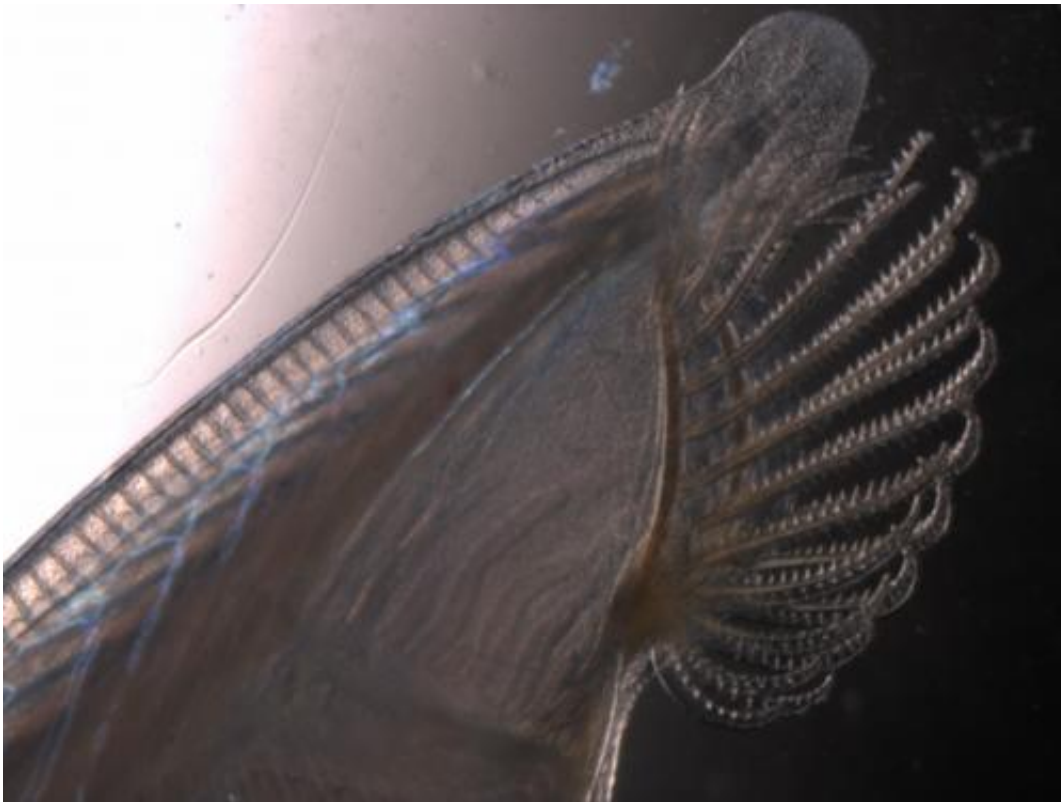


Sensing the light, but not to see: Study offers insight on the evolution of photosensitive cells

February 6 2013, by Diana Kenney



This is the head of the marine invertebrate amphioxus (*Branchiostoma floridae*), magnified 15 times. Amphioxus are the most ancient of the chordates (animals whose features include a nerve cord), according to molecular analysis. They are important to the study of the origin of vertebrates. Credit: Maria del Pilar Gomez/MBL

(Phys.org)—In a primitive marine organism, MBL scientists find

photosensitive cells that may be ancestral to the "circadian receptors" in the mammalian retina.

Among the animals that are appealing "cover models" for [scientific journals](#), lancelets don't spring readily to mind. Slender, limbless, primitive blobs that look pretty much the same end to end, lancelets "are extremely boring. I wouldn't recommend them for a home aquarium," says Enrico Nasi, adjunct senior scientist at the Marine Biological Laboratory (MBL). Yet Nasi and his collaborators managed to land a lancelet on the cover of the *Journal of Neuroscience* last December. These simple chordates, they discovered, offer insight into our own biological clocks.

Nasi and his wife, MBL adjunct scientist Maria del Pilar Gomez, are interested in phototransduction, the conversion of light by light-sensitive cells into [electrical signals](#) that are sent to the brain. The lancelet, also called amphioxus, doesn't have eyes or a true brain. But what it does have in surprising abundance is melanopsin, a photopigment that is also produced by the third class of light-sensitive cells in the mammalian retina, besides the rods and cones. This third class of cells, called "intrinsically photosensitive [retinal ganglion cells](#)" (ipRGCs), were discovered in 2002 by Brown University's David Berson and colleagues. Now sometimes called "circadian receptors," they are involved in non-visual, light-dependent functions, such as adjustment of the animal's circadian rhythms.

"It seemed like colossal overkill that amphioxus have melanopsin-producing cells," Nasi says. "These animals do nothing. If you switch on a light, they dance and float to the top of the tank, and then they drop back down to the bottom. That's it for the day." But that mystery aside, Gomez and Nasi realized that studying amphioxus could help reveal the [evolutionary history](#) of the circadian receptors.



Amphioxus can grow as long as 2.5 inches and are typically found half-burrowed in sand. Credit: Hans Hillewaert/Wikimedia

As so it has. In 2009, Gomez and Nasi isolated the animal's melanopsin-producing cells and described how they transduce light. In their recent paper, they tackled the puzzling question of why the light response of these amphioxus cells is several orders of magnitude higher than that of their more sophisticated, presumed descendents, the ipRGCs. (In mammals, the ipRGCs relay information on light and dark to the biological clock in the hypothalamus, where it is crucial for the regulation of [circadian rhythms](#) and associated control of hormonal secretion.)

By detailing how the large light response occurs in the amphioxus cells, Gomez and Nasi could relate their observations to the functional changes that may have occurred as the circadian receptors evolved and "eventually tailored their performance to the requirements of a reporter of day and night, rather than to a light sensor meant to mediate spatial vision." The [light](#)-sensing cells of amphioxus, they discovered, may be the "missing link" between the visual [cells](#) of invertebrates and the circadian receptors in our own eyes.

More information: Ferrer C., Melagón G., del Pilar Gomez M., and Nasi E. (2012) Dissecting the Determinants of Light Sensitivity in Amphioxus Microvillar Photoreceptors: Possible Evolutionary Implications for Melanopsin Signaling. [J. Neurosci. 32: 17977-17987.](#)

del Pilar Gomez M., Angueyra J.M, and Nasi E. (2009) Light-transduction in melanopsin-expressing photoreceptors of Amphioxus. [PNAS 16: 9081-9086.](#)

Provided by Marine Biological Laboratory

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