Sticky questions tackled in gecko research

Velcro, Superglue and Post-It Notes... Three things that started out as obscure inventions but are now indispensable for everyday life. So what will the next idea to stick with modern society look like? The answer may lie in the tiny toes of a humble lizard, according to a University of Calgary biologist who is trying to figure out how geckos can cling to virtually any surface, including glass.

“Unlike most creatures, geckos don’t use sticky secretions to help them hang on, it’s all due to the structure of their amazing skin,” says professor Anthony Russell, one of the world’s leading experts on the gecko family of lizards. “Figuring out how they are able to run across ceilings and walk up windows is remarkably complex but it is getting a lot of attention because of the possible technology it could yield.”

The latest development in gekkotan adhesive research is a paper by Russell and U of C graduate student Megan Johnson published in the current issue of the *Canadian Journal of Zoology*. It’s one of the only studies to look at how a gecko’s unique toe pads enable it to move through its natural habitat.

“Almost all of the research that has been done has looked at how geckos can walk on glass and other smooth surfaces, but of course their feet evolved for moving over very different surfaces, Russell said. “By looking at how they climb up rocks and other natural surfaces we are hoping to gain an even better understanding of their adhesive system because coping with rough and unpredictable terrain poses quite different problems than does smooth and even ones. This calls for examining both the animals and the terrain they use at the microscopic level.”

Unlike tree frogs and many insects that use some form glue-like fluid to get a grip, geckos are dry danglers. Their fan-shaped, highly flexible feet enable them to get traction on a wide range of surfaces while moving or standing, either up, down, or upside down. This gravity-defying power lies in the tens to hundreds of thousands of hair-like structures, known as setae, on geckos’ toe pads. In 2000, researchers demonstrated that the large surface area of setae allow the animals to take advantage of molecular-level attraction called van der Waals forces to stick to virtually any surface. More recently, it has been shown that friction is also involved, and that these animals use a whole bag of tricks to help them adjust to circumstances from moment to moment.

By looking at the rocky habitat of a southern African species of gecko, Russell and Johnson concluded that the setae likely evolved to give geckos traction on rugged surfaces, since only a small area of each toe pad may be able to find purchase in order to maintain grip.

“It’s kind of like the tire of a car,” Russell explains. “You have a large area of tread but at any moment in time, there’s only a tiny portion that is actually in contact with the road, and you are depending on that to do the job in a variety of circumstances.”

Researchers and corporations around the world are racing to create the first synthetic “gecko glue” and the U.S. military is leading the way in trying to create gecko-inspired robots that can scale any surface.

“The goal is to create a completely dry adhesive that doesn’t leave any residue behind and will remain attached as long as you apply a load to it and can be re-used an unlimited number of times,” Russell said. “Once we conquer how it works it could be reasonably cheap to manufacture and the possible uses are endless.”

Russell says learning from how species are designed by nature to deal with environmental challenges provides key lessons for human innovations.

“This nano-technology has been around for over 50 million years and we are only just beginning to understand how it works,” he said.

Source: University of Calgary

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