All living organisms have a characteristic that they can produce their own kind. This production of the offspring from the parents is called **Reproduction**.

Modes of Reproduction in Plants

Plants have two kinds of parts:

- **Vegetative Parts** - These are the parts of the plant that plays a major role in the life cycle of a plant such as preparation of food, transportation of food, water and nutrients etc. For Example, roots, stems and leaves.
- **Reproductive Parts** - These are the parts of a plant that play a major role in the reproduction process in plants, For Example, flowers, fruits

Reproduction in plants can be categorized into two types:

- **Asexual Reproduction** – The new plants are produced without using the seeds. In this process, generally, the leaves, stems and roots participate in reproduction.
- **Sexual Reproduction** – The new plants are produced with the help of the seeds of a plant. In this process, the flowers of the plants participate in reproduction.
  - **Shoot** – A young plant is often termed as a shoot. Generally, a shoot is regarded as a part of the plant which has stems, leaves and flowers.
  - **Node** – It is a part of the stem or branch of a plant from where the leaf arises.
  - **Vegetative Buds** – Sometimes buds are present in the leaves that are capable of developing into shoots. These are called **Vegetative Buds**.

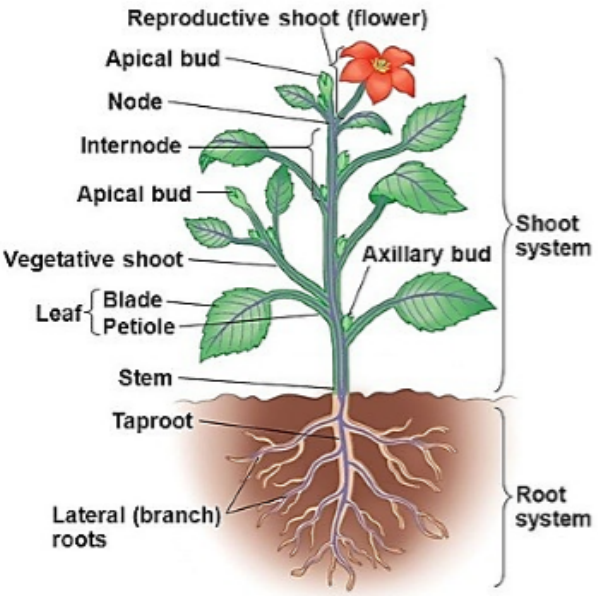


Figure 1: Roots and Shoot in a Plant

Different types of Asexual Reproduction:

1. Vegetative Propagation

- As the name suggests this type of reproduction takes place with the help of the vegetative parts of the plant. Only one parent can produce the identical offspring in vegetative propagation.

Natural means of Vegetative Propagation:

Vegetative Propagation by Roots

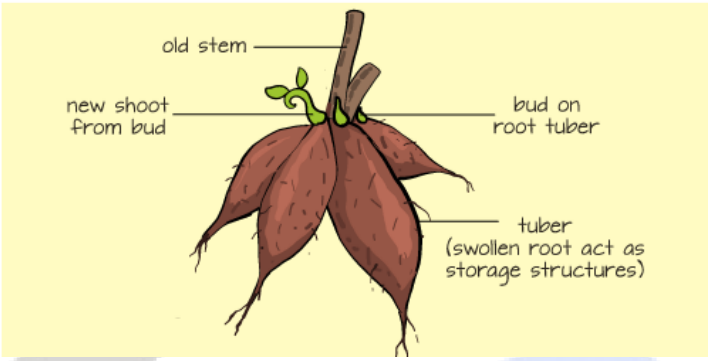


Figure 2: Vegetative propagation by roots in Sweet Potato

- Plants that have tuberous roots, that is, roots which are used as a storage organ in plants participate in vegetative propagation.
- In order to grow new plants, these tuberous roots are sown in the soil.
- There are buds present on the fruits that grow above the ground and a new plant is formed.
- Example: Sweet potato and dahlia

Vegetative Propagation by Stem

- **Stem Tubers**: Just like tuberous roots, some plants have tuberous stems. These stem tubers store the nutrients and bear nodes. These notes bear buds that form the new plants. Example: Potato

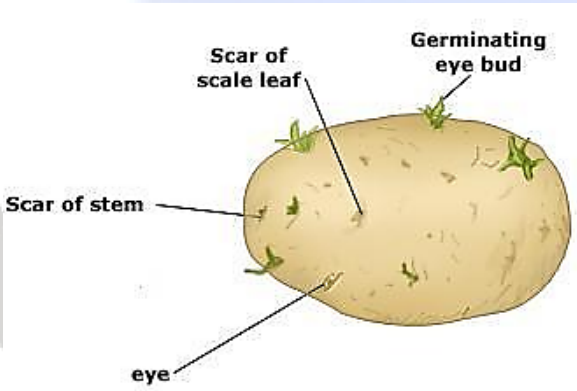


Figure 3: Vegetative propagation by stem in Potato

- **Runners**: Some plants grow along the ground and contain modified stems called **Runners**. These runners contain buds that can produce roots and stems. Example: Strawberries

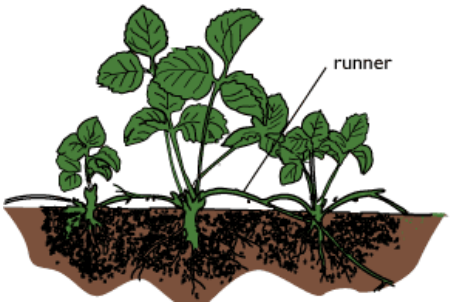


Figure 4: Vegetative propagation by runners stems

Vegetative Propagation by Leaves

- Some plants have leaves that contain buds that can develop into a new plant. Example: Bryophyllum

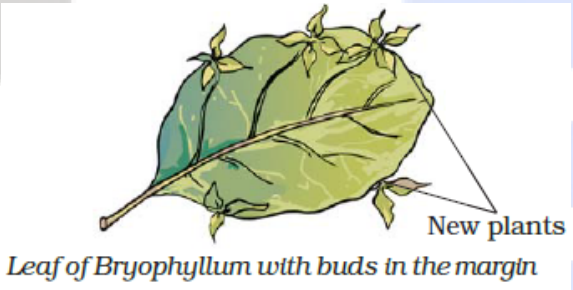


Figure 5: Vegetative propagation by leaves of Bryophyllum

Artificial means of Vegetative Propagation

- **Cutting** - It is a method in which a cutting from a plant is taken and planted. This cutting is a part of the stem or the branch of the plant. Example: Roses

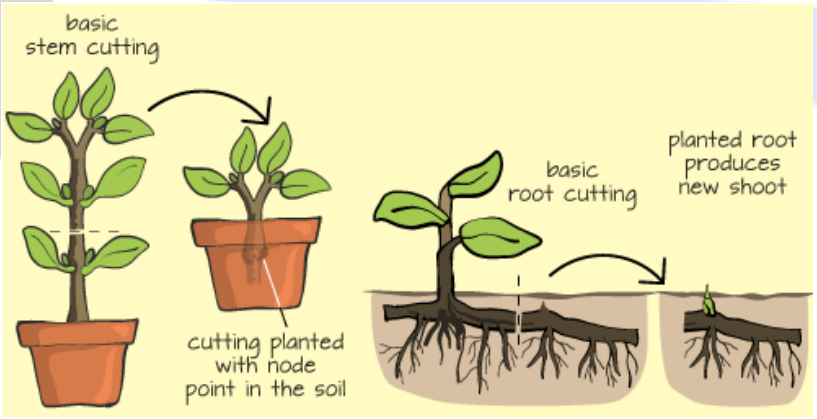


Figure 6: Cutting

- **Grafting** - Sometimes two plants are joined together so that both of them can provide the desired characteristics to the new plant. One plant remains rooted in the ground, which is called the Stock, and provides the essential nutrients and water while the other plants' stem is attached to it. In this way, a new plant develops. Example: Apples

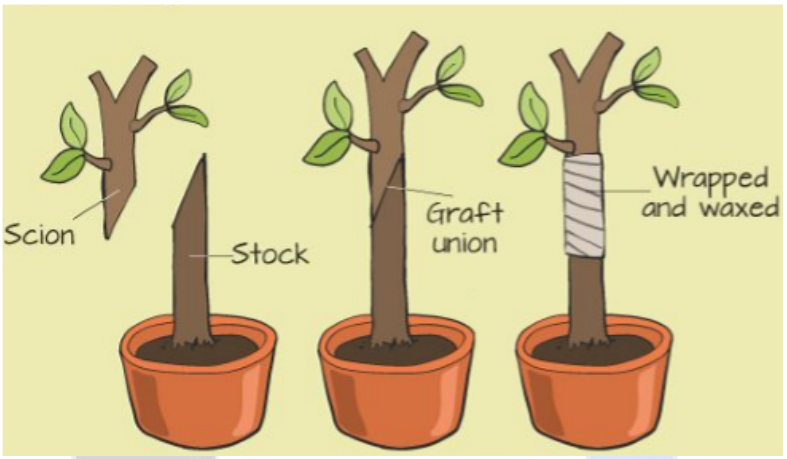


Figure 7 Grafting

Advantages of Vegetative Propagation

- The plants that are produced with vegetative propagation grow faster than those that are produced with sexual reproduction.
- The plants that reproduce with vegetative reproduction have fruits and flowers ahead of time.
- The plants that are produced have exactly the same characteristics as that of their parents.

2. Budding

- Yeast is an organism that contains a single cell. It is a fungi not a plant.
- It can propagate every few hours if the proper amount of nutrients are available to it.
- As the yeast finds favourable conditions, a small bulb-like projection produces from the yeast called **Bud**.
- The bud grows gradually and then gets detached from the parent yeast.
- This new cell then grows measures and produces more cells.

Sometimes a chain of buds is formed which leads to the production of a large number of yeasts altogether.

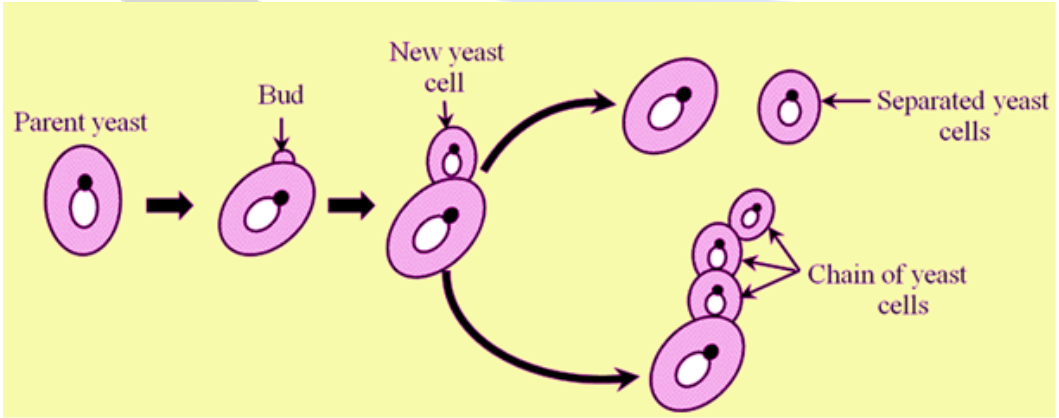


Figure 8: Budding in Yeast

3. Fragmentation

- Algae like *Spirogyra* generally reproduce by the process of fragmentation in which they divide themselves into multiple parts.
- As soon as the algae find enough water and nutrients, it fragments and grows into new individuals.
- This process continues and algae multiply quickly in a short period of time.

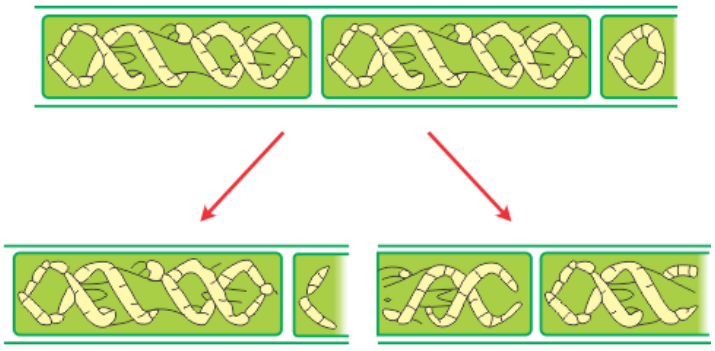


Figure 9: Fragmentation in Algae

4. Spore Formation

- Some plants contain spores that float in the air and cause asexual reproduction.
- A spore has a hard protective cover which protects it from the unfavourable environmental conditions like temperature and humidity.
- As a result, the spores can travel long distances and survive for a long duration of time.
- As soon as they find favourable conditions such as moisture and nutrients, they germinate and form new plants.
- For Example, Moss and ferns propagate in this way.

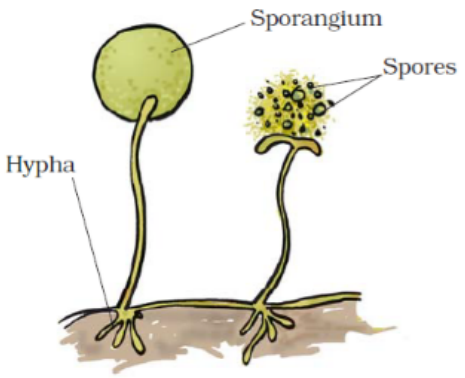


Figure 10: Spore Formation in Fungus

Sexual Reproduction in Plants

- The flowers of a plant are its reproductive organs that participate in the sexual reproduction process.
- The male reproductive parts of a plant are called **Stamen**.
- The female reproductive parts of a plant are called **Pistil**.

- Some flowers contain both stamen and pistil and are called **Bisexual Flowers**. Eg. Lily, rose, brinjal, hibiscus, petunia, mustard etc.
- Some flowers contain either the statement or the pistil and hence are called **Unisexual Flowers**. Eg. papaya, watermelon, cucumber, coconut etc.
- The new plant produced contains the characteristics of both plants that participate in the sexual reproduction.
- The stamen consists of **Anther** that has **pollen grains**. These pollen grains produce male gametes.

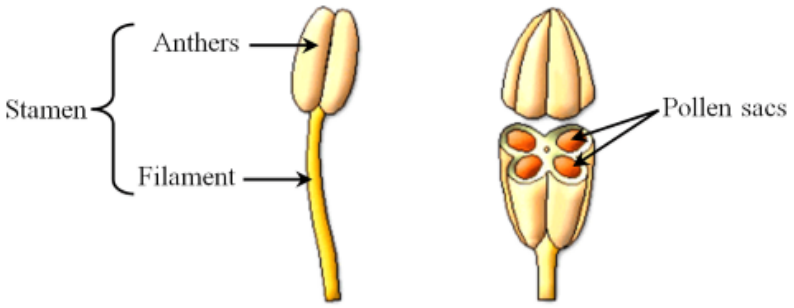


Figure 11: Stamen

- The pistil consists of three parts:
  - **Stigma** – It is a sticky surface where pollen grains get attached.
  - **Style** – It is a tube-like structure which connects the stigma and the ovary.
  - **Ovary** – It contains eggs in which the female gametes or eggs are formed.

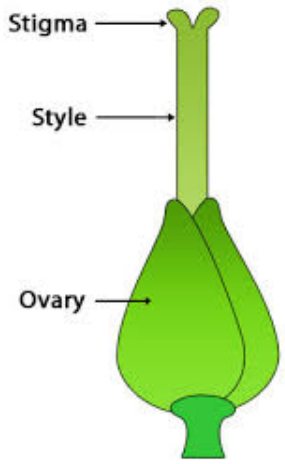


Figure 12: Pistil

How the male gametes reach the female gametes in plants?

- The male and female gametes fuse and form a **zygote**.
- The male gametes reach the female gametes by the process of pollination.
- The pollen grains have a tough covering which allows them in surviving the different climatic conditions.

- Due to their lightweight, winds and water often carry them away to different plants. Sometimes the pollen grains also get attached to insects which carry them to different flowers.
- This process of transfer of pollen grains from one stigma to another is called **Pollination.**

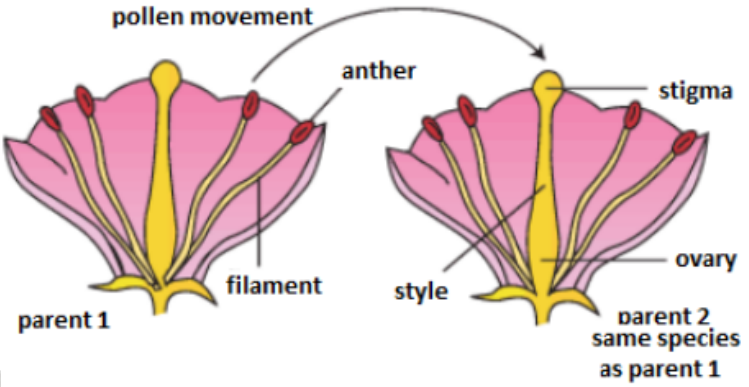


Figure 13: Pollination

- There are two types of pollination:
  - **Self-pollination/ Autogamy**: When the pollen grains land on the stigma of the same flower.
  - **Cross-pollination/ Xenogamy**: When the pollen grains land on the stigma of a different flower, whether of similar kind or different kind.

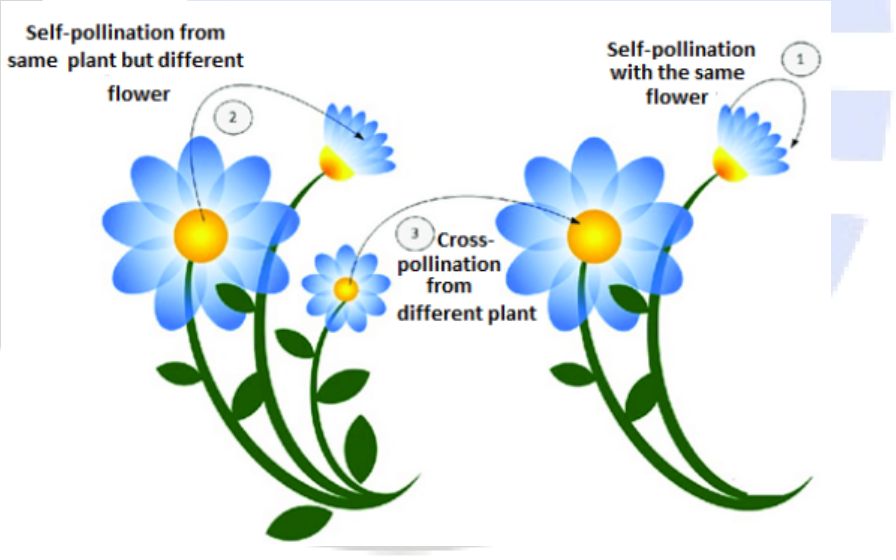


Figure 14: Self-pollination and Cross-pollination

The Fertilization Process

- A zygote is formed as the fusion between the male and female gametes occurs.
- This process of formation of the zygote is called **Fertilization**.
- Then the zygote develops and turns in an embryo.

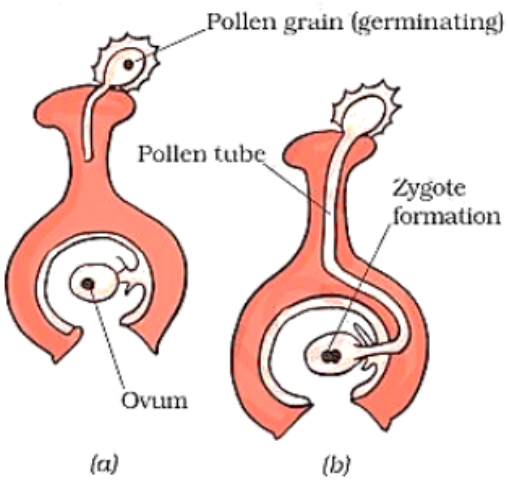


Figure 15: Fertilization

How fruits and seeds are formed?

- After the fertilization process, the ovary of the flowers grows and develops into a fruit.
- The remaining parts of the flower fall off.
- The ovules develop and form the seeds of the fruits.
- The embryo is enclosed inside the seeds.
- Some fruits are fleshy and juicy such as mango, apple and orange. Some fruits are hard like almonds and walnuts

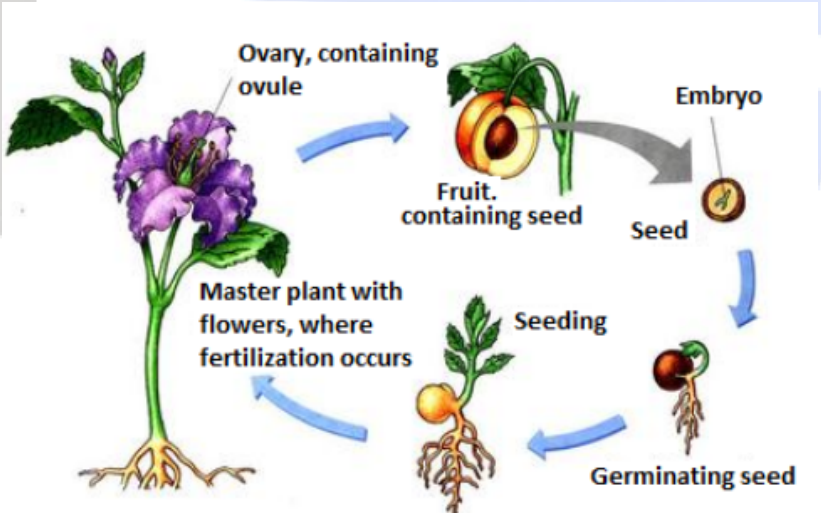


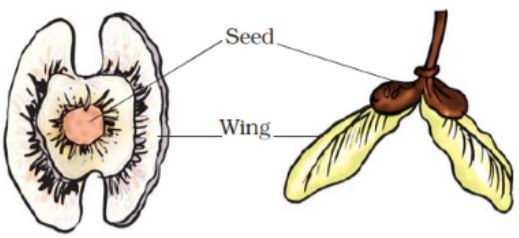
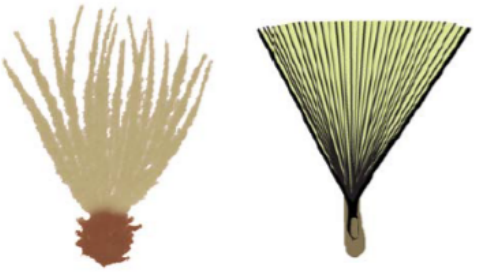
Figure 16: Formation of Fruits and Seeds

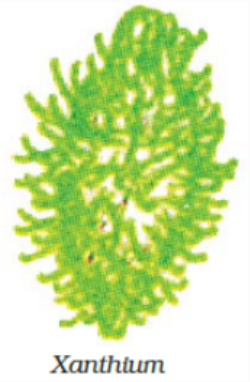
What is seed dispersal?

- The transportation of seeds from the parent plant to different places is called seed dispersal.
- Seed dispersal allows growth of the same kind of plants in different regions.
- This is helpful because it minimizes the competition for food, sunlight, water and minerals among the plants of the same kind in the same area.

- It also allows them to grow in different habitats.

How the dispersion of seeds occurs?

Distribution Factors	Types of Seeds that propagate	
Winds	Drumstick, Maple (Winged Seeds) Grasses (Light weight Seeds) Aak (Hairy Seeds) Sunflower (Hairy Fruits)	 (a) (b) *Seeds of (a) drumstick and (b) maple*  (a) (b) *(a) The hairy fruit of sunflower and (b) hairy seed of madar (aak)*
Water	Coconut (Seeds with spongy and fibrous coating so to float in water)	 **Figure 19: Coconut Seed**

Animals	Spiny seeds like Xanthium and Urena get attached to bodies of animals	
Fruit Bursts	Castor, Balsam	 **Figure 21: Seed Dispersal in Balsam Plant**