

Fragmentation (reproduction)

Fragmentation or **clonal fragmentation** in multi cellular or colonial organisms is a form of asexual reproduction or cloning in which an organism is split into fragments. Each of these fragments develop into mature, fully grown individuals that are clones of the original organism.

The splitting may or may not be *intentional* – it may or may not occur due to man-made or natural damage by the environment or predators. This kind of organism may develop specific organs or zones that may be shed or easily broken off. If the splitting occurs without the prior preparation of the organism, both fragments must be able to regenerate the complete organism for it to function as reproduction.

Fragmentation, also known as splitting, as a method of reproduction is seen in many organisms such as filamentous cyanobacteria, molds, lichens, many plants, and animals such as sponges, acoel flatworms, some annelid worms and sea stars.

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Fragmentation in various organisms

Moulds, yeasts and mushrooms, all of which are part of the Fungi kingdom, produce tiny filaments called hyphae. These hyphae obtain food and nutrients from the body of other organisms to grow and fertilize. Then a piece of hyphae breaks off and grows into a new individual and the cycle continues.

Many lichens produce specialized structures that can easily break away and disperse. These structures contain both the hyphae of the mycobiont and the algae(phycobiont) (see soredia and isidia. Larger fragments of the thallus may break away when the lichen dries or due to mechanical disturbances(see the section on reproduction in lichens).

Plants

Fragmentation is a very common type of vegetative reproduction in plants. Many trees, shrubs, nonwoody perennials, and ferns form clonal colonies by producing new rooted shoots by rhizomes or stolons, which increases the diameter of the colony. If a rooted shoot becomes detached from the colony, then fragmentation has occurred. There are several other mechanisms of natural fragmentation in plants.

- Production of specialized reproductive structures: A few plants produce adventitious plantlets on their leaves, which drop off and form independent plants, e.g. Tolmiea menziesii and Kalanchoe daigremontiana. Others produce organs like bulbils and turions.
- Easily lost parts that have high potential to grow into a complete plant: Some woody plants like the willow naturally shed twigs. This is termed cladogenesis. The lost twigs may form roots in a suitable environment to establish a new

plant. River currents often tear off branch fragments from certain cottonwood species growing on riverbanks. Fragments reaching suitable environments can root and establish new plants.^[4] Some cacti and other plants have jointed stems. When a stem segment, called a pad, falls off it can root and form a new plant. Leaves of some plants readily root when they fall off, e.g. *Sedum* and *Echeveria*.

- Fragmentation is observed in nonvascular plants as well, for example, in liverworts and mosses. Small pieces of moss "stems" or "leaves" are often scattered by wind, water or animals. If a moss fragment reaches a suitable environment, it can establish a new plant.^[2] They also produce gemmae, for example in the splash-cups of *Marchantia polymorpha*^[3] that are easily broken off and distributed.

People use fragmentation to artificially propagate many plants via division, layering, cuttings, grafting, micropropagation and storage organs, such as bulbs, corms, tubers and rhizomes.

Animals

Animals like sponges and coral colonies naturally fragment and reproduce. Many species of annelids and flat worms reproduce by this method.

When the splitting occurs due to specific developmental changes, the terms architomy, paratomy and budding are used. In **architomy** the animal splits at a particular point and the two fragments regenerate the missing organs and tissues. The splitting is not preceded by the development of the tissues to be lost. Prior to splitting, the animal may develop furrows at the zone of splitting. The headless fragment has to regenerate a complete head.

In **paratomy**, the split occurs perpendicular to the antero-posterior axis and the split is preceded by the "pregeneration" of the anterior structures in the posterior portion. The two organisms have their body axis aligned i.e. they develop in a head to tail fashion. Budding can be considered to be similar to paratomy except that the body axes need not be aligned: the new head may grow toward the side or even point backward (e.g. *Convolutriloba retrogemma* an acoel flat worm).^{[4][5]}

Coral

Many types of coral colonies can increase in number by fragmentation that occurs naturally^[6] or artificially. Within the reef aquarium hobby, enthusiasts regularly fragment corals for a multitude of purposes including shape control; selling to, trading with, or sharing with others; regrowth experiments; and minimizing damage to natural coral reefs. Both hard and soft corals can be fragmented. Genera that have shown to be highly tolerant of fragmentation include *Acropora*, *Montipora*, *Pocillopora*, *Euphyllia*, and *Caulastraea* among many others.^[7]



Corals can be multiplied in aquaria by attaching "frags" from a mother colony to a suitable substrate, such as a ceramic plug or a piece of live rock. This aquarium is designed specifically for growing coral colonies from frags.

Echinoderms

In echinoderms, the process is usually known as **fissiparity** (a term also used infrequently for fission in general). Some species can intentionally reproduce in this manner through autotomy. This method is more common during the larval stages.^[8]

Disadvantage of this process of reproduction

As this process is a form of asexual reproduction, it does not produce genetic diversity in the offspring. Therefore, these are more vulnerable to changing environments.

See also

- Fission (biology)
- Budding

- Micropropagation

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