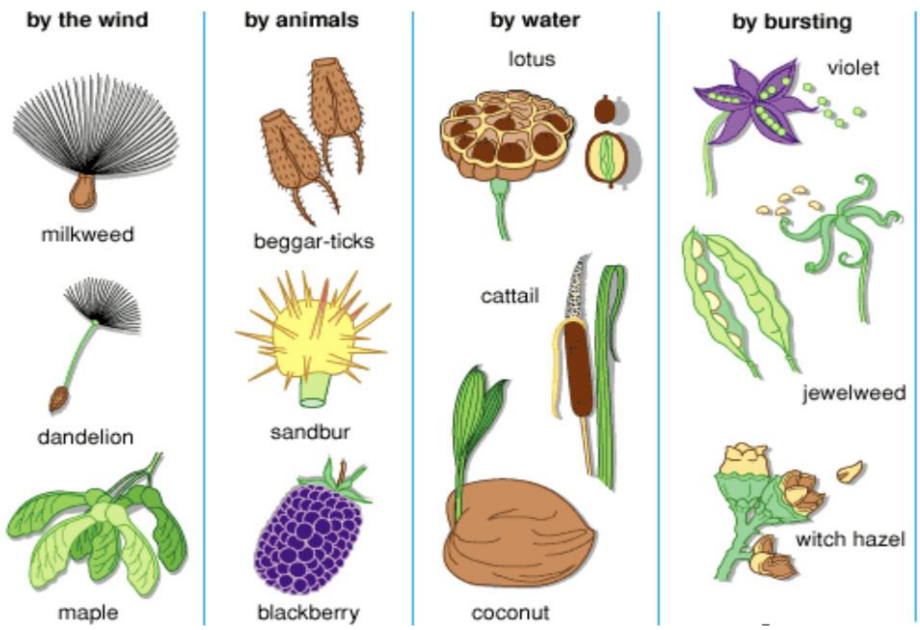
Mutualism

Mutualism is an obligatory positive interspecific interaction that is strongly beneficial to both species. In past, it was termed **symbiosis** . Such mutually beneficial interactions are more common in the tropics than elsewhere. In this case, both of the species derive benefit and there exists a close and often permanent and obligatory contact which is more or less essential for the survival of each. In mutualism, two populations enter into some sort of physiological exchange and resulted in the coevolution of both species . Some common examples of the mutualistic association are the following :

1. **Pollination by animals.** Certain insects such as bees, moths, butterflies, etc., and birds derive food from the nectar, pollen or other plant products, and in return bring about cross-pollination. To ensure the success of this function, various structural adaptations have occurred in both plants and animals, leading to coevolution.

Pollination By Animals

2. **Dispersal of fruits and seeds.** Birds and mammals are of great importance as agents of plant distribution. Seeds, fruits, even entire plants become attached to feathers or fur or ingested seeds are eaten and eliminated unharmed with the faeces.

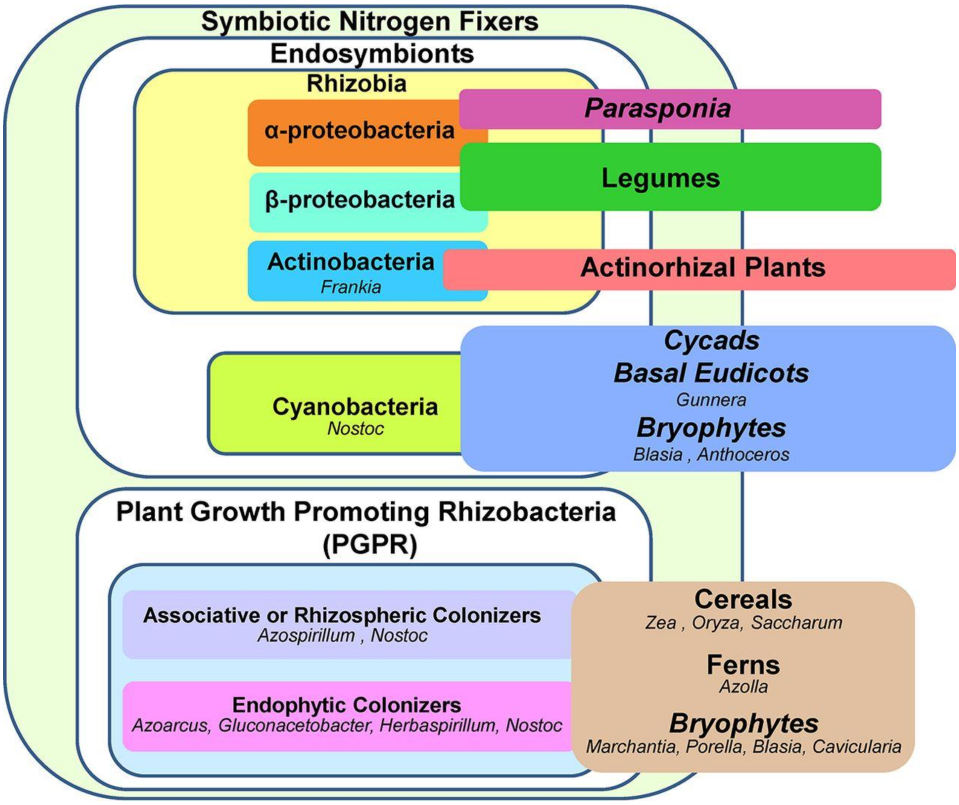


Dispersal of fruits and seeds

3. **Mutual defence in ants and acacias.** A mutualistic system of defence has been achieved by the swollen thorn acacias and their ant inhabitants in the New World Tropics. The ants (Pseudomyrmex sp.) depend on acacia (Acacia sp.) tree for food and a place to live and the acacia depends on the ants for protection from herbivores and neighbouring plants (**Janzen**, 1966). Swollen-thorn acacias (e.g., Acacia cornigera) have large, hollow thorns in which ants live. The ants feed on modified leaflet tips, called **Beltian bodies**, which are the primary source of protein and oil for the ants, and also on enlarged nectaries, which supply sugars. Swollen thorn acacias maintain year-around leaf production, even in the dry season, to provide food for the ants. The acacia ants continually patrol the leaves and branches of the tree and immediately attack any herbivore that attempts to eat acacia leaves or bark. The ants also bite and sting any foreign vegetation that touches an acacia, and they clear all the vegetation from the ground beneath the acacia tree. Some of the species of ants that inhibit acacia thorns are obligate acacia ants and live nowhere else.
4. **Lichens.** They form the examples of mutualism where contact is close and permanent as well as obligatory. The body of lichens is made up of a matrix formed by a fungus, within the cells of which an alga is embedded. The fungus makes available the moisture and minerals to the algae, which prepare food by photosynthesis. In nature, neither of the two can grow alone

independently. Lichens tend to grow abundantly on bare rock surfaces.

5. **Symbiotic nitrogen fixation.** Here a bacterium Rhizobium forms nodules in the roots of leguminous plants and lives symbiotically with the host. Bacteria get a protective space to live in and derive prepared food from the roots of higher plants and in return fix gaseous nitrogen, making it available to the plants. The leguminous plants use this nitrogen in the protein synthesis and so legumes are rich in proteins. Nitrogen fixation-like association also occurs in root nodules of Alnus, Alopecurus, Casuarina, Cycadacease, Myrica, Podocarpus, etc., and leaves of about 400 species of non-leguminous plants.



Symbiotic nitrogen fixation

6. **Mycorrhizae.** In mycorrhizal associations, tree roots become infested with fungal hyphae. The fungi derive their food from the tree roots and in return, their hyphae supply water and minerals that they absorb from the soil much like the root hairs of trees. It is believed that the fungus also regulates the pH and sugar level for good growth of roots in acidic soils (e.g., conifers). Mycorrhizae may be on the surface of roots (**ectotrophic**) or inside between the cells of the roots (**endotrophic**). Ectotrophic mycorrhizae are common in nature on pines, oaks, hickories and beech and

endotrophic ones occur in red maple and are common in roots and other tissues of many orchids and members of Ericaceae. The other similar root associations are met with actinomycetes (actinorhizal) in the form of nodules and with some blue-green algae (cyanobacteria) such as Anabaena and Nostoc forming coralloid roots of Cycas. Both of these kinds of associations are connected with nitrogen fixation by microscopic organisms present in the roots.

7. **Zoochlorellae and Zooxanthellae.** Some unicellular photosynthetic plants, especially algae, known as zoochlorellae, live symbiotically in the outer tissues of certain sponges, coelenterates, molluscs and worms. Some brown or yellow cells, probably flagellates (zooxanthellae) are also present. Algae are photosynthetic and produce oxygen and nitrogenous compounds beneficial to hosts and in exchange, they obtain materials such as carbon dioxide and nitrogenous wastes released by the metabolism of host animals. The unicellular green alga, Chlorella vulgaris lives within the gastrodermal cells of Hydra. Likewise, alga Zoochlorella lives in a planarian, Convoluta roscoffensis.

8. **Microorganisms and cellulose digestion.** Interspecific mutualism is nicely demonstrated by the flagellate protozoan, Trichonympha an obligate anaerobe in the gut of several species of woodeating termites where it digests cellulose. Trichonympha also occurs in the alimentary canal of woodeating roach Cryptocerus. The termite and roach reduce the wood to small fragments, passing them through the alimentary canal to hind gut, where the protozoans digest the cellulose, changing it into sugar. The host benefits the protozoa by removing harmful metabolic waste products and maintaining anaerobic conditions in the intestine.
9. **Fungus gardens.** There exist certain mutualistic associations between insects and fungi. For example, the insect-fungus-galls of gall insects (e.g., midge, Lasioptera) are lined by a fungus which is parasitic on the host plant. It is believed that the female midge deposits spores of fungus at the time she lays her eggs in the plant or when insect sucks plant sap. Gall fungus seems to assist the insect indirectly by partly breaking down the tissues so that the insect can digest it. Besides these gall insects, there are various cases of insect gardeners such as ambrosia beetles, tropical termites and American ants which do gardening of fungi in their nests to get a regular supply of their food directly or indirectly.