. Insects
3. Water

Characteristics of wind pollinated flowers

a. Large production of pollen grains.
b. Flowers are not attractive and scent emitting.
c. Feathery and sticky stigma.
d. The pollen grains are light and non-sticky so that they can be transported in wind currents.
e. Flowers do not possess nectar.
f. Anthers is well exposed e.g. maize flower.



Characteristics of insect pollinated flower

(i) brightly colored petals
(ii) scented
(iii) Have nectar
(iv) Flowers have nectar
(v) Flower have sticky pollen grains

Development after pollination

(i) As soon as a mature pollen grain fall on a receptive stigma. The pollen grain then absorbs the sugary fluid and increase in size and volume.
(ii) The exine burst open and the entine grows into a long narrow tube called the pollen tube. The pollen tube nucleus occupies the position at the tip and controls it growth.
(iii) The generative nucleus again divides mitotically into 2 male nuclei.
(iv) On reaching the ovary the pollen tube enters, usually through the micropyle to the embryo.
(v) One male nucleus fuses with egg cell to forma diploid zygote.
(vi) The second male nucleus fuse with both polar nuclei to form a triploid nucleus which give rise to **endosperm**. The endosperm in cereals is where food reserves are stored. In seed of other plants (dicotyledonous plants) endosperm is absorbed by the developing cotyledon which then provides the main food reserve.

NB. Plants are therefore said to undergo **double fertilisation** because two male nuclei fuse within the ovum; one with the egg cell to form a zygote while another with the polar two polar cells to form an endosperm.

After fertilization

1. The zygote divides mitotically, growing and developing into the embryo. The embryo consists of a radicle (young root) plumule (young shoot) and either on cotyledon or two cotyledons (seed leaves). The embryo is attached to the wall of the expanding embryo sac by a suspensor which acts as passage of food to the embryo.
2. The primary endosperm nucleus (triploid) divides into a mass of nuclei which are separated from one another by thin cell walls. It becomes food storage for the seed.
3. The ovule develops into the seed. The integuments of the ovule become the seed coats. The outer integument is called the Testa while the inner is called tegmen. Bothe of these layers are tough and protective.
4. The ovary develops into a fruit.

Parthenogenesis
This is the development of a new offspring from unfertilised egg. Haploid parthenogenesis, the egg is produced by meiosis whereas in diploid parthenogenesis the egg is produced by mitosis; e.g. production of wingless aphids.

Parthenocarpy
This is the development of a fruit without fertilization such fruits cart be artificially produced for commercial purpose by spraying with auxins.

Cross and self-fertilization

1. Self-fertilization is the union of gametes from the same individual flower.

Advantage:

a. it increases the chances of fertilization and formation of new organism.

b. only one parent is required, and that beneficial qualities are more likely to be passed on to the offspring since all offspring are genetically identical to the parent.

Disadvantage:

a. it reduces genetic variability, so the organism will be less adapted to changes in the environment.
b. It may transfer diseases to the offspring

2. Cross fertilization: is the union of gametes from the different individual or flower of the same species. This brings in genetic mixing and genetic variability which increase the hybrid vigour.

Advantages of sexual reproduction

- Genetic mixing
- Seeds can go through adverse conditions in a dormant stage.
- Allow genetic improvement.

Means employed by plants to limit self-fertilization in plants

(a) Dichogamy: anthers mature and stigma become receptive at different times
  (i) Protandry: anther mature before the stigma
  (ii) Protogyny: stigma mature before the anther
(b) Self-incompatibility: the pollen grain fails to develop on the stigma of the same flower.
(c) Special floral structure: most hermaphrodite flowers have structural features that favour cross pollination; e.g. stigma may be above the anthers thus removing the possibility of pollen falling on the stigma of the same flower. Other have nectar and good scent to attract pollinator.
(d) Inflorescence: having many flowers in close proximity on the same stalk favours cross pollination.

(e) Some plants have monoecious flower, i.e. separate male and female flowers on the same plant. e.g. maize and coconut.
(f) Some plants are **dioecious**, separate male and female flower of different plants. Despite the advantage of cross fertilization, dioecious plants are not many because only half of the plants are able to produce seeds and there is waste of pollen grains in wind dispersal.

Adaptations promoting self-fertilization

1. Bisexual, hermaphrodite flowers e.g. marigold.
2. Anther and stigma ripen at the same time. E.g. tomato.
3. Flowers remain enclosed until fertilization has taken place. E.g. garden pea
4. The flowers are buried in ground e.g. G. nuts.

Advantages and disadvantages of reproduction by seed

Advantages

1. The plant is independent of water for sexual reproduction and therefore better adapted for land environment.
2. The seed protects the embryo
3. The seed contains food for embryo either in cotyledon or in endosperm
4. The seed is adapted for dispersal
5. The seed remain dormant and survive adverse condition
6. The seed as a product of sexual reproduction has advantages genetic variation

Disadvantage

1. Seeds are relatively large structure because of extensive food reserves which makes dispersal more difficult than spores
2. Seeds are often eaten by animals for their food reserves.
3. There is reliance on external agent such as wind, insects and water for pollination which is a risk
4. There is large wastage of seed because the chances of survival of a given seed are limited
5. The food supply in a seed is limited as compared to vegetative reproduction
6. Two individuals are required in dioecious species making the process risky than reproduction in which only one parent is involved.

Fruits and seed

Differences between fruits and seeds

Fruits	Seeds
Formed from ovary	Formed from ovule
Has two scars, one attachment to the plant and the other to the style	One scar which is attachment to the fruit
Contains seed(s)	Contain embryo
Protects seeds	Found in fruit

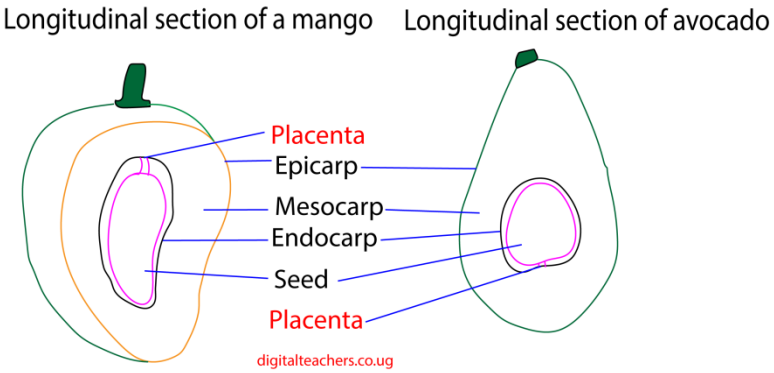
Classification of fruits

Fruits are classified as succulent/fleshy fruits and dry fruits

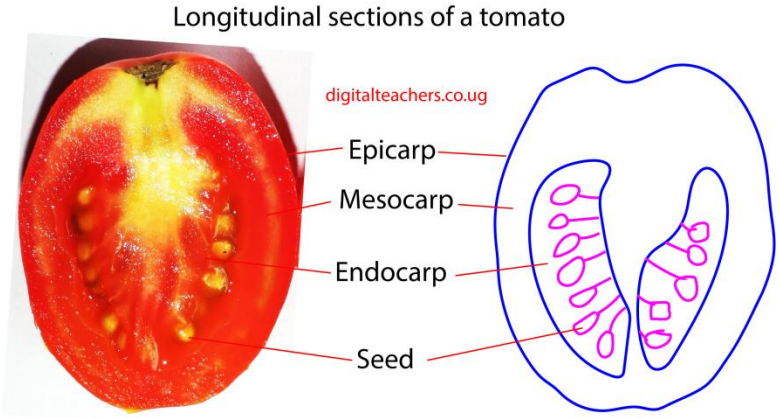
1. Succulent fruits

They are divided into **drupe**, e.g. mango and avocado and **berries** e.g. orange, tomato, passion fruits

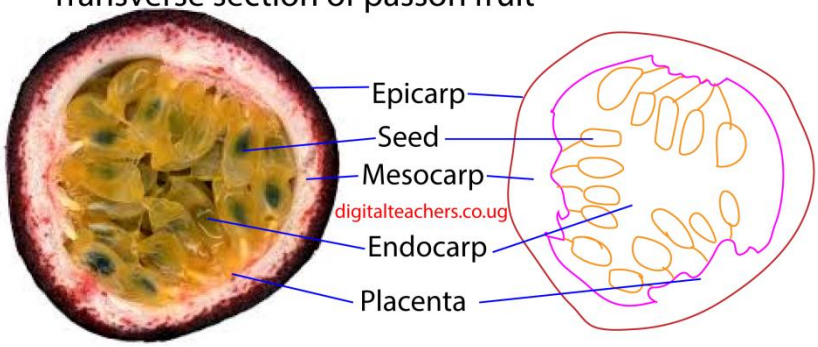
(a) Drupes



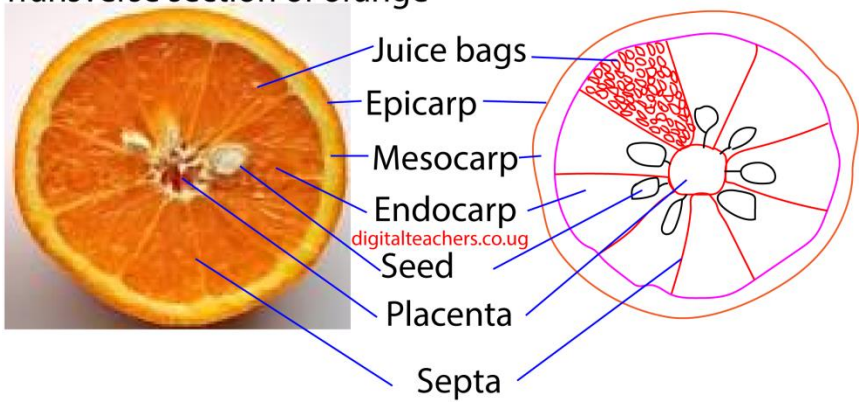
(b) Berries



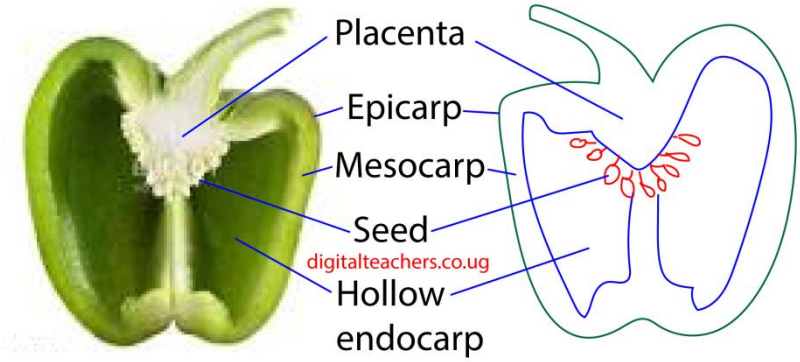
Transverse section of passon fruit



Transverse section of orange



Longitidinal section of green pepper



Differences between drupes and berries

Drupes	Berries
One seed	Many seeds
Woody endocarp	Fleshy/hollow endocarp

2. Dry fruits

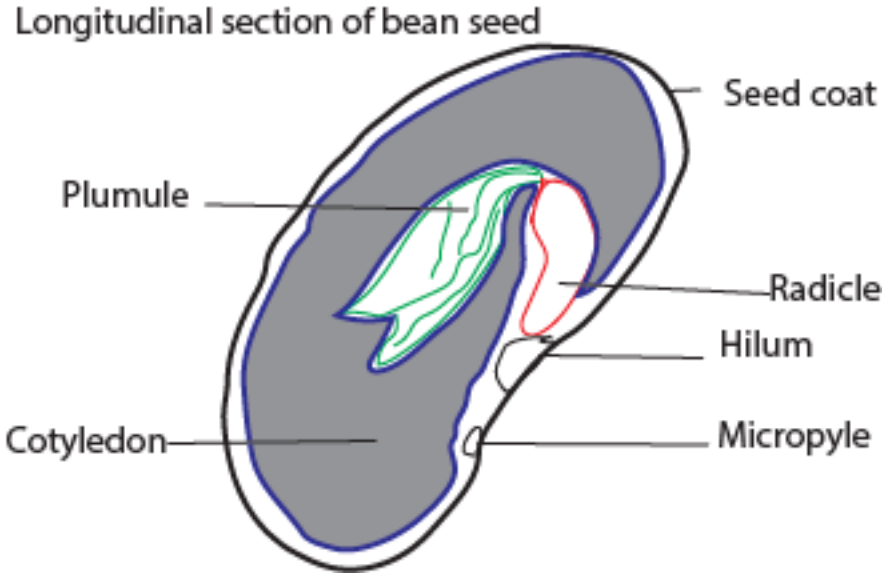
Can be classified as dehiscent fruits (when they break to release their seed) or indehiscent fruits those that do not break to release their seed.

(i) Dehiscent Fruits

Dry fruits which at maturity open by definite natural means to shed the contained seeds. They are classified according to line of sutures.

(a) Follicle A dry dehiscent fruit developed from 1 carpel and at maturity splitting along only one suture. (larkspur, delphinium)

(b) Legume A dry dehiscent fruit developed from 1 carpel and at maturity splitting along both the dorsal and ventral sutures, e.g. beans, peas.



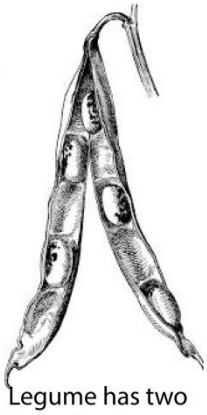
Uses of parts of bean seed

- seed coat protects inner parts of the seed
- Plumule grows into shoot system
- Radicle grows into root system
- cotyledon stores food reserves and protects the embryo
- Micropyle allows in pollen nucleus during fertilization and water during germination
- Hilum attachment of to plant during development

(c) Capsule A dry dehiscent fruit developed from several carpels e.g. Dutchman's capsule.

Dehiscent fruits

Follicle has one line of suture e.g. larkspur, columbine



Legume has two lines of suture e.g. bean and peas

Capsule has many lines of suture e.g. dutchman's capsule

(ii) Indehiscent fruits

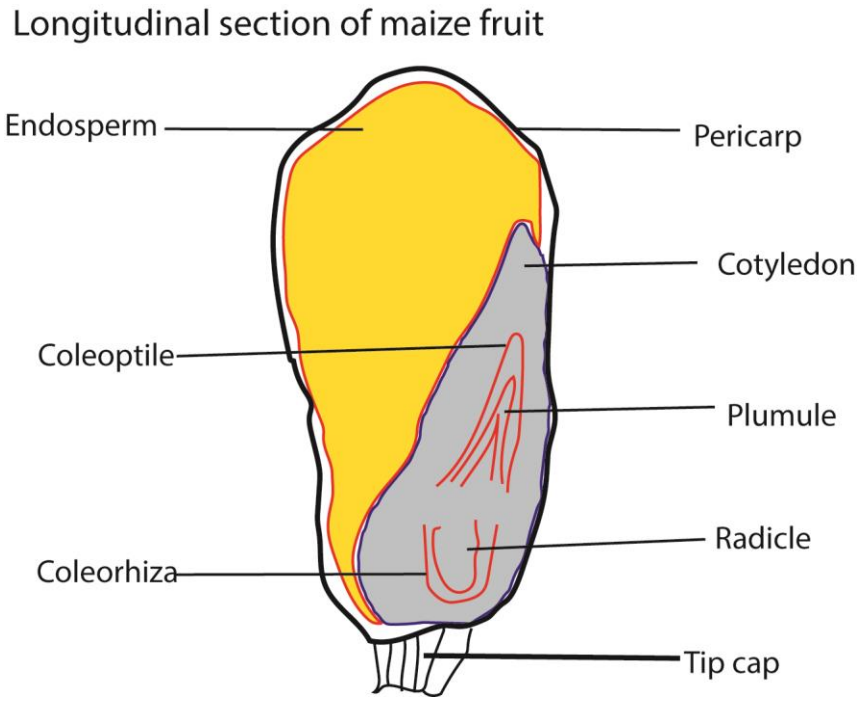
Dry fruits which do not open when mature to shed their seeds. Many of this group are one seeded fruits.

(a) **Achene** - A one-seeded, dry, indehiscent fruit; the one seed is attached to the fruit wall at a single point. (buttercups, dandelion, sunflower).

(b) **Nut** - A dry, indehiscent, one seeded fruit similar to an achene but with the wall greatly thickened and hardened. (beech, chestnut, oak, hazel; walnut and hickory - note: because of extrafloral bracts, or "husk", the latter two fruits are sometimes called "drupes").

(c) **Samara** - A one- or two-seeded dry, indehiscent fruit in which part of the fruit wall grows out into a wing. (elm, maple, ash).

(d) **Caryopsis** - A one-seeded dry, indehiscent fruit in which the fruit wall and the seed coat are fused. (wheat, corn, grasses).



Functions of parts of maize fruit

Pericarp protects the internal parts

Endosperm stores food reserves

Cotyledons protect and nourishes the embryo

Coleoptile protects the plumule

Plumule grows into shoot system

coleorhiza protects the radicle

Radicle grows into root system

(e) **Schizocarp** - A fruit formed from several carpels, each carpel of this pistil enclosing a single ovule, at maturity the carpels separate as separate indehiscent fruits. (mallow, wild carrot, dill).

Indehiscent fruits

Achene of sunflower | Cashew nut | Caryopsis of maize | Cypsela of tridax | Samara of Norway maple | Schizocarp of Desmodium

(iii) Aggregate Fruit

A fruit formed by the development of a number of pistils from the same flower. The individual units may be berries or other specific types. (raspberry, strawberry).

(iv) Multiple Fruit

A fruit formed by the development of a number of pistils often with accessory parts, the pistils being from a number of flowers. (mulberry, fig, pineapple).

Fruits and seed dispersal

This is the scattering of seed and fruits from the parent.

Why dispersal?

1. To avoid overcrowding
2. To increase the distribution of plants so that they can colonise better places
3. To preserve species by spreading them and preventing them from extermination by natural hazard e.g. fire.

Dispersal agent

1. Wind

Fruits and seed dispersal by wind have the following features.

- They are small and light
- They have, flattened wing like structures e.g. Tecoma or a parachute of fine hair e.g. Tridax to increase their surface area and air resistance.

2. Animal

Fruits and seed dispersal by animal have the following features

- May have sticky hairs e.g. Desmodium
- May have hooks to stick on fur e.g. black jack
- Some fruits have attractive colour, scent and sweet mesocarp when ripe, e.g.
- May have small indigestible seed which are deposited in faeces, e.g. passion fruit.

- Some plants have seed enclosed in woody endosperm that cannot be chewed, e.g. mango

3. Water
   Fruits dispersed by water
   - Have floating devices, e.g. the seeds of the water lily have aril, small float, that have in air. The seed can float on water until the aril decays, then it sinks to the bottom and germinate
4. Explosive mechanism of dispersal
   e.g. balsam, bean

Seed Dormancy

Is the state in which a seed that is viable will not germinate even if the conditions that are necessary for germination are provided?

Dormant seed are usually dry, their metabolic activity is much reduced and they respire anaerobically.

Importance of seed dormancy

- Seed are able to withstand adverse external conditions such as very cold or very dry whether.
- It allows seed and fruits to disperse

Causes of seed dormancy

The main factors that causes the seed dormancy are:

1. **Seed coats impermeable to water**: The seed of certain family have very hard seed coats which are impermeable to water. This dormancy remains until the testa layer decay by soil **microorganisms**. The impermeable seed coats are found in the family **leguminosae, Malvaceae, convolvulaceae.**
2. **Seed coat impermeable to oxygen**: This type of dormancy is because of the **impermeability of the seed coats to oxygen**. But later seeds become more permeable to oxygen so that it germinates afterwards. This type of dormancy in found in the **family compositae.**
3. **Mechanically resistant seed coat**: In certain **seeds of weeds have hard seed coats** that prevent the expansion of embryo.
4. **Immaturity of the embryo:** In the seeds of plants like **the Orchids, Ginkgo** etc. The immaturity of the embryo is due to the **failure of the embryo to develop** when the seeds are shed.

5. **Due to the effect of germination inhibitors**: The inhibition caused due to the presence of the **inhibitor substances in the seed coat, endosperm, embryo or any structure**. Some of the important germination inhibitors are; **Coumarin, Phythalids, Ferulic acid, Abscisic acid, Dehydracetic acid and parasorbic acid.**
6. **Low temperature:** In certain plants the seeds **remain dormant after harvest because they require low temperature for germination.** The seeds germinate in the spring season.
7. **Light sensitive seeds:** In certain seed the germination is affected by the light so the absence of light results in the seed dormancy. These seeds which are **sensitive to sunlight** are termed as the **photoblastic seeds**, where as in some other seeds the light inhibits the seed germination so they are **negatively photoblastic.**

Various methods have been used by seed scientist and technologists to break the dormancy of seed.

Simple and widely used methods are

A. Scarification:

Any treatment i.e. physical or chemical that weakness the seed coat, is known as scarification.

Scarification method is applied, when dormancy is imposed by hard seen coat e. g. in legumes-cajanus cajan, (tur), gram etc.

In this method there are various way to break hard seed coat such as:

1. Seeds are either rubbed on a sand paper manually. At the time of rubbing care should be taken that not to damage the axis of the seed e.g. Green gram & subabool.
2. When seed coat is too hard i.e. of woody nature, the seed coat has to be removing completely by breaking it. E.g. Rubber (Havea app) seed India teak wood seed.
3. Soaking treatment: Soaking hard seed coat in concentrated or diluted solution of sulphuric acid for 1 to 60 minutes, it removes seed coat impermeability. E. g. cotton seeds, India teak wood seeds etc.

B. Temperature Treatments:

1. When the dormancy is due to embryo factor i.e. the seed is incubating at low temp. (0- 5o C) over a substratum for 3 to 10 days placing it at optimum temp. Required for germination. E.g. mustard. – (Brassica campestrits)
2. Some seeds required a brief period of incubation (from a few hours to one to five days) at 40 to 50^0 C before germinating at required temp. (in this method care should be taken that moisture content of the seed is not more than 15% e.g. paddy (Oryza Sativa)
3. Hot water treatment is also an effective method of breaking hard- seed ness in legumes. In this method the seeds are soaked in water at 80oC temp. For 1 – 5 minutes (depending up on the type of seed) before putting for germination.

C. Light Treatments:

Same seeds do not germinate in dark thus it provides continuous or periodic exposure of light is essential e. g. Lettuce (Lactuca Sativa) required red light (660nm) or white light is essential for germination to occur.

D. Treatments with growth regulators & other Chemicals:

Endogenous dormancy may be due to presence of germination inhibitors. Application of low level of growth regulators (i.e. Gibberellins, Cytokinins and Ethylene etc) may break the seed dormancy.

Most widely used growth regulators are gibberellins and kinetics e.g. seeds of sorghum crop presoaking seed treatment with GA3 at the conc. Of 100 ppm have been used for breaking seed dormancy

Among other chemicals potassium nitrate (0.2%) and thio – urea (0.5 to 3%) are widely used for breaking seed dormancy in oat (Avena Sativa), barley (Hordeum vulgare), tomato (Lycopersicon spp).

(For prepare 100 ppm solution of GA3, weigh 100 mg of GA3 & dissolve in a few drops of alcohol and make up the final volume (1000 ml) by adding distilled water).

(50 ppm kinetin 5 mg dissolved in few drops of alkaline made with sodium hydroxide and makes the final volume 100ml it gives to final conc. Of 50 ppm)

Asexual reproduction

This is a type of reproduction that does not involve fusion of gametes or combination of genetic materials from different individual.

Types of asexual reproduction

(a) **Fission:** The organism divides into two or more **equal** sized parts, e.g. binary fission in amoeba
(b) Spore formation: Spores are unicellular bodies formed by cell division in a parent organism. Having become detached from the parent, they develop directly or indirectly into a new individual, provided environment conditions are suitable.

Generally, spores are very small which enables them to be distributed by animals.

(c) Budding: this is a method of reproduction where an organism develops an outgrowth which when detached from a parent become self-supporting e.g. yeast and hydra
(d) Fragmentation: this is where an organism is broken into two or more pieces, each of which grows into a new individual. As a means of reproduction, fragmentation depends on organism having good power if regeneration. E.g. spirogyra.
(e) Vegetative reproduction: is a form of asexual reproduction in plants where part of the body become detached and develop into a new self-supporting individual
(f) Parthenogenesis: This is the development of a new offspring from unfertilised egg. Haploid parthenogenesis (e.g. in pineapple, the egg is produced by meiosis whereas in diploid parthenogenesis the egg is produced by mitosis; e.g. production of wingless aphids.

Advantages of asexual reproduction

- producing more offspring than sexual reproduction mode in a given time
- good qualities are retained in the offspring

Disadvantage of Asexual reproduction

- may lead to accumulation of recessive genes in a population
- no genetic variability

Plant Structures for Natural Vegetative Propagation include

1. **Rhizomes**
   Rhizomes are modified underground stems growing horizontally which puts out lateral shoots and adventitious roots at intervals. As rhizomes extend, roots and shoots may arise from segments of the rhizome and develop into new plants.

   Examples include lilies, irises, and orchids, ginger and turmeric.

2. Runners
   This is a long thin stem that usually grows horizontally along the ground and produces roots and shoots at widely spaced nodes, as in a strawberry **plant**.
3. **Bulbs**
   This a resting stage of a plant (such as the lily, onion, hyacinth, or tulip) that is usually formed underground and consists of a short stem base bearing one or more buds enclosed in overlapping membranous or fleshy leaves.
4. Tubers
   Tubers are enlarged structures in some plant species used as storage organs for nutrients. They are used for the plant's perennation (survival of the winter or dry months), to provide energy and nutrients for regrowth during the next growing season, and as a means of asexual reproduction. Example include Iris potato stems
5. Corms
   Corms are vertical, swollen underground plant stem that serves as a storage organ that some plants use to survive winter or other adverse conditions such as summer drought and heat (perennation). Example is yam.
6. Plantlets
   Plantlets are a small, undeveloped plant produced on the leaf margins of a kalanchoe or the aerial stems of a spider plant

Artificial Vegetative Propagation

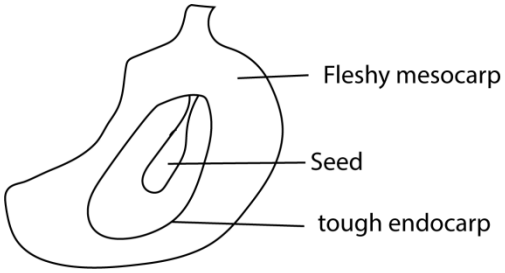
Artificial vegetative propagation is a type of plant reproduction that involves human intervention. The most common types of artificial vegetative reproductive techniques include

(i) **Cutting:** A part of a plant, typically a stem or leaf, is cut off and planted. Adventitious roots develop from the cuttings and a new plant forms. Example is cassava.
(ii) **Grafting:** In grafting, a desired cutting or **scion** is attached to the stem of another plant that remains rooted in the ground. The tissue systems of the cutting become grafted into or integrated with the tissue systems of the base plant over time.
(iii) **Layering:** This method involves bending plant branches or stems so that they touch the ground. The portions of branches or stems in contact with the ground are then covered with soil. Adventitious roots or roots that extend from structures other than plant roots develop in the parts covered by soil and the attached shoot (branch or stem) with new roots is known as a layer. This type of layering also occurs naturally. In another technique called **air layering**, branches are scraped and covered with plastic to reduce moisture loss. New roots develop where the branches were scraped and the branches are removed from the tree and planted.
(iv) **Suckering:** Suckers attach to a parent plant and form a dense, compact mat. Since too many suckers can lead to smaller crop size, excess numbers are pruned. Mature suckers are cut away from a parent plant and transplanted to a new area where they sprout new plants. Suckering has the dual purpose of growing new shoots and removing nutrient-sucking buds that prohibit a main plant from growing.
(v) **Tissue Culture:** This technique involves the culturing of plant cells that may be taken from different parts of a parent plant. The tissue is placed in a sterilized container and

nurtured in a special medium until a mass of cells known as a callus is formed. The callus is then cultured in a hormone-laden medium and eventually develops into plantlets. When planted, these mature into fully grown plants.

Exercise

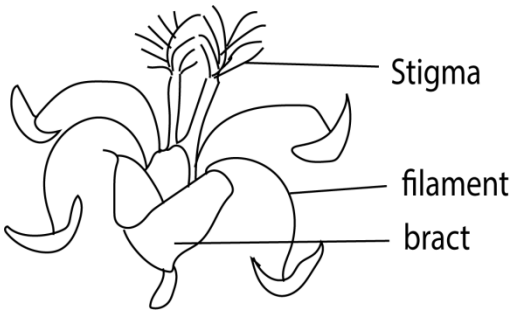
1. Which one of the following factors favours cross pollination?
    A. Stamen and carpel maturing at the same time
    B. Flowers remaining closed after maturation
    C. Stamens being situated below the stigma
    D. Style being shorter than the filament
2. Which of the following is an example of a monoecious plant?
    A. Maize
    B. Paw paw
    C. Pineapple
    D. Bean
3. Plants that bear both pistilate and staminate flowers are called
    A. Hermaphrodite plant
    B. Dioecious plants
    C. Monoecious plants
    D. Bisexual plants
4. Which one of the following is a function of integuments after fertilization?
    A. Storage of food for the embryo
    B. Provision of support to the seed
    C. Protection for inner parts of the seed
    D. Allowing air into the seed
5. Which one of the following results into a diploid zygote in flowering plants? Fusion of one male nucleus with the
    A. Egg cell
    B. Polar nuclei
    C. Synergids
    D. Antipodal cell
6. The agent of dispersal of the fruit in figure below is



    A. Wind
    B. Water
    C. Animal
    D. Self
7. Double fertilization in flowering plants refers to fusion of two male nuclei with
    A. Antipodal nuclei and polar nuclei
    B. Egg nucleus and polar nuclei

C. Egg nucleus and antipodal nuclei
D. Two egg nuclei

8. The type of pollination that the flower in figure below is adapted for is



A. Cross pollination
B. Self-pollination
C. Wind pollination
D. Insect pollination

9. Which one of the following contains a set of cells all haploid
A. Pollen grain, ovules, and root hair
B. Sperms, pollen grain and ova
C. Sperms, ovules and brain cells
D. Cells of epidermis, ovules and ova

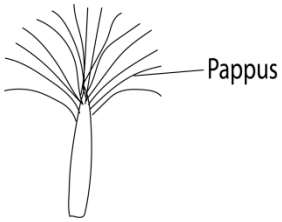
10. Which one of the following contains a set of characteristic which are all for wind-dispersed fruits and seeds?
A. Parachute like, hooked and light
B. Dry, curled inwards and spiked
C. Parachute-like, winged and light
D. Succulent, buoyant and light

11. Which one of the following is **not** a correct statement of a flower plant?
A. Sepals and petals form perianth
B. Sepals form calyx
C. Carpels form androecium
D. Petals form corolla

12. Which of the following is a characteristic of wing pollinated flowers?
A. Feathery stigma and smooth pollen grains
B. Stigma growing much higher than the stamen
C. Free stamen growing higher than the stigma
D. Large pollen grain of firm anthers

13. Which of the following is the least important benefit of seed and fruit dispersal to a plant
A. Increasing chances of finding better habitat for multiplication
B. Avoiding being eaten by animals in its original habitat
C. Reducing competition for food resulting from overcrowding
D. Encouraging colonization of different habitats

14. The pappus on the fruit in the figure below are remains of the

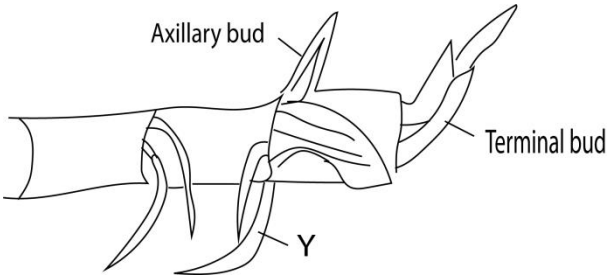


A. Petals
B. Perianth
C. Stamen
D. Calyx

15. Which of the following plant organs can be used for vegetative reproduction?
A. Stem tuber of Iris potatoes
B. Root tuber of cassava
C. Tap root of carrot
D. Leaves of onion

16. Which one of the following types of fruit is a pineapple?
A. Drupes
B. Multiple fruits
C. Indehiscent fruits
D. Berry

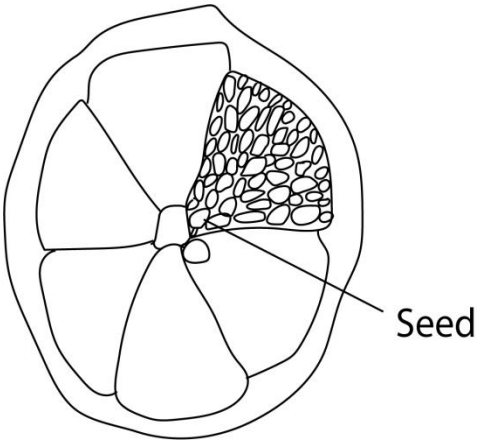
17. The type of roots labelled Y n figure 1 are called



A. Prop roots
B. Lateral root
C. Clasping roots
D. Adventitious roots

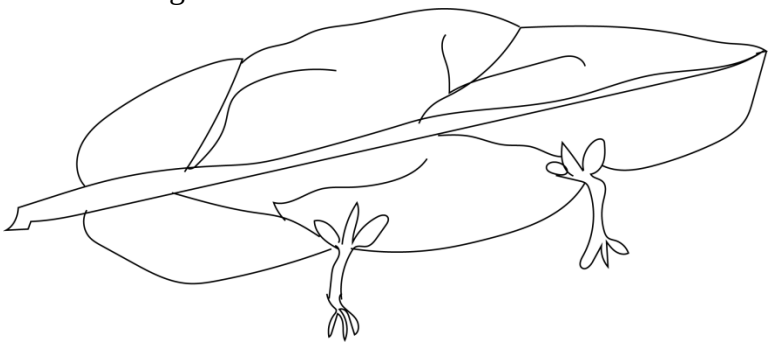
18. Which one of the following is a form of sexual reproduction?
A. Binary fission
B. Fragmentation
C. Conjugation
D. Spore formation

19. Which of the following structures is necessary in dispersal of seeds and fruits by water?
    A. Wings
    B. Tough tests
    C. Hairs
    D. Dry testa
20. Which type of fruit is shown in the cross section of the figure below?



A. Berry
B. Drupe
C. Caryoposis
D. Achene

21. Which of the following occurs in a flower after fertilization
    A. Petals, stigma and style persist
    B. Ovary, petals and sepals dry and fall
    C. Ovary develop into seed coat
    D. Ovules develop into seeds.
22. Which of the following modes of reproduction is sexual?
    A. Spore formation
    B. Budding
    C. Fragmentation
    D. Conjugation
23. The leaf in figure below is modified for



    A. Absorption of nutrients
    B. Reproduction

C. Photosynthesis
D. Water storage

24. Which of the following parts of a flower are essential for fertilization
    A. Filament, style and petals
    B. Petals, receptacle, sepals
    C. Ovary, anther, stigma
    D. Filament, sepal and receptacle
25. In grass, the anther hang out below the flower and stigma is held out above the anthers. The importance of the arrangement is to
    A. To improve the chances of pollination
    B. Encourage cross pollination
    C. Minimize waste of pollen grains
    D. Encourage self-pollination.
26. Which one of the following structures of a flower develops into a seed coat after fertilization?
    A. Embryo sac
    B. Integuments
    C. Receptacle
    D. Ovary
27. Sexual reproduction in spirogyra is described as
    A. Fragmentation
    B. Conjugation
    C. Binary fission
    D. Budding
28. Which part of Iris potato plant is used for vegetative reproduction?
    A. Stem
    B. Root
    C. Leaf
    D. Flower
29. Which of the following organisms reproduce by budding?
    A. Yeast
    B. Amoeba
    C. Spirogyra
    D. Mucor
30. Which one of the following fruits is an example of drupe?
    A. Avocado
    B. Passion
    C. Tomato
    D. Orange
31. Which of the following is an example of berry?
    A. Avocado
    B. Passion
    C. Ground nuts

D. Cotton

32. (a) (i) State the difference between Self and cross-pollination.
    (ii) Give three features of a flower that ensure cross-pollination
33. Using examples, describe how new plants are formed by asexual reproduction?

34. (a) What is pollination?
    (b) How is self-pollination prevented in plant?
    (c) Describe the features that favor pollination by insects

35. (a)(i) What is vegetative reproduction? (02marks)

    (ii) outline the different methods of artificial vegetative reproduction, giving examples of plants used in each method (06mark)

    (d) Give the advantages and disadvantages of vegetative reproduction to plants (07marks)

36. (a) Explain how flowers are adapted to wind pollination. (10marks)
    (e) What are benefits of sexual reproduction in plants (05marks)

37. Using examples, describe the methods of fruit and seed dispersal (15marks)
38. (a) Explain how flowers are adapted to wind pollination (10marks)
    (b) what are benefits of sexual reproduction in plants (05marks)

Answers

1	C	6	C	11	C	16	B	21	D	26	B
2	A	7	B	12	A	17	D	22	D	27	B
3	A	8	C	13	B	18	C	23	B	28	A
4	C	9	B	14	D	19	B	24	C	29	A
5	A	10	C	15	A	20	A	25	B	30	A

31. B

32. (a) Differences between self and cross-pollination

Self-pollination is the transfer of pollen grains from the anther to the stigma of the same flower or another flower of the same plant.

Cross pollination is the transfer of pollen grains from the anther of one flower to the stigma of another flower on a different plant of the same species.

(b) ways of promoting cross pollination

a. Dichogamy: anthers mature and stigma become receptive at different times
   (iii) Protandry: anther mature before the stigma
   (iv) Protogyny: stigma mature before the anther
b. Self-incompatibility: the pollen grain fails to develop on the stigma of the same flower.
c. Special floral structure: most hermaphrodite flowers have structural features that favour cross pollination; e.g. stigma may be above the anthers thus removing the possibility of pollen falling on the stigma of the same flower. Other have nectar and good scent to attract pollinator.
d. Inflorescence: having many flowers in close proximity on the same stalk favours cross pollination.
e. Some plants have monoecious flower, i.e. separate male and female flowers on the same plant. e.g. maize and coconut.
f. Some plants are **dioecious**, separate male and female flower of different plants. Despite the advantage of cross fertilization, dioecious plants are not many because only half of the plants are able to produce seeds and there is waste of pollen grains in wind dispersal.

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(a) Rhizomes

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Plantlets are a small, undeveloped plant produced on the leaf margins of a kalanchoe or the aerial stems of a spider plant

34. (a) This is the transfer of pollen grains from an anther to the stigma.

(b) ways of freventing self-pollination

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(c) Feature that promote insect pollination

(i) brightly colored petals
(ii) scented
(iii) Have nectar
(iv) Flowers have nectar
(v) Flower have sticky pollen grains

(vi) Flowers have stout style and sticky stigma