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Nature's Design Workshop

Engineers turn to biology for inspiration.

By Anne Underwood
Newsweek

Breck P. Kent / Agpix

Millions of tiny split hairs on the lizard's feet establish billions of points of contact with a surface, each exerting a weak molecular attraction. The gecko just curls its toes to break the contact.

Sept. 26, 2005 issue - If we have Batman and Spider-Man, why don't we have any mussel superheroes?" asks biochemist Herbert Waite of the University of California, Santa Barbara. Mussels may not be the biggest or the flashiest of sea creatures. But they do one thing exceedingly well. They make a glue that lets them anchor themselves firmly to a rock and remain there—drenched by water, buffeted by the ocean's waves. "I don't know any other adhesive that can do that," says Waite.

In fact, nature can accomplish feats that engineers have only been able to dream of until now. But as scientists peer deeper into the cellular and molecular workings of nature, engineers are starting to find information they can apply to everything from advanced optics to robotics—even a mussel-inspired glue that could one day be used to repair shattered bones. The result is a new field called biomimicry, or biologically inspired design. And though nature's innovations often need radical adaptation to suit human purposes, the new approach has the potential to improve the way we do everything, from desalinating water to streamlining cars. "If you have a design problem, nature's probably solved it already," says Janine Benyus, cofounder of the Biomimicry Guild. "After all, it's had 3.8 billion years to come up with solutions."

In fact, nature turns out to be an enormous wellspring of ideas. Jewel beetles, which lay their eggs in freshly burned trees, can detect fires from miles away; the defense industry is studying the beetles for clues to designing new low-cost, military-grade infrared detectors. Meanwhile, Volvo is tapping locusts' famed ability to fly in dense swarms without colliding for a possible key to anti-collision devices in cars. NASA-supported researchers at Princeton are analyzing the remarkable strength of abalone shells to help make impact-resistant coatings for thermal tiles. And the Defense Advanced Research Projects Agency is funding development of a robot that can climb vertical surfaces, using the same principle that

geckos use to walk up walls and saunter upside down across ceilings. "Imagine a Mars rover that's not limited to flat terrain," says biologist Kellar Autumn of Lewis & Clark College, who is working with DARPA.

Even everyday devices may benefit from nature-inspired improvements. You know how the screens on digital cameras and laptops wash out in bright light? The solution could lie in peacock feathers. Their iridescent blues and greens come not from pigments—the only actual pigment in peacock feathers is brown—but from repeating microstructures on the feather that reflect certain wavelengths in perfect sync, intensifying a given hue. Using the same principle, Qualcomm is designing a display that uses adjustable microstructures just behind the screen's surface to create color. Because its brightness depends on ambient light rather than illumination from within, the colors actually intensify outdoors. And since a display that doesn't generate its own light requires less power, says Miles Kirby, director of product management, "a screen like this in a cell phone could be always on, and the phone could go longer between charges."

Ultimately, the goal is not just to mimic nature's designs, but her production methods as well. Scientists at Sandia National Laboratories are devising novel assembly techniques inspired by seashells. Combined in a beaker of water, molecules with segments that are drawn to water and others that are repelled by it arrange themselves in predictable patterns. "As the water evaporates, they self-assemble into layers, like those in shells," says Jeffrey Brinker at Sandia. Using the same principle, but different types of molecules, he's making water filters with pores just a nanometer in diameter. "You don't need fancy instruments or nanotweezers," he says. And the process works at room temperature, without industrial furnaces and toxic solvents. "The truth is, natural organisms have managed to do everything we want to do without guzzling fossil fuels, polluting the planet or mortgaging the future," says Benyus. No wonder some people call them superheroes.

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