Reproduction of fungi

Reproduction is the formation of new individuals having all the characteristics typical of the species. Two general types of reproduction are recognized: Sexual and asexual. Asexual reproduction sometimes called somatic or vegetative, does not involve the union of nuclei sex cells or sex organs. Sexual reproduction on the other hand, is characterized by union of two nuclei.

In the formation of reproductive organs, either sexual or asexual, the entire thallus may be converted into one or more reproductive structure, so that somatic and reproductive phases do not occur together in the same individual, fungi that follow this pattern are called (Holocarpic) . In the maturity of fungi, however the reproductive organs arise from only a portion of the thallus, while the remainder continuous its normal somatic activities, the fungi in this category are called (Eucarpic).

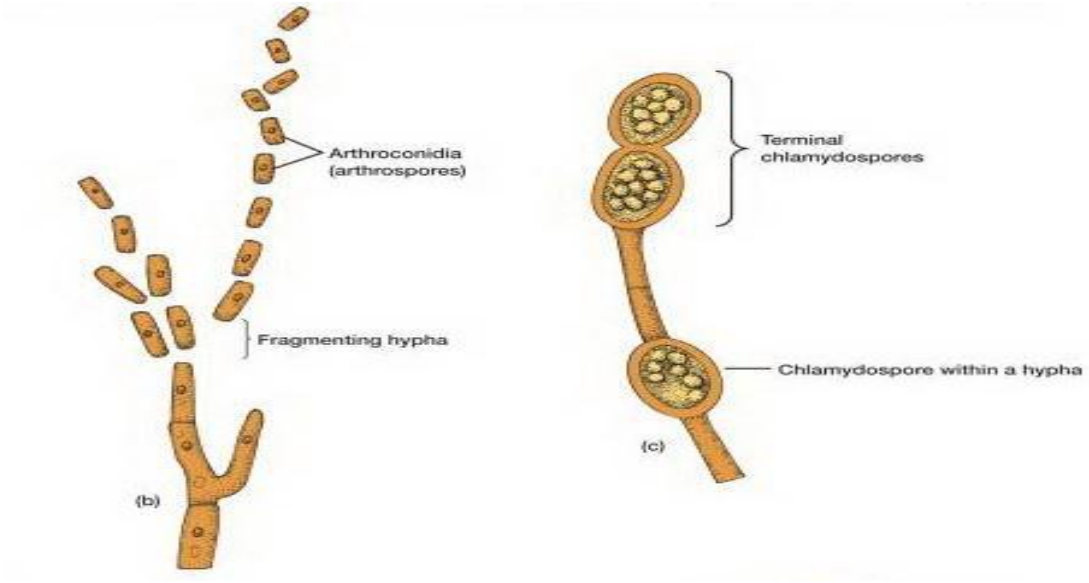
Asexual Reproduction

In general, asexual reproduction is more important for the propagation of the species because it results in the production of numerous individuals, and particularly since the asexual cycle is usually repeated several times during the season, whereas the sexual stage of many fungi is produced only once a year.

The asexual methods of reproduction commonly found in fungi may be summarized as follows

1) Fragmentation

Each fragment growing into a new individual. Some fungi employ fragmentation of hyphae as a normal means of propagation. The hyphae may break up into their component cells that behave as spore. These spores are known as **arthrospores**. If the cells become enveloped in a thick wall before the separate from each other or from other hyphal cell, they are often called **chlamydospores**. Fragmentation may also occur accidentally by the tearing off of parts of the mycelium through external forces. Such pits of mycelium under favorable conditions will start a new employ mycelia fragmentation to keep fungal cultures growing on artificial media by transferring a bit of mycelium to fresh media and thus starting a new colony.



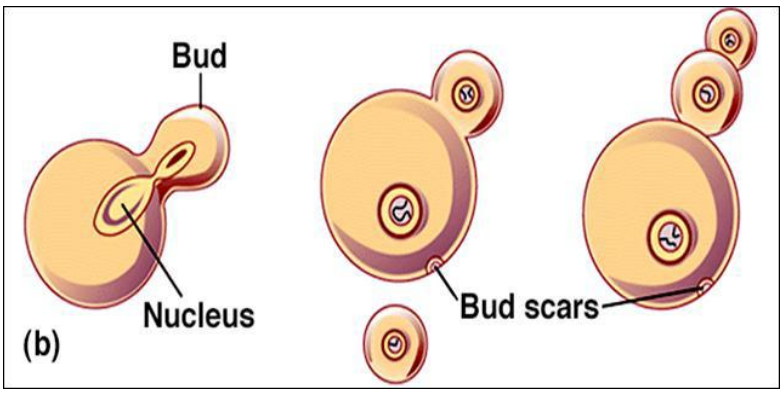
Arthrospores and chlamydospores

2) Simple fission of somatic cells into daughter cells

Fission, the simple splitting of a cell into two daughter cells by constriction and formation of a cell wall, is characteristic of a number of simple organisms including some yeast.

3) Budding of somatic cell or spores

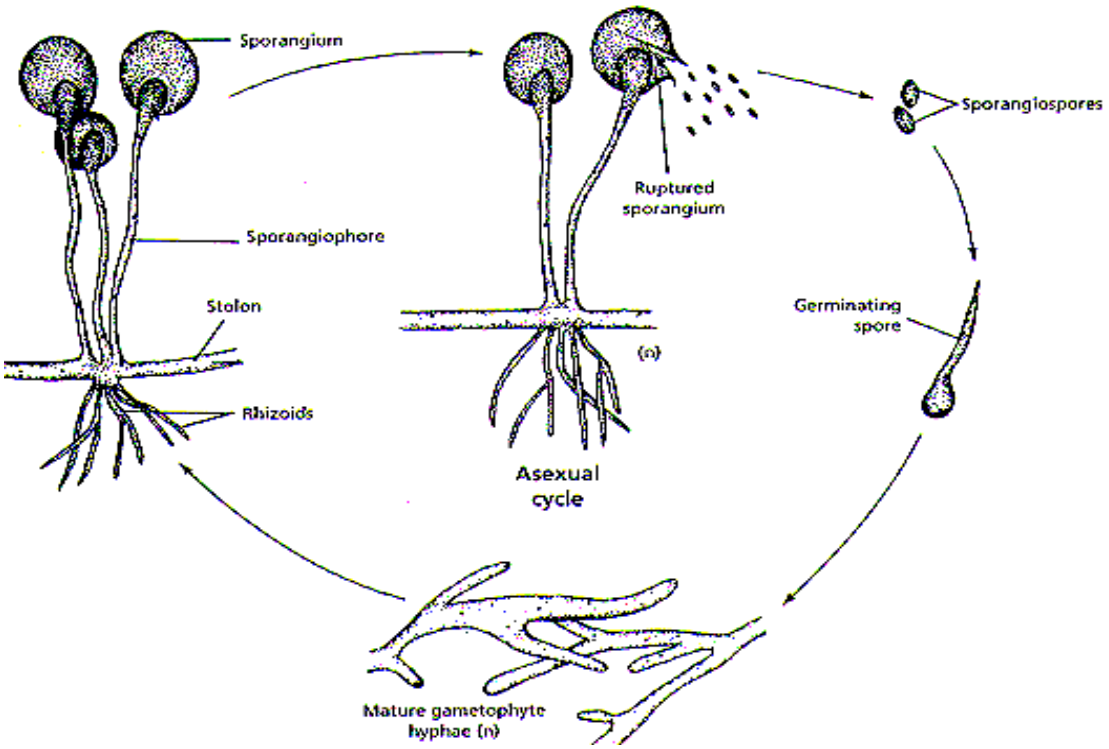
Each bud producing a new individual. As the bud is formed, the nucleus of parent cell divides and one daughter nucleus migrates into the bud. The bud increases in size while still attached to the parent cell and eventually breaks off and form a new individual, example ***Saccharomyces*** **.**



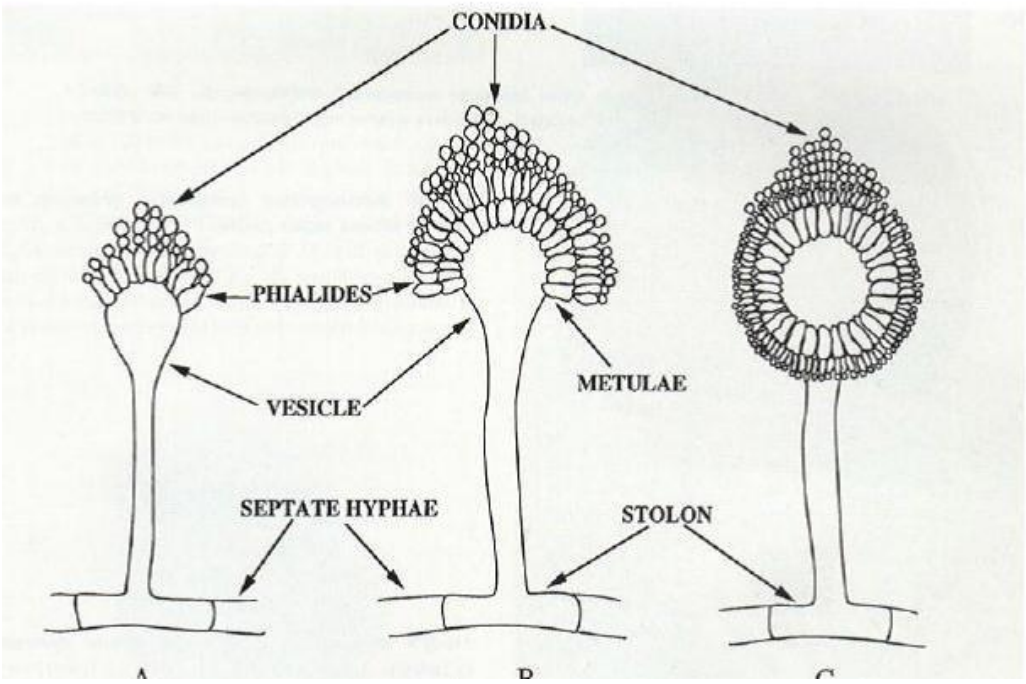
Budding

4) Spore formation(vegetative reproduction)

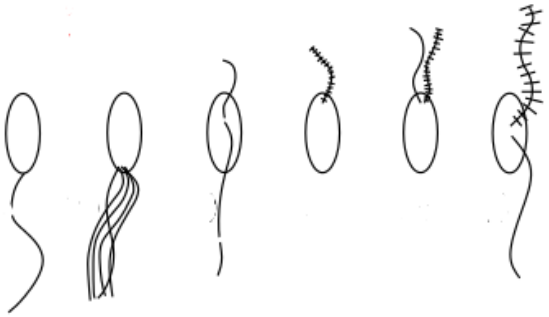
The most common method of asexual reproduction in fungi is by means of spores. Spores vary in color from hyaline through green, yellow, orange, red, brown to black; in size from minute to large; in shape from globose through oval, oblong, needle-shape to helical; in number of cell, from one to many; in the arrangement of cells; and in the way in which the spores them-self is borne . Some fungi produce only one type of spore, whereas other produces as many as four types. Fungal spores produced asexually are either borne in **sporangia** (sporangium) and then are called **Sporangiospores** as in ***Rhizopus*** and ***Mucor*** , or are produced at the tips or sides of hyphae in various ways and are then called **conidia** (conidium) as in ***Aspergillus* spp**. Sporangiospores may be motile or non- motile. In simpler fungi the Sporangiospores are usually motile and are called **zoospores**, if non- motile are called **aplanospores**. Fungal zoospores are equipped with one or two flagella (flagellum). There are at least two types of flagella in the fungi: The **whiplash** and **tinsel**. The flagella in fungi are differing in position, types, and number.



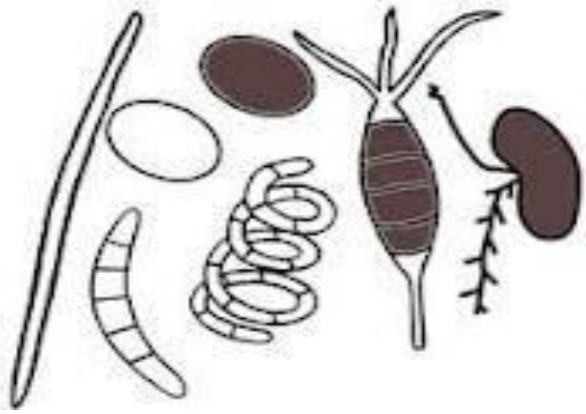
Sporangiospores formation in *Rhizopus*



conidia formation in *Aspergillus* spp.



Whiplash and tinsel flagella



Varity of spore shapes and size

Sexual reproduction

sexual reproduction in fungi as in other living organisms involves the union of two compatible nuclei. The process of sexual reproduction typically consist of three distinct phases:

1.Plasmogamy: a union of two protoplasts brings the nuclei close together within the same cell.

2.Karyogamy: The fusion of the two nuclei brought together by plasmogamy.

3.Mieosis: The reduction of chromosomes number to the half. Karyogamy follows plasmogamy almost immediately in many of the simpler fungi.

In the more complex fungi, however, those two processes are separated in time and space, with plasmogamy resulting in a binucleate cell containing one nucleus from each parent. Such pair of nuclei we call a **(Dikaryon)**. The sex organs of fungi are called **gametangia** (gametangium), these may form differentiated sex cell called **gametes** or may contain instead one or more gamete nuclei. We use the terms **(isogametangia and isogametes)** to designated gametangia and gametes that are morphologically indistinguishable; we use **(heterogametangia and heterogametes)** to designate male and female gametangium and gamete that are morphologically different, in the later case , the male gametangium is called the(**antheridium**) and the female is called the (**Oogonium**).

We now list the various methods by which compatible nuclei are brought together in the process of plasmogamy. These methods are often referred to as methods of sexual reproduction. Fungi employ five general methods to bring compatible nuclei together for fusion. These methods are:

1.Planogametic copulation: Planogametic copulation involves the fusion of two naked motile gametes (planogametes) as in ***Allomyces***.

2. Gametangial contact: Here gametes are not released from gametangia, instead male and female gametangia come in close contact with help of fertilization tube. Then one or more male nuclei migrate in to the female gametangium. The gametangia never fuse or lose their identity during the sexual act. Male gametangium is called antheridium and and female gametangium called Oogonium (Ascogonium in Ascomycota) Example: ***Albugo, Aspergillus, Pythium***

3.Gametangial copulation: he entire content of two compatible gametangia fuse each other The gametangia come in close contact, wall at the point of contact dissolves and their contents mix each other Then karyogamy is established .Example **zygomycota**

4.Spermatization: In some higher fungi sex organs are completely absent Here sexual process is accomplished by minute spore like spermatia and specialized (receptive) hyphae acting as male and female structures respectively spermatia are carried by air, water or insect to the receptive hyphae. Spermatia attached to the trichogyne of receptive hyphae and migrate in to the cytoplasm .

5.Somatogamy. in this method, sex organs are not formed and two vegetative cells or vegetative hyphae take over the sexual function and fuse together
advanced fungal groups such as ***Morchella, Peziza, Agaricus***.

Sexual compatibility : Those in which every thallus is sexually self-fertile and, can therefore, reproduce sexually by it self without the aid of anther thallus, these type of fungi we called **(Homothallic fungi).** Those in which every thallus is sexually self-sterile, and requires the aid of anther compatible thallus or a different mating type for sexual reproduction, these types of fungi called **(Heterothallic fungi).**