

The Surprising Intelligence of the Octopus

Imagine a creature with blue blood, three hearts, and no skeleton—earthling or alien? Meet the octopus, the most intelligent invertebrate on our planet. Even though the octopus is built nothing like us, its intelligence is surprisingly similar to not only humans, but also to animals we call smart, like dolphins, dogs, crows, and elephants. This puzzle has scientists scurrying to study the octopus more.

Intelligence is synonymous with “braininess,” and yet the octopus brain is designed completely differently from ours. The octopus’s brain is spread all over its body as a network of nerves, with only a small part in its head. It’s terrific at catching food, escaping predators, manipulating objects, and sensing its environment—all underwater, of course. So, how is it that octopuses share so many aspects of intelligence with us humans? That’s why scientists are intrigued.



How do octopuses show intelligence?

Octopuses are curious and playful, creative, and problem-solvers. Like other intelligent animals, octopuses can tell individual people apart. Take the octopus who disliked an aquarium worker so much, it squirted her every time she walked past.



Octopuses have been seen unscrewing jar lids, navigating mazes, juggling hermit crabs for fun, squirting light bulbs to break them and “turn the lights out,” and finding creative ways to obtain food. One hungry octopus climbed out of its tank at night when no one was watching to eat the fish in a nearby tank. Because they have no bones, octopuses can squeeze through tiny openings, making them great escape artists.

An octopus once exited its tank through the overflow valve, slithered across the floor, and



An octopus using a nut shell and a clam shell to hide.

escaped down a narrow drainpipe to the ocean. Octopuses in the wild have been seen using shells as tools to protect themselves from predators. Even more amazingly, they stack and carry the shells for future use, showing the ability to plan ahead. Some researchers say octopuses may even dream.

While octopus intelligence can be very like ours, it can be very different, too. Octopuses use thousands of special cells under their skin—called chromatophores—to change skin color and patterns, control whether their skin is bumpy or smooth, and shape-shift to mimic their surroundings. In a heartbeat—or three heartbeats, in their case—they can become a “rock” or a “coral reef.” Not only is this quick-change act critical for hiding from predators, but octopuses also communicate using their smart skin. They “talk” underwater with color and shape! Inspired by this discovery, researchers have recently designed a synthetic smart skin that can transform into 3D shapes.

How does an octopus's brain work?



Two-thirds of an octopus's neurons are in its tentacles, and can act without input from the brain.

One species studied, the common octopus, has roughly 500 million neurons (nerve cells that transmit a signal). That's about the same number that a dog has. But unlike a dog, only a third of octopus neurons are in the head. The other two thirds are spread through their eight legs, particularly in the suction cups.

The octopus's head-brain has some control. It might tell the leg-brains it's hungry, for example. Then—without the head-brain even knowing—the leg-brains use their all-in-one sense of touch+chemical+light to capture lunch. Imagine telling your hands you're hungry and, next thing you know, a sandwich is right in front of your mouth!

Octopus brains are different right down to the molecular level. For instance, octopuses practice a type of genetic makeover that's very rare in the rest of the animal kingdom. When temperatures plunge, for example, they can rewrite tens of thousands of genetic molecules (RNA) to adapt. It's like repainting themselves using their own genetics—amazing! Humans can't do that.



What does octopus intelligence teach us?

Scientists think intelligence develops from living in groups, where individuals learn from each other, and from living a long time, thus experiencing more and passing along know-how to their youngsters. All this is true for primates, elephants, dolphins, and most other intelligent species. But octopuses are solo creatures that only live three to five years and die soon after they mate and lay eggs. So, again, octopuses defy our notions of intelligence.

If octopuses studied us, we might seem pretty stupid. After all, our hands don't think for themselves and our fingers don't have numerous senses like touch, taste, and light—only touch. And we can't repaint ourselves with genetic code. We can thank octopuses for inspiring us to open our minds (those unlucky neurons stuck in our heads) to a broader definition of intelligence.