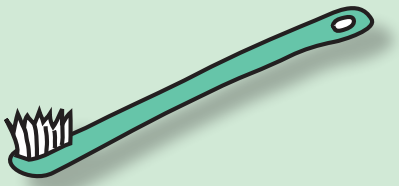
Clean Teeth and Sticky Toes

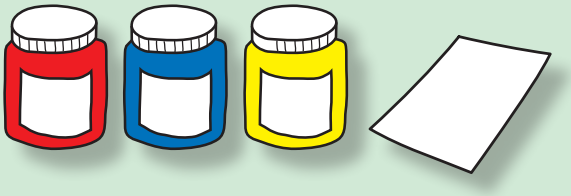
Watch a video of this activity on the Bio-Inspired Designs, Latest Updates page.

Find What You Need..

- An old toothbrush
- Paints and paper (optional)



An old toothbrush



Paints and paper

What kind of toes could help you climb the walls?

Gecko toes can cling strongly to walls, windows and even ceilings. Their amazing toes stick when they need to, but pull off easily when the gecko lifts its foot. What kind of surface could do both those things? Scientists studied gecko toes to find out.

You'd think that a gecko's toes would be sticky to the touch, but they're not! Gluey toes would either stick the geckos to walls permanently, or become covered in glued-on dirt. So where do they get their sticking power? Every time two objects touch, the atoms at the point of connection attract each other, pulling the objects together. This *adhesive* (sticking) force is generally too small to notice. But the more points of connection you have, the larger the adhesive force.

Gecko toes have a HUGE number of points of connection on their little toes. The end of each toe has about a million tiny fibers, and each fiber sprouts hundreds of microscopic fibers called *nanofibers*. When the gecko presses its toe to the wall, the side of each fiber clings slightly to the wall. The resulting adhesive force is strong enough to hold up the gecko.

In this activity, you'll experiment to answer this questions: Why do the fibers hold up the gecko, but let go easily when it lifts its foot?

Fact:

There are hundreds of different species of gecko. The smallest is less than an inch long.

Activity Instructions

1. Imagine that your toothbrush is the surface of a gecko's toe. Hold the brush gently against a mirror, window, or other smooth surface and slide the brush up and down. Note which part of each bristle is touching the mirror. Does the brush slide easily?
2. Now press your brush firmly into the mirror while sliding down. This now resembles the gecko toe when the gecko is clinging to a wall. Notice which part of each bristle is touching the glass. Slowly slide the brush down the wall. Do you feel any resistance? Imagine a gecko toes as being made of thousands of tiny toothbrushes. Does that give you an idea why it doesn't easily slide down the wall?
3. Now imagine that your gecko wants to take a step. Lessen the pressure so you're holding the toothbrush lightly against the glass again. Is it hard to pick up?
4. You can use paint to better see how gecko toes work. Mash toothbrush bristles down into wet paint to cover as much of the bristle as possible. Then "step" lightly onto paper and see the mark left by the end of the bristles. Now press the bristles down to help the gecko cling to the wall. How much more contact did the paint make with the paper?
5. Make some gecko art: Use different colors and "walk" the brush all over the paper!

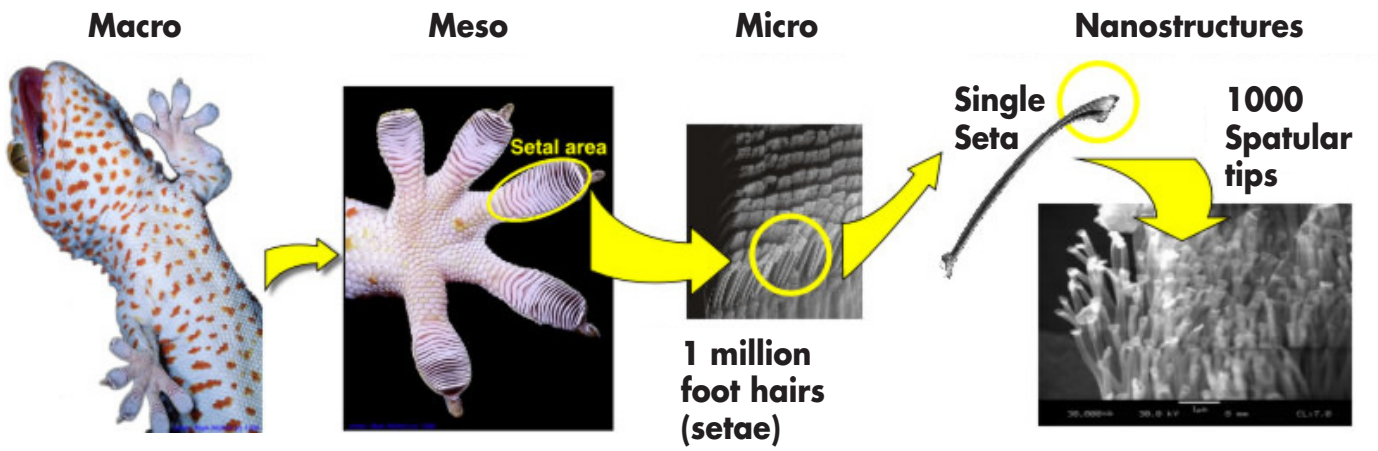
Conclusions

Could you feel a little of the force that makes a gecko cling? How much of this do you think it would take to hold *you* to a wall. Why? If you had gloves and boots that let you stick to walls, what would you use them for?

Brain Blaster:

What other functions of a gecko would you like to mimic? Learn more about geckos, then think of a machine based on a different gecko function.

Gecko Adhesive System



Our thanks to Dr. Ron Fearing – professor in the Dept. of Electrical Engineering and Computer Sciences – UC Berkeley