The New York Times https://www.nytimes.com/2025/06/17/science/octopus-arms-microbiome.html

TRILOBITES

Eight Arms to Taste Your Microbiome

Scientists discovered that octopuses use their limbs to sample the microbiomes on the surfaces they touch.

By Sofia Quaglia
Sofia Quaglia earlier reported on fish that use their legs (yes, legs) to taste things.

June 17, 2025

When octopuses extend their eight arms into hidden nooks and crannies in search of a meal, they are not just feeling around in the dark for their food. They are tasting their prey, and with even more sensory sophistication than scientists had already imagined.

Researchers reported on Tuesday in the journal Cell that octopus arms are fine-tuned to "eavesdrop into the microbial world," detecting microbiomes on the surfaces around them and deriving information from them, said Rebecka Sepela, a molecular biologist at Harvard and an author of the new study.

Where octopus eyes cannot see, their arms can go to identify prey and make sense of their surroundings. Scientists knew that those eight arms (not tentacles) sense whether their eggs are healthy or need to be pruned. And the hundreds of suckers on each arm have over 10,000 chemotactile sensory receptors each, working with 500 million neurons to pick up that information and relay it throughout the nervous system.

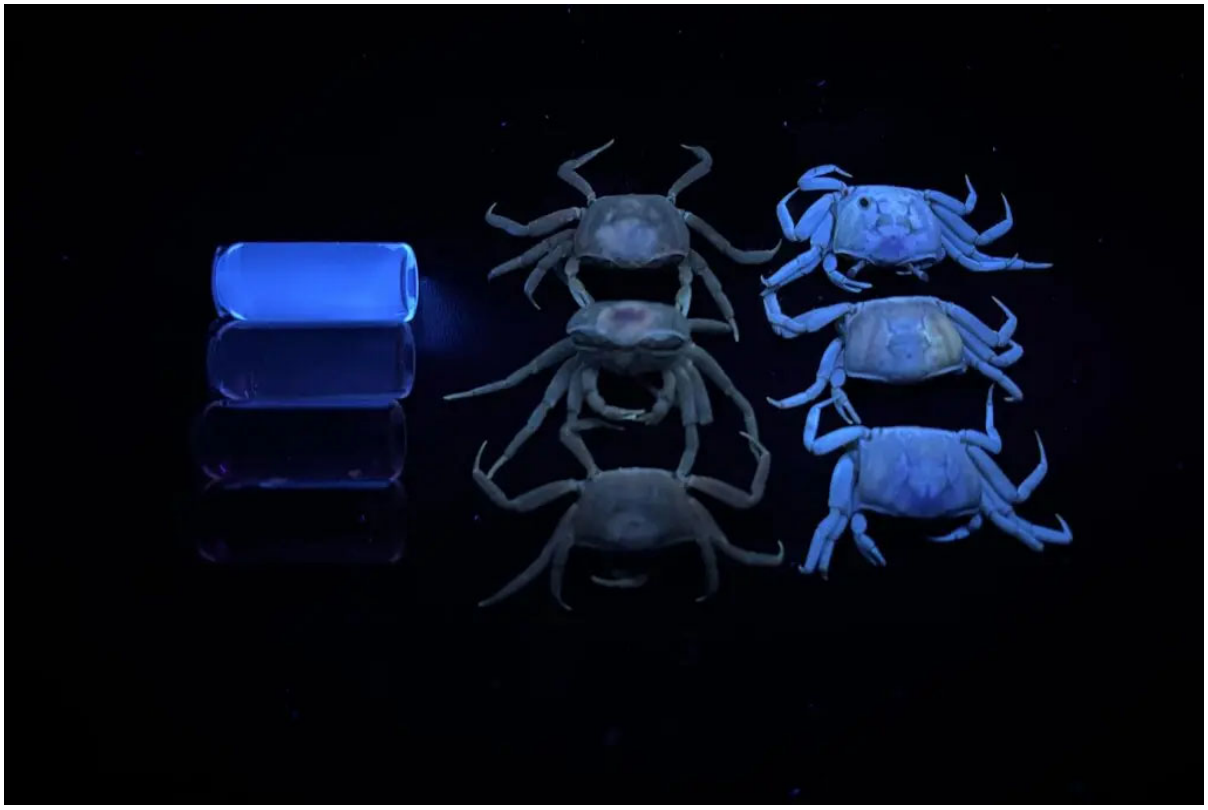
Yet, what exactly the octopus is tasting by probing and prodding — and how its arms can distinguish, say, a rock from an egg, a healthy egg in its clutch from a sick one or a crab that's safe to eat from a rotting, toxic one — has long baffled scientists.

What about the surfaces are they perceiving?

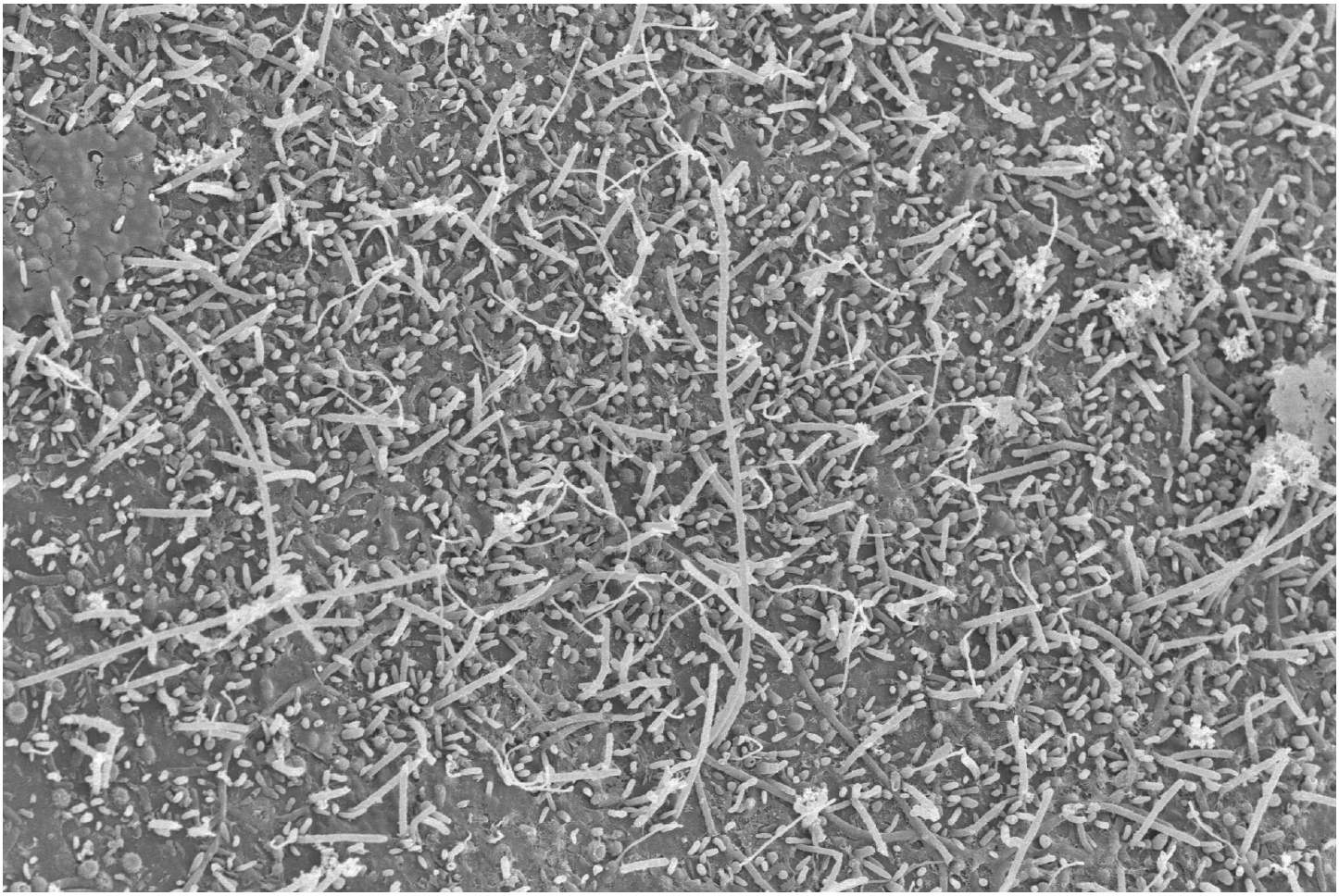
For Dr. Sepela, this question was heightened when her team discovered 26 receptors along the octopuses' arms that didn't have a known function. She supposed those receptors were tuned only to molecules found on surfaces, rather than those diffused in water.

So she and her colleagues collected swaths of molecules coating healthy and unhealthy crabs and octopus eggs. They grew and cultured the microbes from those surfaces in the lab, then tested 300 microbial strains, one by one, on two of those 26 receptors.

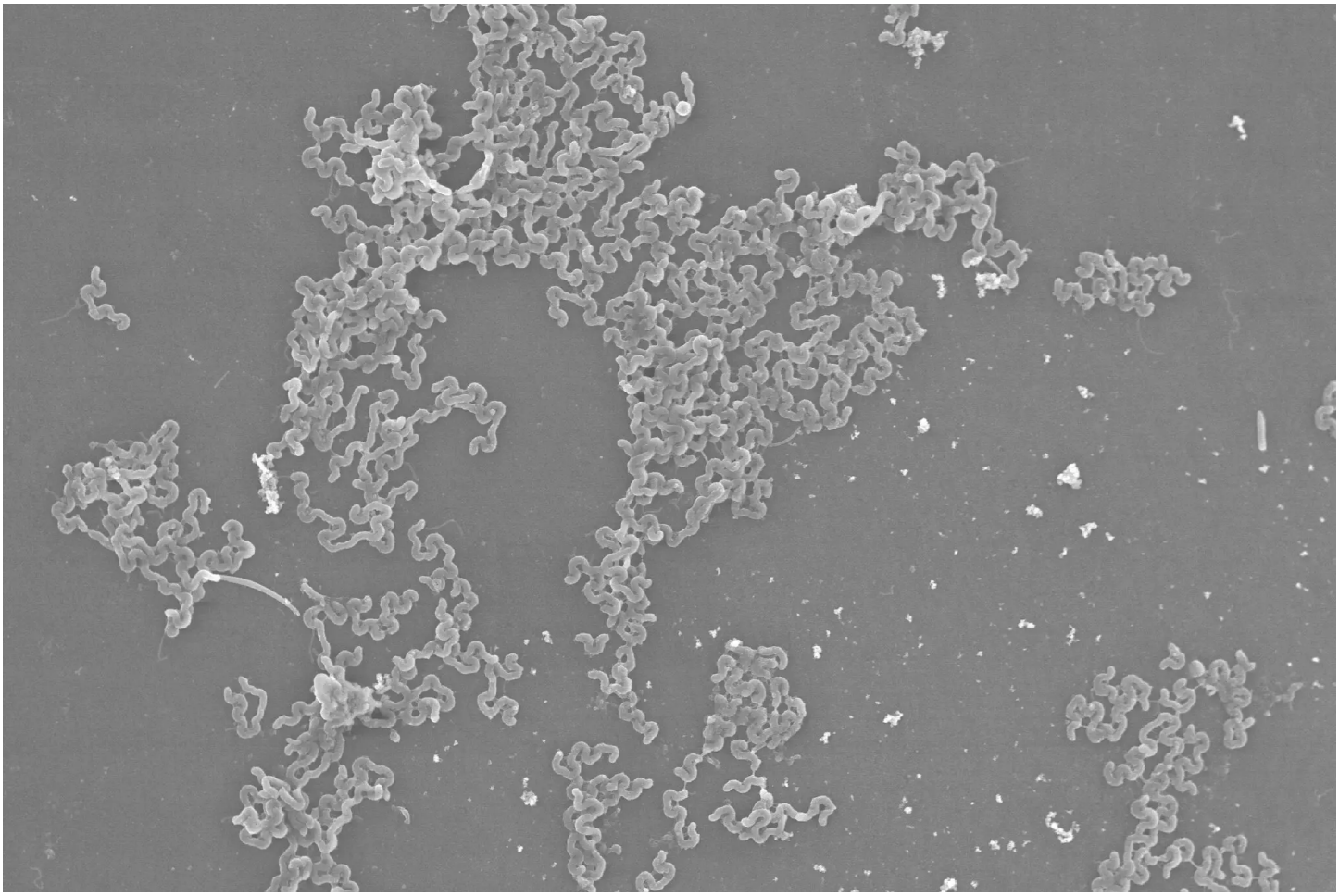
During the screening, only particular microbes could switch open the receptors, and these microbes were more abundant on the decaying crabs and dying eggs than on their healthy counterparts.



An image under UV-light of glass vials, left, filled with increasing concentrations of a molecule isolated from microbial cultures; fiddler crabs, middle; and fiddler crabs, right, that have been left to decay for two days. The decayed fiddler crabs glowed blue under UV-light, just like the molecule isolated from the microbial cultures. Sepela et al., Cell 2025



A scanning electron micrograph showing the diversity of bacteria present on the surface of eggs that were removed from a mother's clutch. Sepela et al., Cell 2025



A scanning electron micrograph showing a distinct array of bacteria on the surface of eggs that had been rejected by a brooding mother octopus. Sepela et al., Cell 2025

It's not the surface itself, but the surface's microbiome that influences the octopus's behavior, said Nicholas Bellono, who leads the Harvard laboratory in which Dr. Sepela works. Microbes are constantly collecting information about the surface they're on and responding by releasing chemicals into the surrounding environment. Those emissions are what the octopus is tasting.

This is similar to what happens when you taste spoiled milk: The sour taste comes from the microbes breaking it down. But it is also analogous to how the microbes inside our bodies, especially in our guts, tell our various organ systems different things about infections or irritants or even positive stimuli, like food.

This method, so far, seems to help octopuses detect what they do not like: the specific microbes are aversive signals. "Basically, if they don't sense it, you know, then it's good to eat," said Marcus Stensmyr, who studies sensory biology at Lund University in Sweden and was not involved in the study. This is unusual compared with, say, insects, which tend to primarily detect chemicals they're attracted to, he said.

This microbial detection ability raises “so many questions,” Dr. Stensmyr said. He added that the results so far are most likely not the whole picture.

This fine-tuned ability to process chemical information from microbes could also play a role in how octopuses interact with one another and mate, said Chelsea Bennice, a researcher at the Florida Atlantic University Marine Science Laboratory who studies the microbiome on octopus skin and was not involved in the study. Understanding these microbial signals could also play a role in helping octopuses avoid disease, said Dr. Bennice, a danger that is predicted to increase in the coming years because of ocean warming.

A California two-spot octopus, octopus bimaculoides, incubating a clutch of eggs in her den. Anik Grearson

And the implications go beyond octopuses. While this study looked into only a small set of microbes, the findings seem to say something about how animals, in general, use microbes to interact with the world around them.

The entirety of animal evolution has unfolded in unison with that of microbes and bacteria, so microbes have likely defined the rules of biology more than we give them credit for, Dr. Bellono said. They rule the world, and science is still far from fully grasping how they affect the lives of the more complex creatures around them.

These results could suggest that eavesdropping on microbes “is likely a universal

language across different kingdoms of life," Dr. Bellono said.

A version of this article appears in print on , Section D, Page 2 of the New York edition with the headline: On the Surface: For This Taste Test: Eight Arms, Thousands of Receptors and Millions of Neurons