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Chapter 1 : Biomembranes in SearchWorks catalog

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Chapter 2 : Download Biomembranes Part H Visual Pigments And Purple Membranes I

Isolation of organelles and membranes containing visual pigments Research article Full text access [3] Isolation and mounting of whole vertebrate retinas for optical studies.

Water absorbs light so that with increasing depth the amount of light available decreases quickly. The optical properties of water also lead to different wavelengths of light being absorbed to different degrees. For example, visible light of long wavelengths e. Light enters the eye at the cornea , passing through the pupil to reach the lens. Most fish species seem to have a fixed pupil size, but elasmobranchs like sharks and rays have a muscular iris which allows pupil diameter to be adjusted. Pupil shape varies, and may be e. Compared to terrestrial vertebrates, fish lenses are generally more dense and spherical. In the aquatic environment there is not a major difference in the refractive index of the cornea and the surrounding water compared to air on land so the lens has to do the majority of the refraction. Like other vertebrates, the photoreceptors are on the inside layer so light must pass through layers of other neurons before it reaches them. The retina contains rod cells and cone cells. Cone cells provide higher spatial and temporal resolution than rods can, and allow for the possibility of colour vision by comparing absorbances across different types of cones which are more sensitive to different wavelengths. The ratio of rods to cones depends on the ecology of the fish species concerned, e. Colour vision is more useful in environments with a broader range of wavelengths available, e. Some areas have higher densities of cone cells, for example see fovea. Fish may have two or three areas specialized for high acuity e. The distribution of photoreceptors may also change over time during development of the individual. This is especially the case when the species typically moves between different light environments during its life cycle e. This enhances sensitivity in low light conditions, such as nocturnal and deep sea species, by giving photons a second chance to be captured by photoreceptors. Some species are able to effectively turn their tapetum off in bright conditions, with a dark pigment layer covering it as needed. In a similar manner, fish have a vestibulo-ocular reflex which stabilizes visual images on the retina when it moves its tail. Whereas birds and mammals achieve accommodation by deforming the lens of their eyes, fish and amphibians normally adjust focus by moving the lens closer or further from the retina. In bony fishes the muscle is called the retractor lentis, and is relaxed for near vision, whereas for cartilaginous fishes the muscle is called the protractor lentis, and is relaxed for far vision. Thus bony fishes accommodate for distance vision by moving the lens closer to the retina, while cartilaginous fishes accommodate for near vision by moving the lens further from the retina. This is achieved by the vestibulo-ocular reflex , which is a reflex eye movement that stabilises images on the retina by producing eye movements in the direction opposite to head movements, thus preserving the image on the centre of the visual field. For example, when the head moves to the right, the eyes move to the left, and vice versa. In many animals, including human beings, the inner ear functions as the biological analogue of an accelerometer in camera image stabilization systems, to stabilize the image by moving the eyes. When a rotation of the head is detected, an inhibitory signal is sent to the extraocular muscles on one side and an excitatory signal to the muscles on the other side. The result is a compensatory movement of the eyes. Typical human eye movements lag head movements by less than 10 ms. Each pigment is constructed from a chromophore and the transmembrane protein, known as opsin. Mutations in opsin have allowed for visual diversity, including variation in wavelength absorption. UV vision may be related to foraging, communication, and mate selection. The leading theory regarding the evolutionary selection of UV vision in select fish species is due to its strong role in mate selection. Behavioral experiments show that African cichlids utilize visual cues when choosing a mate. Their breeding sites are typically in shallow waters with high clarity and UV light penetration. Male African cichlids are largely a blue color that is reflective in UV light. Females are able to correctly choose a mate of their species when these reflective visual cues are present. This suggests that UV light detection is crucial for correct mate selection. In experimental settings, female guppies spent significantly more time inspecting males with UV-reflective coloring than those with

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UV reflection blocked. The prominent role of UV light detection in fish mate choice has allowed the trait to be maintained over time. UV vision may also be related to foraging and other communication behaviors. Many species of fish can see the ultraviolet end of the spectrum, beyond the violet. For example, juvenile brown trout live in shallow water where they use ultraviolet vision to enhance their ability to detect zooplankton. As they get older, they move to deeper waters where there is little ultraviolet light. There is further evidence for this view that some fish use ultraviolet as a "high-fidelity secret communication channel hidden from predators", while yet other species use ultraviolet to make social or sexual signals. It has been unambiguously demonstrated in anchovies. Polarized light is most abundant at dawn and dusk. Each member of the double cone may have a different peak absorbance, and behavioural evidence supports the idea that each type of individual cone in a double cone can provide separate information i. Eye of a four-eyed fish 1 Underwater retina 2 Lens 3 Air pupil 4 Tissue band 5 Iris 6 Underwater pupil 7 Air retina 8 Optic nerve Fishes that live in surface waters down to about metres, epipelagic fishes, live in a sunlit zone where visual predators use visual systems which are designed pretty much as might be expected. But even so, there can be unusual adaptations. Four-eyed fish have eyes raised above the top of the head and divided in two different parts, so that they can see below and above the water surface at the same time. Four-eyed fish actually have only two eyes, but their eyes are specially adapted for their surface-dwelling lifestyle. The eyes are positioned on the top of the head, and the fish floats at the water surface with only the lower half of each eye underwater. The two halves are divided by a band of tissue and the eye has two pupils, connected by part of the iris. The upper half of the eye is adapted for vision in air, the lower half for vision in water. These fish spend most of their time at the surface of the water. Their diet mostly consists of the terrestrial insects which are available at the surface. Mesopelagic fishes live in deeper waters, in the twilight zone down to depths of metres, where the amount of sunlight available is not sufficient to support photosynthesis. These fish are adapted for an active life under low light conditions. Most of them are visual predators with large eyes. Some of the deeper water fish have tubular eyes with big lenses and only rod cells that look upwards. These give binocular vision and great sensitivity to small light signals. For more sensitive vision in low light, some fish have a retroreflector behind the retina. Flashlight fish have this plus photophores, which they use in combination to detect eyeshine in other fish. At this depth the ocean is pitch black, and the fish are sedentary, adapted to outputting minimum energy in a habitat with very little food and no sunlight. Bioluminescence is the only light available at these depths. This lack of light means the organisms have to rely on senses other than vision. Their eyes are small and may not function at all. The deepwater stoplight loosejaw produces red bioluminescence so it can hunt with an effectively invisible beam of light. Flatfish are benthic fish with a negative buoyancy so they can rest on the seafloor. Although flatfish are bottom dwellers, they are not usually deep sea fish, but are found mainly in estuaries and on the continental shelf. When flatfish larvae hatch they have the elongated and symmetric shape of a typical bony fish. The larvae do not dwell on the bottom, but float in the sea as plankton. Eventually they start metamorphosing into the adult form. One of the eyes migrates across the top of the head and onto the other side of the body, leaving the fish blind on one side. The larva loses its swim bladder and spines, and sinks to the bottom, laying its blind side on the underlying surface. It was natural, therefore, that when the ancestors of [flatfish] took to the sea bottom, they should have lain on one side But this raised the problem that one eye was always looking down into the sand and was effectively useless. Predators usually have eyes in front of their head so they have better depth perception. Underwater camouflage and mimicry and Category: Animals that can change color Fish have evolved sophisticated ways of using colouration. For example, prey fish have ways of using colouration to make it more difficult for visual predators to see them. In pelagic fish, these adaptations are mainly concerned with a reduction in silhouette, a form of camouflage. One method of achieving this is to reduce the area of their shadow by lateral compression of the body. Another method, also a form of camouflage, is by countershading in the case of epipelagic fish and by counter-illumination in the case of mesopelagic fish. Countershading is achieved by colouring the fish with darker pigments at the top and lighter pigments at the bottom in such a way that the colouring matches the background. When seen from the

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top, the darker dorsal area of the animal blends into the darkness of the water below, and when seen from below, the lighter ventral area blends into the sunlight from the surface. Counter illumination is achieved via bioluminescence by the production of light from ventral photophores, aimed at matching the light intensity from the underside of the fish with the light intensity from the background. For example, the deepwater velvet belly lantern shark uses counter-illumination to hide from its prey. The four-eye butterflyfish gets its name from a large dark spot on the rear portion of each side of the body. This spot is surrounded by a brilliant white ring, resembling an eyespot. A black vertical bar on the head runs through the true eye, making it hard to see. Most predators aim for the eyes, and this false eyespot tricks the predator into believing that the fish will flee tail first. The John Dory is a benthopelagic coastal fish with a high laterally compressed body. Its body is so thin that it can hardly be seen from the front. It also has a large dark spot on both sides, which is used to flash an "evil eye" if danger approaches. The large eyes at the front of the head provide it with the bifocal vision and depth perception it needs to catch prey. The barreleye has barrel-shaped, telescopic eyes which are generally directed upwards, but can also be swivelled forward. Right: The brownsnout spookfish is the only vertebrate known to employ a mirror eye as well as a lens:

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Chapter 3 : Biomembranes. Part H: Visual pigments and purple membranes. I.

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Part B) Which of the following is NOT part of the vascular tunic of the eye? Part C) The area of the retina that contains the highest concentration of cones is known as the _____. Part D) What is the epithelium that covers the inner surfaces of the eyelids and the outer surface of the eye called?