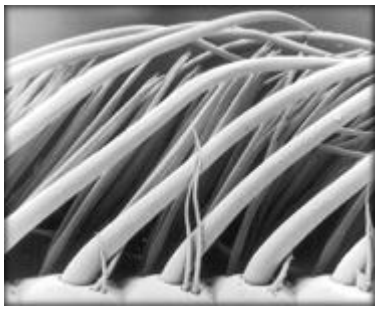

A scanning electron micrograph of hairs on the end of a spiny lobster antenna. The smaller hairs (at center) can sense odor. (Jeff Goldman, Duke University)

Inspired by Nature

Lobsters, Fish and Octopi Could Hold the Answers to Better Tech

By Lee Dye
Special to ABCNEWS.com

Dec. 6 — Forget about Ginger, or "IT," or whatever its name is. The invention the world really needs is a gizmo that can swim like a fish while grabbing stuff from the water with several arms, and still be able to smell like a lobster.

That may sound a bit strange, but in fact scientists are increasingly turning to animals like the octopus and the lobster for help in designing the robots of the future. The reason is simple. Nature did it first and did it best, so we ought to be able to learn a lot by looking at biological systems that do some things a lot better than we can.

Much of the research is supported by the military, particularly the Office of Naval Research and the Defense Advanced Research Projects Agency, because it would be a lot safer to send a robot into a cave instead of a soldier. To figure out how to build such a robot, scientists are studying all sorts of critters to see how they function in what would seem to us a very hostile environment.

Underwater Sniffer

Take the Caribbean spiny lobster, for instance. *Panulirus argus* can sniff out odors underwater (when was the last time you tried that?) and distinguish between prey and food.

That's a really nifty trick, and if scientists could figure out exactly how the lobster does that, they would be a bit closer to building robots that can follow scents under water.

So scientists at the University of California at Berkeley and Stanford University are trying to figure out exactly how a lobster smells. It turns out to be an extremely complex system. The lobster uses odor-sensitive hairs in its antennae to pick up the scent of a tasty morsel, like a rotten fish.

"When you look at the animal kingdom, you see lots of creatures that capture odor from water or air using antennae that are feathery or hairy," says Mimi A.R. Koehl, professor of integrative biology at Berkeley and lead author of a report on the research in the Nov.

MORE ON THIS STORY

> RELATED STORIES

- An Octopus Impersonates a Cast of Species
- Sea Creature Coated With a Complex Compound Eye
- Navy Developing Submarine Based on Boxfish
- Scientists Learning How Geckos Stick

ALSO ON abcNEWS.com

- 'Daisy Cutter' Hits Suspected Hideout
- Aid Worker Sees No Quick-Fix for Afghans
- New Breast Cancer Drug May Save Lives

SCI / TECH HEADL

- 'Harry Potter' Mo Video Games
- Study: Mars Has Global Warming
- Astronauts Spac Do Engine Work
- Attack of the Onl
- Technology for P Displays

E-MAIL US
Write Lee Dye

ARCHIVE
Lee Dye's past co

30 issue of the journal *Science*.

"We want to know how these feathery structures interact with water or air … and which aspects of their design affect how they perform at catching odors."

The researchers used high-resolution video cameras to capture images of the lobsters sniffing around in an aquarium. That gave them a few clues, but it's pretty hard to train a lobster, so to test out their findings they created a robotic lobster that could mimic the real thing.

Stroke, Stroke, Smell

The images revealed that when the lobster is trying to smell something it initiates a series of movements with its antennae. First, there's a very rapid down stroke, lasting only about 100 milliseconds, followed by a slower upstroke of about 300 milliseconds, and then a 400-millisecond pause.

Each of those functions appears to play a key role in the lobster's olfactory system. The down stroke is just the right speed to cause water to swirl around tiny odor-sensitive hairs near the tip of the antennae, capturing any chemicals that might indicate the source of an odor. The upstroke apparently is slower so the lobster can try to figure out exactly what the trapped chemical — or the odor — is. And the pause allows the animal to flush out its system as it prepares to sniff again.

At least that's what it looks like at this stage of the research. Koehl and her team will now work with neuroscientists to try to determine what kind of electrical signals are triggered by the odor-sensitive hairs. Only then will they be able to say if the lobsters are really deciphering odors, or just messing around.

The scientists picked lobsters for their research partly because a lot of work has already been done on the nervous system of spiny lobsters.

Swim Like a Fish

Meanwhile, scientists at the Massachusetts Institute of Technology and Texas A&M University are also studying marine organisms, but for a very different purpose. A ship, or even a submarine, leaves a wake as it moves across the sea, and it's clearly visible from the air.

That's not a problem for a pleasure boat, but for a warship it's sort of like tying red bandannas along the road while trying to run from an enemy.

And since submarines are driven by propellers, they also make a lot of noise that is easily detected by underwater listening devices.

A fish doesn't do that. So the scientists are trying to figure out how to make a vessel act more like a fish.

"The military wants at least small vehicles to maneuver more like fish do rather than like clunky submarines," says Othon Rediniotis, an aerospace engineer at Texas A&M.

Rediniotis' team is using tiny wires that expand or shrink with temperature changes to mimic the muscles of a fish. The goal is to build a device with a metal skeleton that will flex back and forth as it moves through the water, just like a fish.

And it would be helpful if the device could do something as it cruises through the water. A set of arms would be useful.

Grab Like an Octopus

So scientists at the Hebrew University of Jerusalem and the Weismann Institute in Israel are trying to figure out how an octopus can move its eight arms independently of each other without tying itself in a knot.

"How the octopus controls each arm so that tasks can be performed without chaos, and without the need to spend enormous time in deciding how to perform a specific arm movement, is precisely what robotics designers would like to know," says Tom McKenna, program manager for the Office of Naval Research, which is funding the work.

So far, the findings are a bit intriguing. It appears that the octopus can issue a command