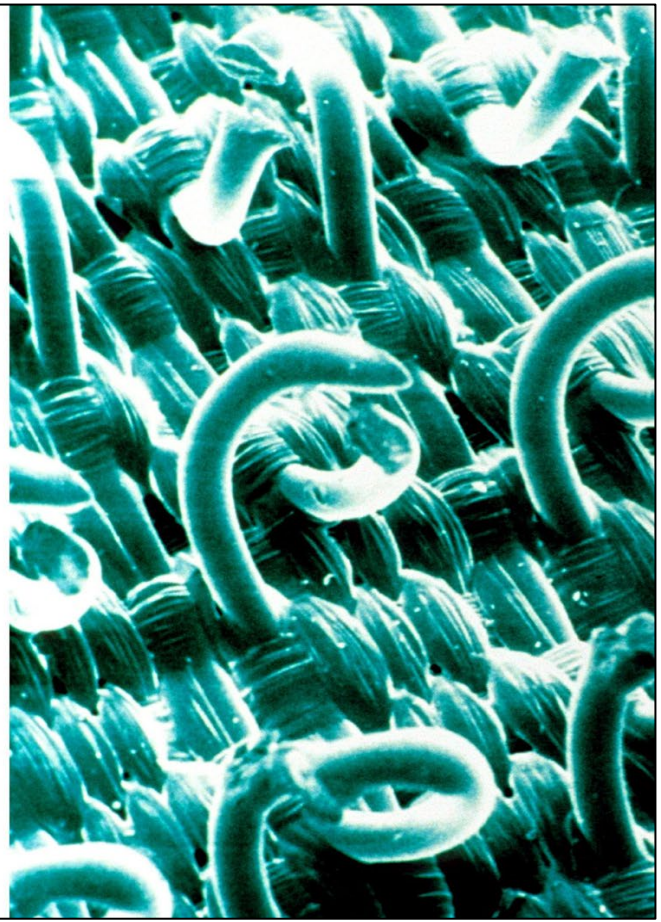
TeachEngineering

STEM Curriculum for K-12

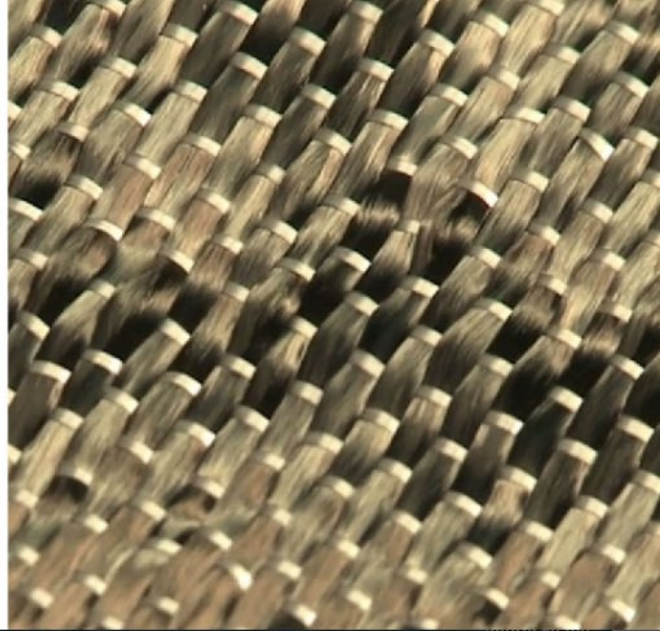
Nature is the Solution: Image Set

Station 1



Velcro

After a hunting trip in the Alps in 1941, Swiss engineer George de Mestral's dog was covered in burdock burrs (part of a common plant). Mestral put one under his microscope and discovered a simple design of hooks that easily attached to fur and socks. After years of experimentation, he invented Velcro — and earned U.S. Patent 2,717,437 in September 1955. It is probably the best-known and most commercially successful instance of biomimicry.



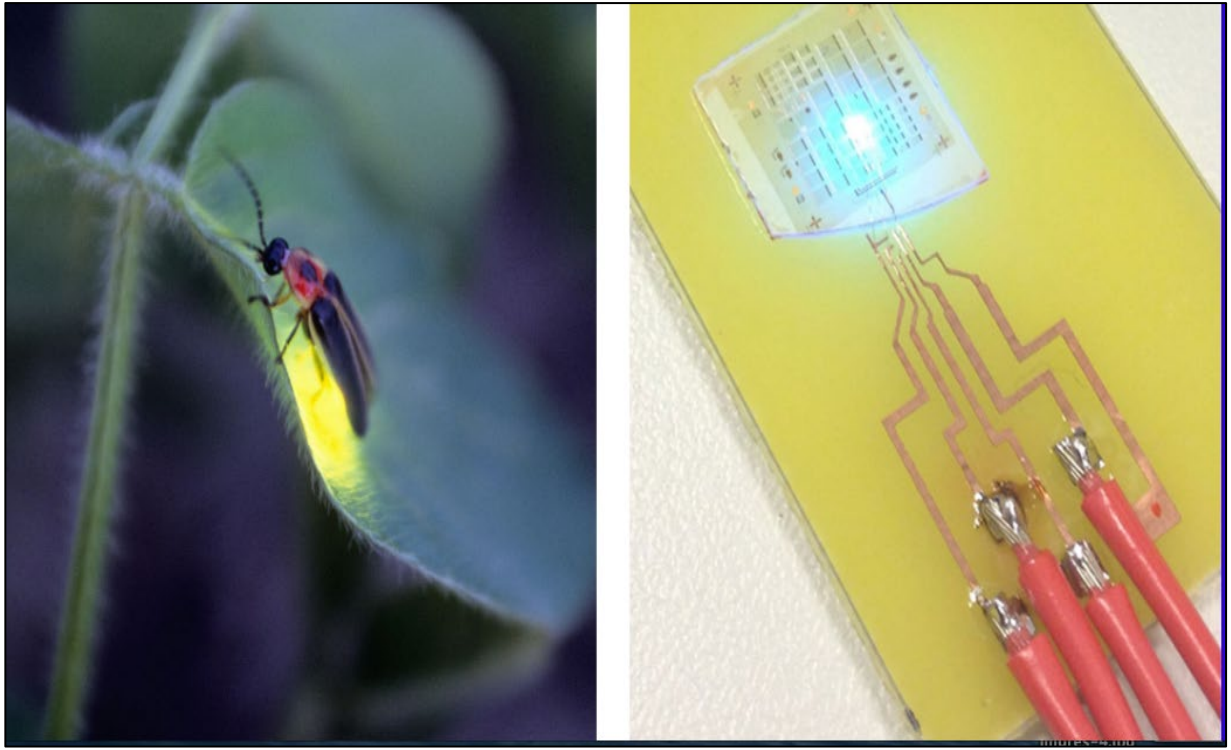
Gecko Feet Adhesives

Geckos are born with the mythical ability to scale smooth walls and scamper upside-down across ceilings. The source of their grip is millions of microscopic hairs on the bottom of their toes. Each hair's attraction is minuscule, but the net effect is powerful. Scientists estimate that the setae from the tiny toes of a single gecko could theoretically carry 250 pounds. The real trick is that by changing the direction of the setae, the grip is instantly broken: no sticky residues, no tearing, no pressure necessary.A team of University of Massachusetts, Amherst, researchers has developed Geckskin, an adhesive so strong that an index-card-size strip can hold up to 700 pounds. A form of gecko tape could replace sutures and staples in the hospital. And the ability to don a pair of gecko-tape gloves and scale walls like Spiderman may not be far off.

Station 2

Boats, Hospitals Don Sharkskin

For creatures that move slowly through the ocean, sharks stay remarkably clear of algae and other fellow travelers. This is largely a function of their unique skin, covered with microscopic patterns called dentricles. These help reduce drag and keep microorganisms from latching on. NASA scientists copied the patterns to create drag-reducing patterns they call *riblets*. They worked with 3M to adapt the riblets to a thin film used to coat the hull of the sailboat Stars & Stripes, which won an Olympic medal and the America's Cup in 1987. The America's Cup race banned and then reinstated the riblets. Other applications can help planes, boats and windmills reduce drag and conserve energy. Sharklet Technologies, based in Aurora, Colorado, makes surface materials for hospitals, restaurants, public bathrooms, etc. that repel bacteria. Dentricle-like nano-scale structures on the surface also keep bugs from attaching.

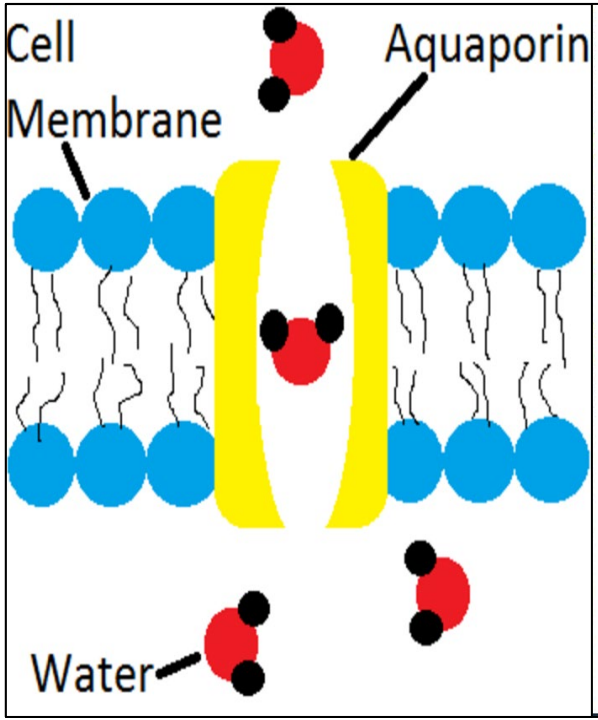


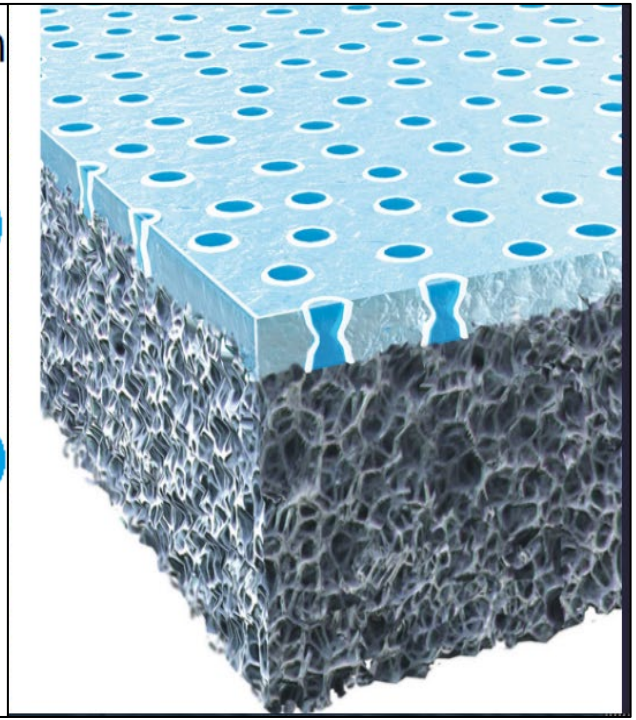
Firefly Lightbulbs

When insects of the genus *Photuris* light fires in their bellies, the radiance is amplified by their anatomy — sharp, jagged scales, that illuminate according to research published by scientists from Belgium, France, and Canada.

Based on this observation, the scientists then built and laid a similar structure on a light-emitting diode (LED), which increased its brightness by 55 percent.

Station 3





Nature's Water Filter

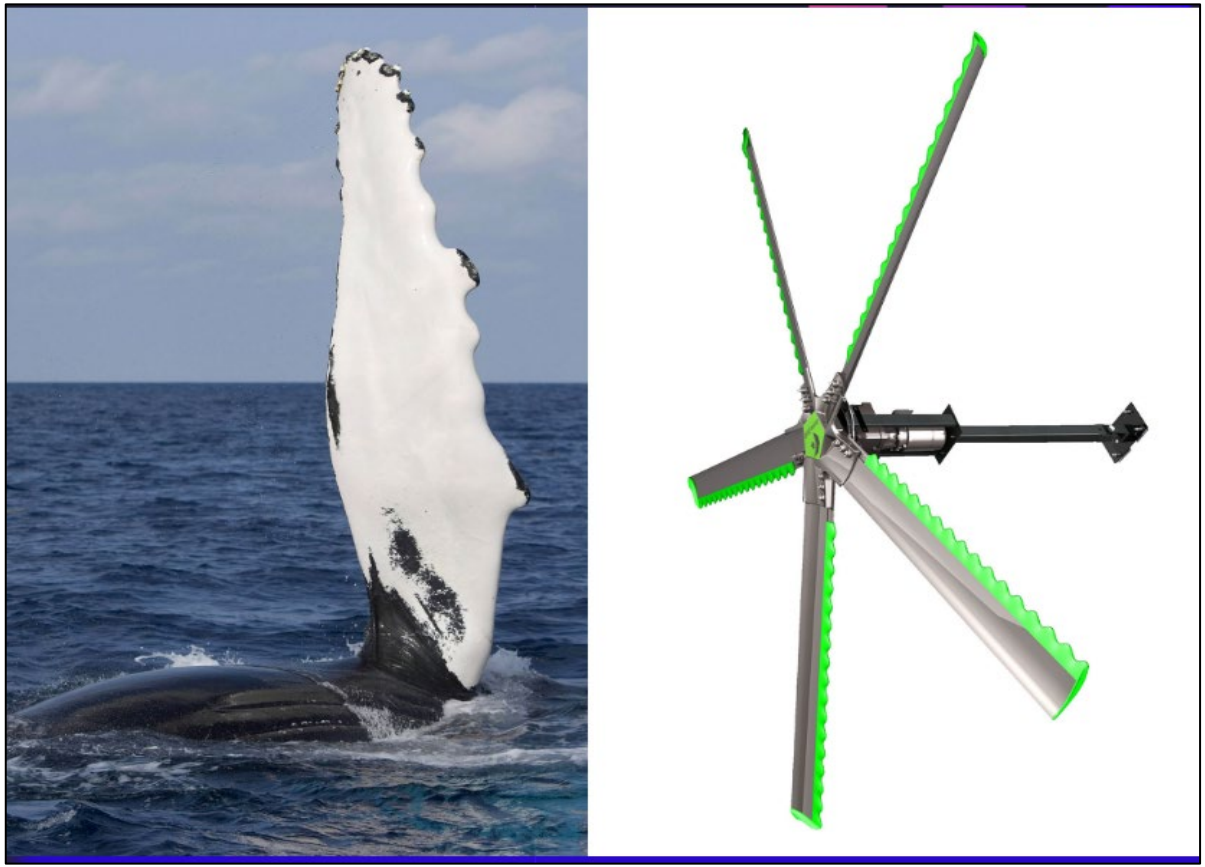
The 2003 Nobel Prize was awarded in part to Peter Agre of Johns Hopkins for his discovery of a membrane protein that allows water to pass through cell walls and can trap salt. The discovery of this aquaporin solved a longtime problem in biochemistry.

The Danish company Aquaporin has developed a new approach to seawater desalination (process that gets rid of salt) that avoids the use traditional industrial polymers and instead uses the elegant complexity and energy efficiency of biological membranes.

Harvesting Desert Fog

The Namibian Beetle raises its back into the air as fog rolls into its desert habitat. Bumps on its shell catch water droplets, which then run down chutes toward its mouth. "The design of this fog-collecting structure can be reproduced cheaply on a commercial scale and may find application in water-trapping tent and building covers," wrote the authors of a paper that revealed how the water collection works. Inventors and designers have taken note. A "Dew Bank Bottle," designed by Pak Kitae of Seoul National University of Technology, imitates the beetle's water-collection system. Morning dew condenses on it and conveys it to a bottle, which has a drinking spout.

Station 4



Fin to the Wind

Humpback whales are surprisingly agile swimmers considering each weighs about 80,000 pounds. Part of their swimming prowess may come from a row of warty ridges, called tubercles, on the front edge of their fins. Frank Fish, biology professor, discovered that by adding rows of similar bumps to turbine blades he could reduce drag and noise, increase speed to changing wind direction and boost the power harnessed by 20 percent. Prof. Fish developed the idea after he noticed bumps on a whale statue in a Boston gift shop. He assumed, incorrectly, that the artist got it wrong and that the bumps shouldn't go on the front edge of fins, which typically are straight and sharp. The bumps are now being sold on industrial fans and surfboards.

Shinkansen Bullet Train

High-speed trains can literally cause headaches. That's why Japan limits their acceptable noise-pollution level, which can be particularly high when the trains emerge from tunnels. As they drive through, air pressure builds up in waves and, when the nose emerges, can produce a shotgun-like thunderclap heard for a quarter mile. Eiji Nakatsu, a bird-watching engineer at the Japanese rail company JR-West, in the 1990s took inspiration from the kingfisher, a fish-eating bird that creates barely a ripple when it darts into water in search of a meal. The train's redesigned nose — a 50-foot-long steel kingfisher beak — didn't just solve the noise problem; it reduced power use and enabled faster speeds.