

Physical properties

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Chemistry

Spectrum

In the sea, bioluminescent light is concentrated in the blue window of greatest optical transparency of seawater. Most organisms emit between 440 nm and 479 nm. Some cnidarians have green fluorescent proteins that absorb an initially blue emission and emit it shifted towards the green (~505 nm). One remarkable fish has a similar mechanism to shift the initial emission into the red for use in viewing prey in the near infrared with its red-sensitive eyes. (More detail in the organism section.) Measurements in situ at various depths confirm emission clustering in the blue to green region of the spectrum.

Intensity

The luminescence of a single dinoflagellate is readily visible to the dark adapted human eye, as the demonstration will show. Most dinoflagellates emit about 6×10^8 photons in a flash lasting only about 0.1 second. Much larger organisms such as jellyfish emit about 2×10^{11} photons per second for sometimes tens of seconds. The intensity of luminescence by photosynthetic dinoflagellates is strongly influenced by the intensity of sunlight the previous day. The brighter the sunlight the brighter the flash.

Kinetics

Some organisms emit light continuously, but most emit flashes of durations ranging from about 0.1 s to 10 s. Some dinoflagellates can respond repetitively to excitation over a short period. In most multicellular species luminescence is neurally controlled. Thus in some fish the sympathetic nervous system controls luminescence by way of the neurotransmitter nor-adrenaline. In fireflies the transmitter is glutamate. In most marine invertebrates the transmitters are unknown. In such forms the "trigger" to luminescence is some detected behaviorally significant event.

In single cell organisms like dinoflagellates or radiolarians luminescence is triggered by deformation of the cell surface by minute forces (1 dyne per square cm). Mechanical deformation causes an action potential sweeping over the vacuole membrane and this is thought to induce light emission by admitting

protons from the acidic vacuole into contact with the cellular elements that contain the light emission chemistry. (Details in the [Research Forum](#)).

In some instances in marine invertebrates with eyes or other light receptors, light emission can be induced by photic excitation, even by another luminescing organism. Called "empathetic" luminescence, this phenomenon has as yet undemonstrated potential to enhance the luminescence generated by a moving source by photic transfer from the luminescent organisms mechanically triggered by the moving source.

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