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# *Order Octopoda*



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Course Number
May 15th 2020

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Octopoda, commonly known as octopuses, is an order within the class of Celalophoda in a larger phylum of Mollusca. Tracing back their history, the ancestors of this order were most likely shelled predatory mollusks that lost their shells later on. From such an animal it is believed that the Cephalopod class and then various families, genus, and species of Octopoda evolved (Campbell, 2017). All Cephalopods are marine, have bilateral symmetry, and have tentacles that are equipped with suckers. They possess a radula and a parrot-like beak in the center of their tentacles with which they can use to bite and tear tissue. There are many different types of octopuses, from those that inhabit shallow waters to those that walk the bottom of the ocean, each that have defeated the odds of evolution and ultimately developed abilities that helped the species survive their environment today.

Cephalopod brains, especially those of octopuses, are very well developed which allows for their high intelligence that they are known for. The octopus' ability to solve all sorts of problems and have a good memory is due to the development of the brain and the brain-to-body mass ratio, which is the largest of all invertebrates (Tricarico et al, 2014). This enlarged brain and intelligence allow them to be equipped for their active, predatory lifestyle. A potential driving evolutionary force, in fact, behind the development of such intelligence is most likely a result of their need to locate and capture their prey (Villanueva et al, 2017) as unlike squid octopuses are slower-moving and opt for a more sit-and-wait strategy. In addition to being able to catch crabs using their patient problem-solving skills, various studies have shown the octopuses' ability to learn basic skills, play, and even use tools (Mather & Anderson, 1998). Figure 1.0 is from the first brain atlas of an adult cephalopod that was done on *Octopus minor,* more commonly known as the Long Arm Octopus (Jung et al, 2018). The image on the left of Figure 1.0 shows a live specimen of *O. minor* resting in seawater, showing the large head-to-body size ratio. The image on the right shows where the brain would be located, and its large size relative to the head. One striking application of their intelligence is their demonstrated ability to communicate visually via a change in skin color and/or texture, posture, and locomotion.

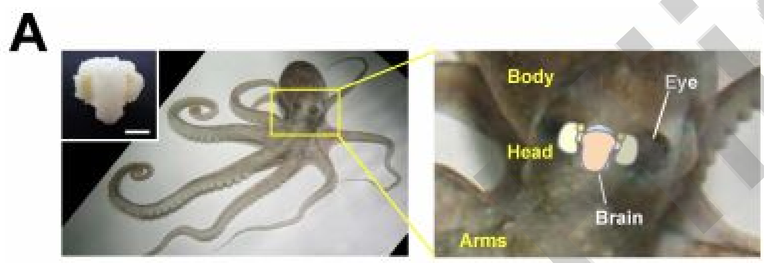


Figure 1.0: The brain of *Octopus minor*. Retrieved from Jung et al, 2018.

Octopuses, like other cephalopods such as squid and cuttlefish, are capable of remarkable camouflage by changing the color and texture of their skin. This is done as a means of defense, when hiding from predators or prey, or when attempting to attract a potential mate. Octopus skin contains chromatophores, which are pigment-containing cells that can be expanded or contracted to change the animal's color. In addition, they also have a layer of iridocytes below the layer of chromatophores, which differentially reflect light. These, in combination with the papillae they use to change the texture of their skin, allow them to masterfully blend in with their surroundings or to ward off danger to the extent of even being able to send waves of color sweeping over its body. Thaumoctopus mimicus, also known as the mimic octopus, is a great example of an octopus that uses both high intelligence and its ability to camouflage to impersonate a wide variety of marine animals. This gives the animal an even better advantage compared to other cephalopods such as additional safety and ease in hunting for prey. Whereas most octopuses spend most of their time hiding in reefs for protection, this species lies out in the open either by mimicking a toxic animal or lies in the sand as a sessile animal (Hanlon et al., 2018). It is also able to use these miming abilities to approach wary prey, such as by imitating a crab as a potential mate only to devour its deceived suitor. Another good example of intelligence in octopuses is here, as T. mimicus decides which mimicry behavior would be most appropriate and acts on it.

Other features that the octopus evolved with as a means to benefit their highly active predatory lifestyle is their very well-developed eyes and their ability to release ink as defense. The development of the eye of the octopus, like other cephalopods, is one that is comparable to those of vertebrates. There is evidence supporting the argument that in certain aspects their eye is better designed than that of humans. Figure 1.1 shows the structure of the vertebrate retina compared to that of the cephalopod (Lents, 2015). In the image to the left, it shows that the vertebrate's retinal cells face the back of the eye, and so their nervous connections and associated blood vessels run between the retina and the lens. In the image to the right, it shows that the cephalopod's retina cells are innervated and supplied with blood from behind the retina. The interference of the flow of light in the veretbrate's eyes, as well as the blind spot due to a lack of retina cells where the nerves exit the eye to the optic nerves, makes it less efficient to human eyes. Octopus eyes do not face the problems that the vertebrate eye does. Ink release in octopuses is made possible by their large ink sac that holds a multipurpose ink that is in high concentration of the melanin pigment and alkaloids. When under threat the octopus releases ink to distract the predator, and when catching prey they can also use the ink to anesthetize fish.

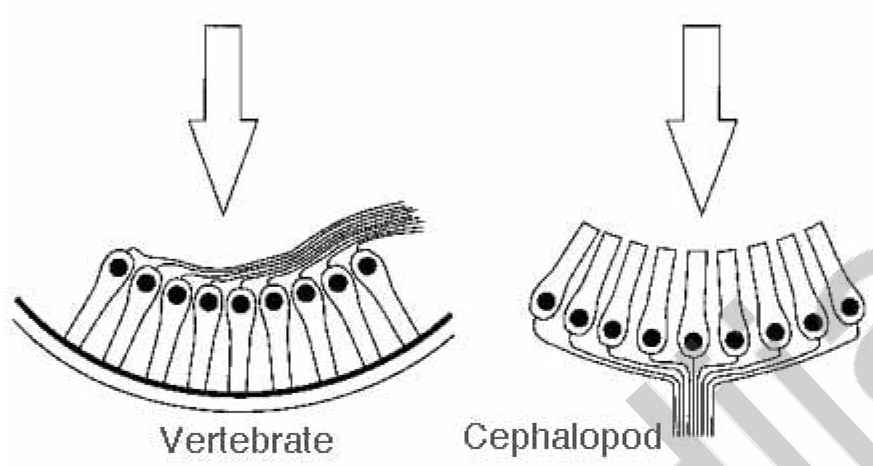


Figure 1.1: Vertebrate Retina Compared to Cephalopod Retina. Retrieved from Lents, 2015.

Octopuses are remarkable animals yet, like many other marine animals, they remain facing environmental threats due to the destruction of their habitat and a reduction of their main diet of molluscs, crayfish and crabs. These animals offer many exciting possibilities in biological research and have stirred up increasing interest and curiosity. It is unsurprising that with such a highly evolved mammal-like intelligence octopuses have been historically compared to, by some native traditions, descendants of hypothetical intelligent extraterrestrials (Baer, 2016).

Word Count: 1000

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