Seeing SKIN

Report by ***Alex Rose***
Photographs by ***Michael AW***

There are few marine animals as fascinating to watch as cephalopods. From their tentacles that each seem to move autonomously, to their unbelievable ability to change colour and texture, to their alien feeding habits, these molluscans never cease to amaze.

Although they look absolutely nothing like clams, cephalopods are considered molluscs and are more closely related to bivalves than any other group of sea creatures. Octopuses, squid, cuttlefish, and nautiluses all belong to the class Cephalopoda, which means "head foot". Molluscs in general are not known for their intelligence and most do not even have a proper head, let alone an impressive brain. But cephalopods differ drastically. They have large brains and well-developed senses and it almost seems as though there is an evolutionary correlation between the loss of a shell and increased brain function.

Perhaps as the hard, constrictive shell shrank, there was more room for a larger brain to develop, along with a need for intelligence in the field of self-defense now that their calcified armor was no longer around to protect them. Nautiluses, the most primitive cephalopods still in existence, most closely resemble their shell-dwelling relatives, and in defense can completely withdraw their tentacles and other soft body parts into their shells. Cuttlefish have a thick internal shell called a cuttlebone, and squid have an even further reduced structure called a pen, while octopuses lack one altogether.

CEPHALOPOD SKIN

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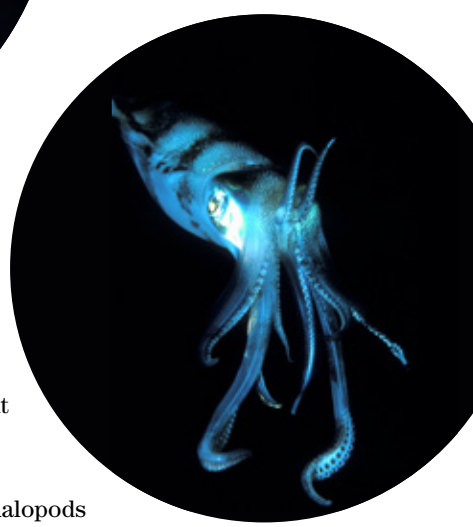
Cepahlopods are known for their startling ability to rapidly change color. They can do this by manipulating extremely high densities of skin pigment cells (chromatophores and leucophores) and reflective cells (iridophores), allowing them to produce many different colours and patterns in rapid succession, in order to communicate with conspecifics, camouflage themselves from predators, or warn intruders of their toxicity. The science explain; "Each chromatophore is an elastic sac of pigment, surrounded by a starburst of muscles. If the muscles relax, the sac contracts into a small dot that's hard to see. When the muscles contract, they yank the sac into a wide disc, revealing the color it contains."

It was also recently been discovered that cephalopod skin is loaded with light-sensitive proteins known as opsins, the same ones that render eyes capable of sight. While it is unlikely these creatures can actually "see" with their skin, it seems probable that these proteins play an important role in light detection independent of their eyes. As explained by vision expert Tom Cronin, "We don't know if they contribute to camouflage or are just general light sensors for circadian cycling or are driving hormonal changes. They have a job to do but we don't know what it is." More research is needed to determine the exact function of opsins in cephalopod skin.



Part of this riddle that needs solving has to do with the location of opsins in cephalopod skin. In some cephalopods such as the common cuttlefish and longfin squid, opsins are found only in the chromatophores, whereas in the California two-spot octopus, the opsins are present in tiny, hair-like structures called cilia. This difference in opsin placement can likely be at least partially explained by the fact that certain branches of cephalopods are separated by over 280 million years of evolution, a huge span of time that can more than account for the development of light-sensitive proteins that function in different ways. As Tom Cronin says, "Cuttlefish and squid do seem to display to each other more than octopuses, while octopuses do pattern dramatically in response to environmental changes, but we don't know of displays in octopuses designed for other octopuses." Opsins in the skin could be used for different species-specific tasks.

One thing is for sure. Cephalopods have now become even more fascinating, and further research is needed to determine the extent of their ability to sense light with their skin independently of their brains.