

BIOLUMINESCENCE

WHAT IS BIOLUMINESCENCE:

- Bioluminescence of 'living light' is of wide occurrence in the marine environment, especially in the deeper zones of the sea.

Light producing creatures:

- Marine organisms like dinoflagellates, radiolarians, hydroids, jellyfishes, alcyonarians, ctenophores, bryozoans, polychaetes, brittle stars, many crustaceans, gastropods, bivalves, cephalopods, prochordates, gastropods, bivalves, cephalopods, prochordates, fishes, etc., are able to produce light.

Habitat of light producing organisms:


- Light -producing animals are of wide occurrence and represented in all the marine communities from the surface of the sea to abyssal depths.
- In the tropical waters, it is more common than in higher latitudes.

Nature of cold light:

- The light produced by living organisms is cold light, since only a very negligible quantity is lost as heat.
- This light is different from sunlight, as it is free from ultra-violet and infrared rays.
- Besides the predominant blue colour, colours such as yellow and green are also produced.

Light producing Mechanism:

- The light is produced by an oxidizing reaction involving substances like luciferin, possibly a poly peptide and an enzyme, luciferase.
- In many organisms, the reagents involved are not clearly known.
- Some animals are known to discharge luminous secretions into the water.

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- In certain others, the reaction is truly intracellular the group of luminous cells being backed by reflecting layer and sometimes covered by a lens.
 - In some other animals, the presence of luminous bacteria in the tissues is responsible for the light production.
 - In cases of extracellular luminescence, the luminous secretion is discharged into the ambient water.

Luminescent organ:

- The light-producing glands in such cases are either unicellular or multicellular structures distributed throughout the body or restricted to definite areas.
- In the nemertean worm , *Emplectonema kandai*, the photogenic cells are distributed throughout the body.
- In *Chaetopterus variopedatus*, the luminous secretion is liberated from glands situated in the aliform notopodia.
- In *Odontosyllis*, the glands lie at the base of the parapodia.

- In ostracod Cypridina, the secretory cells of the photophore contain two kinds of inclusions;
- yellow granules of luciferin and small colourless granules of luciferase, When discharged, they dissolve in sea-water, producing a blue light
- Many mollusks have luminescent organs.
- In the pelagic gastropod *Phyllirhoe bucephala*, the luminescent organs made of single cells or group of cells are scattered all over the body.
- The luminous material is in granular form.

- In the bivalve *Photas dactylus*, the luminous secretion is liberated from three different areas.
- A narrow band on the anterior edge of the mantle, a pair of bands in the inhalant siphon and two triangular spots near the retractor and two triangular spots near the retractor muscle.
- In the deep-water squid *Heteroteuthis dispar*, the luminous gland has a reservoir having two openings to the mantle cavity.

Intracellular luminescent organ:

- Intracellular luminescence is also widespread among the marine animals.
- In *Nocitluca*, light production is achieved by granules present in the periphery of the cell.
- In hydromedusae, the luminous cells are grouped beneath the endoderm of marginal canals and in sea-pens in the endoderm of tentacles.
- Ctenophores have glandular structures within the radial canals

- Intracellular luminescence is of wide occurrence among crustaceans such as shrimps and euphausiids.
- The photophores of certain pelagic caridean and penaeid shrimps are distributed over the appendages.
- In *Sergestes*, a biconvex cuticular lens and an underlying layer of cells constitute the light organ.
- In the euphausiids *Meganyctiphanes*, the photophores contain lenses and a thickened corneal layer, besides the gland cells.


- In the deep-sea squids such as Lealchia the ocular photophores contain lenses and a thickened corneal layer, besides the gland cells.
- In the deep-sea squids such as Leachia, the ocular photophores have a central glandular mass, lying within a reflector of connective tissue.
- Many deep-sea teleosts such as myctophum, Argyropelecus, stomias, Photostomias and Astromesthes have numerous photophores, arranged in groups along the body.

Pattern and intensity of light production:

- The pattern of light production and the intensity of light produced etc are subjected to individual variations.
- In many cases, a luminous slime is secreted over parts of the body or released as a glowing cloud as in the case of the squid *Heteroteuthis*.
- In some animals, the intensity of light produced is high.

significance of luminescence:

- There is still much uncertainty about the possible function and significance of luminescence in marine animals.
- Bioluminescence does not apparently serve any useful purpose to the organisms which produce it in the surface water, in those forms living in the dark abyss of the ocean.
- In some higher forms with specialized luminous organ, having a nervous control and arranged in definite patterns.

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- Many deep-sea forms living in complete darkness use this as the only source of light.
 - This is clearly indicated by the fact that eyes are present in deep-sea forms , whereas in the fresh water fauna of dark caves where there is no light producing organisms, the fishes are virtually blind.
 - The light produced helps animals with eyes to recognize or locate individuals of their own species or their prey.

Benefits of bioluminescence:

- Luminescence is thus an important source of light in the dark depths of the ocean.
- It is helpful to attract a passing prey or to meet the opposite sex and to keep together in large shoals as in the case of fishes.
- To some organisms, these may serve as recognition signs, a means of communication or courtship display.
- Thus both sexes of the polychaete *Odontosyllis* produce light during spawning.

- The luminescent organs on the tips of barbels and anterior fin rays of stomioid fishes such as Eustomias and Chirostomias and Ceratisa and other ceratioid anglerfishes, function as allure for the prey.
- In some, such as the deep sea shrimp *Squilla* the squid *Heteroteuthis*, the mysid *Gnathophausia* and the teleost *Malacocephalus* which discharge a luminous cloud into the surrounding water when irritated, light production serves as an aid to frighten or confuse their attackers.
- The wide occurrence of bioluminescence in the animal kingdom, is an indication that it serves some useful function to the organisms possessing it.