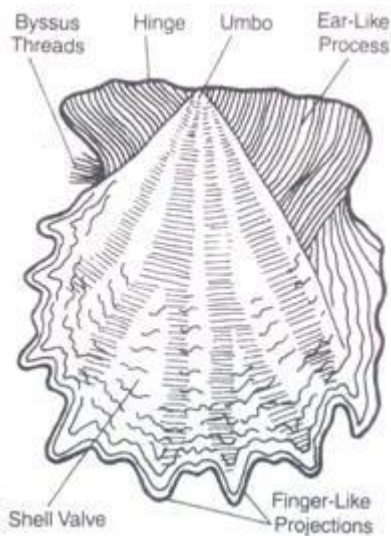


Wonders of animal world part I

Mechanism of pearl formation in Mollusca

Pearl is a valuable gem known to mankind since ancient times. The pearl oyster belongs to genus *Pinctada*, family pteriidae, and class bivalvia of phylum mollusca. The important species producing good quality of pearl are *Pinctada fucata*, *Pinctada marigavitifera* (produces the highly valuable black pearl), *Pinctada chemnitzii*, *Pinctada anamioides* and *Pinctada atropurpurea*. All these species are Marine and it is the marine forms which produce the pearl of fine quality. *P. fucata* species is the common pearl oyster of India. The major sites of pearl fisheries in India are Gulf of Manaar both on Indian as well as Ceylonese sides, Gulf of Kutch, Palk Bay, Baroda and Tuticorin.

Certain fresh-water forms of mussels belonging to the genera unio and Anodonta also produce pearls but they are of inferior quality. However, the European species belonging to the family unionidae have been found to produce superior quality pearls.



External features of pearl oyster-

Source: <https://www.yourarticlelibrary.com/biology/pearl-culture-in-india-types-of-pearl-oysters-and-formation-of-pearl/24118>

Formation of Pearl:

Pearl is secreted by the mantle of the pearl oyster as a protection against foreign objects which may be sand particles, minute larval forms or a parasite. Whenever any sort of foreign body enters and gets between the mantle and shell, it becomes enclosed in a sac of mantle epithelium. This foreign body now acts as an irritant and stimulates the mantle epithelium to secrete concentric layers of nacre around this foreign body. These layers when harden becomes pearl. Size of pearl is directly proportional to the degree of irritation cause by foreign agents. Time taken for the formation of a pearl of average size is three to five years.

Shell of pearl oyster has three layers

1. Periostracum:

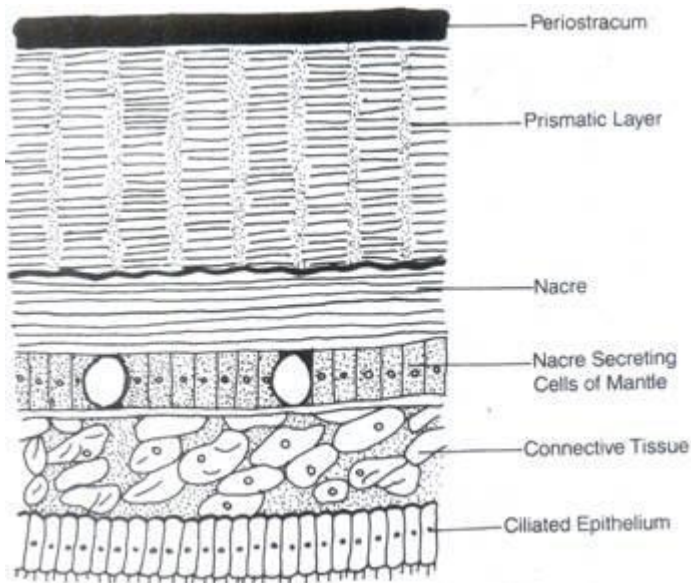
It is the outermost, greenish-brown, thin, translucent layer made up of an organic substance “Conchiolin”. It is secreted by mantle. It serves to protect the underlying layers from harmful effects of weak carbonic acid in water.

2. Prismatic Layer:

It is the middle layer secreted by mantle. This layer is made up of minute crystals of calcium carbonate, separated by thin layers of conchiolin. These crystals are arranged perpendicular to the shell surface. It gives strength and rigidity to the shell.

3. Nacreous Layer:

It is the innermost layer of shell also called as mother of pearl, because this layer is responsible for the formation of pearl. It consists of alternate layers of calcium carbonate and conchiolin, which are parallel to the surface of the shell. This layer is also secreted by mantle. It protects delicate surface from harmful effects of the foreign particles.

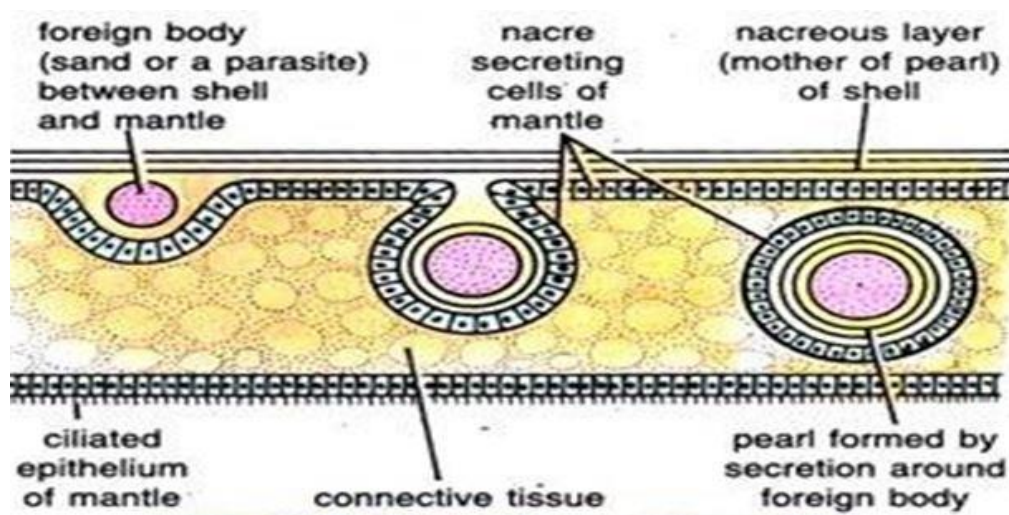


Shell & mantle of pearl oyster-

Mantle is also made up of three layers as follows-

1. Columnar epithelium- It contains numerous nacre secreting unicellular glands.
2. Connective tissue layer- It is middle fibrous layer, composed of connective tissue.
3. Ciliated epithelium- It is innermost layer containing mucous secreting cells.

A pearl has central foreign particle (called nucleus) around which several layers of nacre are laid to form beautiful pearl.



Stages in Formation of pearl-

<https://blog.ucbmsh.org/department/zoology-department/pearl-formation>

Bioluminescence in animals

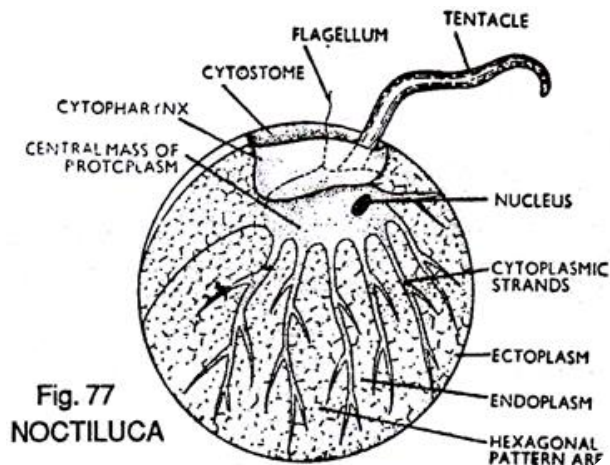
Bioluminescence is the production and emission of light by living organisms with the help of chemicals. It is thus a form of chemiluminescence called as 'cold light, portraying a spectra of red, green, yellow, orange, white, etc. It widely occurs in marine invertebrates and vertebrates as well as in some fungi, microorganisms like bacteria and terrestrial invertebrates like fire flies. In some animals, the light is produced by symbiotic organisms such as *Vibrio* bacteria. Yellow green light is produced by various insects including glow worms and fire flies, but it is in the oceans where we see most animal light.

1. Noctiluca:

Noctiluca is a unicellular, microscopic, free living marine animal belonging to kingdom Protista. It is noted for its phosphorescence at night, when stimulated, by night swimming, boating or the waves striking the rocks, it emits greenish white or bluish-white light and gives the water and the sand an eerie glow at night.

The phosphorescence is caused by the oxidation of certain phylogenetic granules scattered in the cytoplasm, having proteinaceous substance called luciferin, which under the influence of an enzyme luciferase emits light. Large populations of Noctiluca are called as blooms. Millions of Noctiluca collide due to wave action, lighting and adding sparkle to the water. Hence it is commonly called as 'Sea sparkle'.

The sea sparkle is used as a collective defense mechanism. It lights up when it senses the presence of predators nearby. The produced light attracts larger predators which eat up the small predators feeding on Noctiluca. Thus colony of Noctiluca remains safe.



Source: <https://www.bartleby.com/questions-and-answers/briefly-describe-the-cytoplasm-of-noctiluca./3a215c75-c78b-4bca-8ab1-7f846233edac>

2. Glow worm:

They are the larvae or maggots of some beetles and flies. Glow worms are found in shady, protected places with high humidity. They build 'snares' made of silk fibres coated with mucus. The snares consist of tubes in which the glow worms remain suspended as the long

hanging filaments coated in sticky beads of mucus. The glow worms emit a pale light which attract insects towards the sticky threads of their snare & get trapped in the snare. The snares actually catch small bugs such as midges, but insects as big as cockroaches can be entrapped.



Source: <https://www.alamy.com/stock-photo/glowworm.html>



Source: <https://teara.govt.nz/en/photograph/9737/glow-worm-snares>

3. Firefly:

It is a carnivorous beetle of the family Lampyridae. They are misnamed as fireflies. The flashing light is used by males and females to attract each other. The firefly regulates the emission of light by varying the amount of air supplied to the cells. The larvae and wingless females are known as glow worms. The larva of firefly has a flat, segmented body and possesses two little openings at the posterior end of the body through which a pale green glow is seen. The reason for larval glow is unknown. Many species are distinguished by their unique flashing pattern during courtship. Some female fireflies mimic the flashing pattern of females of other species and when the male of that species approaches them they feed on the male.

Sea firefly is a small crustacean found in the sediments. At rest it emits a dull glow, but when disturbed it darts away leaving a cloud of shimmering blue light to confuse the predator.



Source:<https://houstonsarboretum.org/2016/05/fireflies/>

4. Angler fish:

Distinctive bioluminescent patterns characterize the males and the females of many bathypelagic fishes. Tiny, light producing cells called photophores are arranged on their bodies. The light is also produced by symbiotic species of photobacterium and *Vibrio* bacteria in some fishes. Some photophores may act as signals in the darkness of the deep sea, where mates may be difficult to find.

Angler fish is a deep sea fish. In the deep sea where light does not penetrate, angler fish uses this light to lure prey. In angler fishes the photophores are present in the modified fin ray as lure, present on the head and are responsible for luminescence. The lure is called esca & it moves with the help of a basal bone that slides in a groove along the roof of the skull and the back. It looks like a fishing pole. Female angler fishes have a bioluminescent lure that is species specific.



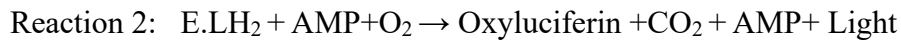
Source:<https://sketchfab.com/3d-models/angler-fish-aaafd31bf6b74167a9860f15520d511b>

Mechanism of bioluminescence:

The light is produced in a chemical reaction in which an enzyme, luciferase stimulates a reaction between Luciferin and oxygen, which results in the emission of light as well as oxyluciferin. It is a cold light source.

Reaction 1: $E+LH_2+Mg.ATP \rightarrow ELH_2,-AMP+ PP$

In this reaction Luciferase (E) combines with Luciferin (LH₂) in the presence of Mg-ATP, in which an adenyl transfer from ATP to the carboxyl group of Luciferin takes place to form luciferyladenylate with the elimination of inorganic pyrophosphate (PP).



In the second reaction, the enzyme complex reacts with oxygen to give light.

Significance of bioluminescence: Bioluminescence helps the animals in different ways, it includes counter illumination resulting in camouflage. Bioluminescent animals mimic other organisms by flashing light thus luring the prey, hence bioluminescence aids in feeding. This phenomenon also passes signals to other individuals of the same species to facilitate mating, thus helping in reproduction. The light emitted also conveys signals to the like individuals so as to alarm them against danger, thus escaping predation. The intensity may vary accordingly and that the emission may be limited to specific seasons. Some of the bioluminescent animals form a cloud of luminescent material hence distracting and repelling a potential predator, while the animal escapes to safety.

Regeneration in Animals

Regeneration is a process by which a lost or injured part of an organism is reformed or the formation of a whole organism occurs from a small part. The power of regeneration decreases as the complexity of organization of animals increases.

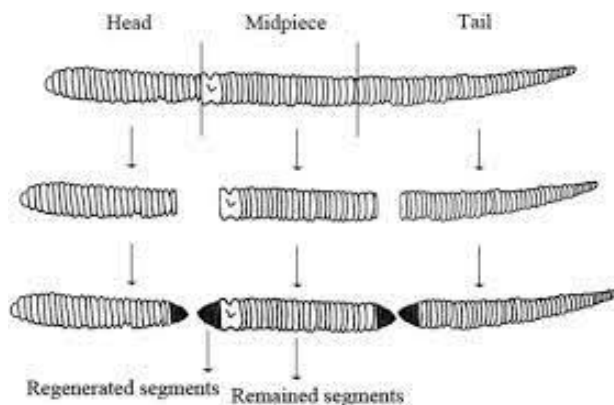
Regeneration in Earthworm (Annelida):

Earthworms have a considerable power of regeneration by which they produce segments that are either lost or damaged, but this ability is limited. The posterior portion is regenerated at a faster rate than the anterior which may be attributed to fewer complexities in the posterior region Clitellum and the sexual organs are not regenerated. It is observed that undifferentiated pluripotent cells migrate to the site of injury directed by the nerve cord. The said cells undergo mitotic divisions to produce the missing parts in the region. The number of segments regenerated is usually less than the number of segments lost

In regeneration, the wounded surface first seals and then a blastema is formed over the wound. The blastema is contributed by the mesoderm and is covered by the cells from the ectoderm. Hormones from the brain then help to create regenerative structures within the blastema. Another interesting aspect of regeneration is the importance of nervous systems and how it regenerates by itself Okada (1934) has found that a new head may be induced to form at any level in the body by transduction of the nerve cord. Regeneration is dependent on the presence of nervous tissue. When the nerve cord is severed just behind the sub-pharyngeal ganglion and the nerve cord hooked out of a hole from the side of the body, a lateral head and a few anterior segments are formed.



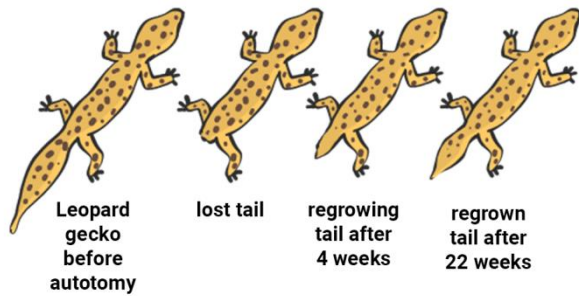
Fig: 1



Regeneration in Wall lizard (Reptilia):

Autotomy or self-amputation is the behaviour whereby the animal sheds or discards one or more of its own body appendages, usually for self-defense, to elude a predator's grip or to distract the predator and thereby allow escape. The lost body part is regenerated later. The new section will contain cartilage rather than regenerating vertebrae. In many species of lizards the tail vertebrae are incompletely ossified in the zone midway across the vertebra. If the tail is seized, the vertebrae separate at one of these breaking points and the animal scuttles to freedom and the lost part is regenerated over a period of few weeks.

The autotomous tail is characterized by various structural adaptations, which help minimize blood loss and trauma to the adjacent tissues. The early phase of wound healing involves a leucocytic response but limited inflammation. Regeneration begins with the formation of the blastema, a mass of proliferating mesenchymal cells. As the blastema expands, it is invaded by blood vessels and the spinal cord. It is also found that at least 326 genes at specific spots along the tail were turned on during regeneration, thus suggesting that lizard DNA has a genetic recipe for it. The skin of the regenerated part generally differs distinctly in colour and texture from its original appearance. It is a phenomenon seen in hemidactyls like geckos and skinks.



Mimicry

In evolutionary biology, **mimicry** is an evolved resemblance between an organism and another object, often an organism of another species. Often, mimicry functions to protect a species from predators, making it an anti-predator adaptation.

The resemblances that evolve in mimicry can be visual, acoustic, chemical, tactile, or electric, or combinations of these sensory modalities. Mimicry may be to the advantage of both organisms that share a resemblance, in which case it is a form of mutualism; or mimicry can be to the detriment of one, making it parasitic or competitive.

Defensive or protective mimicry takes place when organisms are able to avoid harmful encounters by deceiving enemies into treating them as something else.

The first three such cases discussed here entail mimicry of animals protected by [warning coloration](#):

- [Batesian mimicry](#), where a harmless mimic poses as harmful.
- [Müllerian mimicry](#), where two or more harmful species mutually [advertise](#) themselves as harmful.
- [Mertensian mimicry](#), where a deadly mimic resembles a less harmful but lesson-teaching model.

Batesian mimicry:

Batesian mimicry is named after [Henry Walter Bates](#), an English naturalist whose work on [butterflies](#) in the [Amazon rainforest is well known](#). It is the resemblance of the mimic to a model that is obnoxious or distasteful to predators. Many potential prey animals, the mimics, are edible but they resemble due inedible models, as they carry the same warning colours and patterns. The Great Eggfly (Female) is the Batesian mimic of the distasteful Common Crow. In this case, female, Egg fly, resembles the model, Common Crow, in markings on the Wings and both exhibit darker body colouration. When a gravid female starts laying eggs, her movements are very slow as she flies from one host plant to other. During this she is vulnerable to being attacked by a predator and by mimicking an obnoxious model she gets protection.

Mullerian mimicry:

Müllerian mimicry, named for the German naturalist [Fritz Müller](#), describes a situation where two or more species have similar warning or [aposematic](#) signals and both share genuine [anti-predation](#) attributes (e.g. being unpalatable). If a common predator confuses two species, individuals in both those species are more likely to survive. In this type of mimicry, a few distasteful or noxious species resemble each other thereby avoid being predated upon. All species having colour pattern identical to a noxious species tend to be avoided by the predators. This is because, once a predator comes to know about a noxious species, it will avoid all the mimics. Mullerian mimics are inedible themselves, but share the same appearance and warning colouration with another inedible species. This renders double protection from their predators



<https://naturallycuriouswithmaryholland.wordpress.com/2018/08/18/viceroy-vs-monarch/>



<https://www.treehugger.com/uncanny-animal-lookalikes-4869019>

Image- A. Viceroy & B.Monarch butterflies

The monarch butterfly (*Danaus plexippus*) is a member of a Müllerian complex with the viceroy butterfly (*Limenitis archippus*), sharing coloration patterns and display behaviour.

Monarch and Viceroy Butterflies share a unique quality. Both of these butterflies have a similar shape, both are almost the same size, and both have the same colors. These butterflies have orange wings with black veins and white spots on the black wing tips. The big difference is that the viceroys have a narrow black band across each hind wing. This black band is absent from the hind wings of the monarch. However, to the untrained eye, the monarch and the viceroy look alike.

It was found that the viceroy butterfly also has a taste that is offensive to the predators. Because both butterflies look alike and both taste bad, any predators who would have the misfortune of eating either species learn twice as quickly to avoid either butterfly. This type of mimicry, in which both similar looking species taste bad, is called Mullerian Mimicry and was named after Fritz Muller who was a 19th century Brazilian zoologist who first described this phenomenon.

Coral reefs

Corals (coral animals) are marine, solitary or colonial, polypoid coelenterates, living in a secreted skeleton of their own. Their calcareous or horny skeleton is also commonly known as **coral**. Some corals grow into massive, solid structures, others form large, branched colonies. Most of the corals belong to the class Anthozoa and a few to the class Hydrozoa of phylum coelenterata.

Coral Reefs

Coral colonies grow continuously in size by budding of polyps and often form extensive masses, known as coral reefs. According to T. Wayland Vaughan (1917). A coral reef is a ridge or mound of limestone, the upper surface of which is near the surface of sea and which is formed chiefly of calcium carbonate (CaCO_3) by the action of organisms chiefly corals. Principal builders of coral reefs are stony corals (Madreporaria), but other important contributors are Millepora, Tubipora, Heliopora, Alcyonaria, Gorgonians, Foraminifera, Coralline algae, branching algae, etc.. Reef building corals require warm shallow & clean waters (normally above 20°C). They are therefore limited to the Indo-Pacific, the Central-Western Pacific, and the Caribbean regions north of Bermuda. The upper surface of coral reef is just below the sea surface and it is exposed at low tides.

Types of coral reefs:

The coral reefs are of three kinds, depending on how they are formed.

1. Fringing reefs:

The fringing reefs are also called as shore reefs. They are built from sea bottom and extend from the shore upto 1/4 miles having no navigable channel between the shore and the reef. This zone of the sea is called edge or front. However, sometimes reef beds are broken to result into irregular channels called lagoon. Such reefs are composed largely of coral sand having living and dead corals building reefs, mud and other animals.

E.g. Fringing reefs can be seen at the New Hebrides Society islands off Australia and off the southern coast of Florida.

2. Barrier reefs

Barrier reefs are extensive linear reef complexes that parallel a shore, and are separated from it by lagoon. The barrier reef is situated in the sea nearly 1km to 15km away from the shore. This is the largest (in size, not distribution) of the three reefs, runs for hundreds of kilometres and is several kilometres wide. It extends as a broken, irregular ring around the coast or an island, running almost parallel to it. Barrier reefs are far less common than fringing reefs or atolls, although examples can be found in the tropical Atlantic as well as the Pacific. Barrier reefs are like fringing reefs but they are located some distance away from the shore. The stretch of water called lagoon separates the barrier reef from land. Lagoon may be half a mile to 10 miles or more in width. It is 10 to 50 fathoms deep and suitable for navigation.

E.g. The Great Barrier Reef—largest, comprising over 2,900 individual reefs and 900 islands stretching for over 1200 miles long, 20-70 miles side and situated 90 miles away from shore. off Queensland, North-eastern coast of Australia.

3. Atoll:

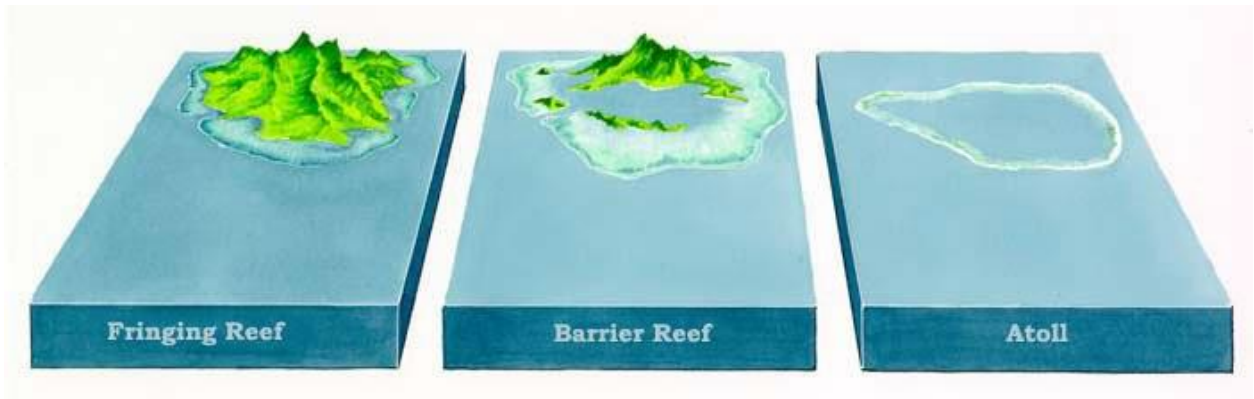
An atoll is also termed a coral island or lagoon island. It is a ring-like or horse-shoe-shaped reef that encircles a lagoon but not an island, and are usually located in the middle of the sea. Atolls usually form when islands surrounded by fringing reefs sink into the sea or the sea level rises around them (these islands are often the tops of underwater volcanoes). The fringing reefs continue to grow and eventually form circles with lagoons inside. An atoll is a roughly circular (annular) oceanic reef system surrounding a large (and often deep) central lagoon. The lagoon has a depth 80-150 metres and may be joined with sea water through a number of channels cutting across the reef. Atolls are located at great distances from deep sea platforms, where the submarine features may help in formation of atolls, such as a submerged island or a volcanic cone which may reach a level suitable for coral growth. Atolls are far more common in the Pacific than any other ocean. E.g. A large number of atolls occur in the Lakshadweep Islands and in Maldives.

Formation of coral reefs:

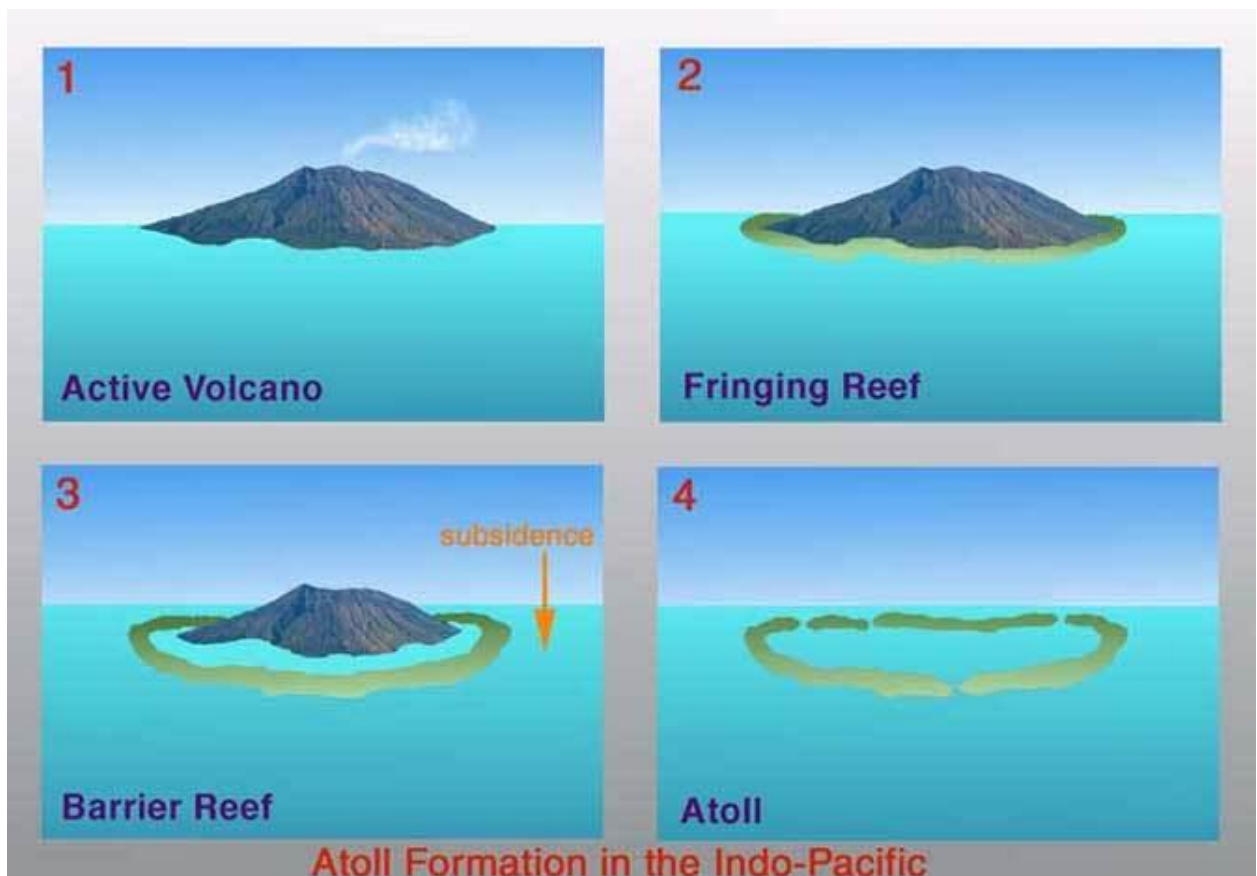
The stony corals (some anthozoans) are the builders of coral reefs and islands. They are mostly colonial, sometimes solitary and are provided with hard exoskeletons secreted by epidermis, outside the polyp body. Considerable part of each coral polyp is inseparably fixed in a cup-like structure of calcium carbonate. The skeleton is formed by calcareous crystals that are precipitated in a colloidal matrix secreted to the outside of the epidermis.

The skeleton of the whole colony is called as corallum and the skeleton of each polyp is called as corallite. The corallite consists of a cup containing vertical ridges radiating from the centre of the periphery called the sclerosepta. The bottom of the cup beneath the polyp is called as the basal plate, the wall of the cup that encloses the aboral portion of the polyp is termed the theca. Outside the theca another wall may be secreted called epitheca that is separated from the theca and is crossed by the continuations of sclerosepta called costae.

Synapticula are skeletal bars connecting the adjacent sclerosepta. Horizontal plates between the sclerosepta are called tubulae, if extending completely across the corallites.



<https://rwu.pressbooks.pub/app/uploads/sites/7/2019/05/figure4.9.5.png>



<https://www.pmfias.com/coral-reef-fringing-reefs-barrier-reefs-atolls/>
