Activity 1 Teacher Resources

Biomimicry: linking form and function to evolutionary and ecological principles

Teacher background information on some examples of biomimicry

Lotus flower = paint

The lotus flower is like the shark skin of dry land. The flower's micro-rough surface naturally repels dust and dirt particles, keeping its petals sparkling clean. If you've ever looked at a lotus leaf under a microscope, you'll have seen a sea of tiny nail-like protuberances that can fend off specks of dust. When water rolls over a lotus leaf, it collects everything from the surface, leaving a clean and healthy leaf behind.

A German company, Ispo, spent 4 years researching this phenomenon and developed paint with similar properties. The micro-rough surface of the paint pushes away dust and dirt, diminishing the need to wash the outside of a house.

Beetle = water collection

The *Stenocara* beetle is a master water collector. This small black bug lives in a harsh, dry desert environment and can survive thanks to the unique design of its shell. The *Stenocara*'s back is covered in small, smooth bumps that serve as collection points for condensed water or mist. The entire shell is covered in a slick, Teflon-like wax and has channels, so that condensed water from morning dew is funnelled into the beetle's mouth. It's brilliant in its simplicity.

Researchers at MIT have been able to build on a concept inspired by the *Stenocara*'s shell first described by Oxford University's Andrew Parker. They have crafted a material that collects water from the air more efficiently than existing designs. About 22 countries around the world use nets to collect water from the air, so such a boost in efficiency could have a big impact.

Shark skin = swimsuit

Shark-skin-inspired swimsuits received a lot of media attention during the 2008 Summer Olympics, when the spotlight was on Michael Phelps.

Seen under an electron microscope, shark skin is made up of countless overlapping scales called dermal denticles (or "little skin teeth"). The denticles have grooves running down their length that align with water flow. These grooves disrupt the formation of eddies, or turbulent swirls of slower water, making water pass faster. The rough shape also discourages parasitic growth, such as algae and barnacles.

Scientists have been able to replicate dermal denticles in swimsuits (which are now banned in major competition) and on the bottom of boats. When cargo ships can squeeze out even an extra 1% in efficiency, they burn less fuel and don't require cleaning chemicals for their hulls. Scientists are applying the technique to create surfaces in hospitals that resist bacterial growth – bacteria can't attach to the rough surface.

Termite den = office building

Termite dens look otherworldly, but they are surprisingly comfortable places to live. While the temperature outside changes dramatically throughout the day, from lows in the 30s to highs of over 38 degrees Celsius, the inside of a termite den remains constant at a comfortable (to a termite) 30 degrees Fahrenheit.

Mick Pearce, architect of the Eastgate Centre in Harare, Zimbabwe, studied the cooling chimneys and tunnels of termite dens. He applied those lessons to the 333,000 square foot Eastgate Centre, which uses 90% less energy to heat and cool than traditional buildings. The building has large chimneys that naturally draw in cool air at night to lower the temperature of the floor slabs, just like termite dens. During the day, these slabs retain the coolness, greatly reducing the need for supplemental air conditioning.

Burr = Velcro

Velcro is a widely known example of biomimicry. You may have worn shoes with Velcro straps as a youngster, and you can certainly look forward to wearing the same kind of shoes in retirement.

Velcro was invented by Swiss engineer George de Mestral in 1941 after he removed burrs from his dog and decided to take a closer look at how they worked. The small hooks found at the end of the burr needles inspired him to create the now ubiquitous Velcro. Think about it: without this material, the world wouldn't know Velcro jumping – a sport in which people dressed in full suits of Velcro attempt to stick their bodies as high up on a wall as possible.

Whale = turbine

Whales have been swimming around the ocean for a long time, and evolution has crafted them into a super-efficient form of life. They are able to dive hundreds of feet below the surface and stay there for hours. They sustain their massive size by feeding on animals smaller than the eye can see, and they power their movement with über-efficient fins and a tail.

In 2004, scientists at Duke University, West Chester University, and the U.S. Naval Academy discovered that the bumps on the front edge of a whale fin greatly increased its efficiency, reducing drag by 32% and increasing lift by 8%. Companies like Whale Power are borrowing this concept and creating wind turbine blades that greatly boost the amount of energy created per turbine. Other companies are applying the idea to cooling fans, aeroplane wings, and propellers.

Birds = jets

Birds can boost the distance they're able to fly by more than 70% though the use of V-shaped formations. Scientists have discovered that when a flock adopts the familiar V formation, when one bird flaps its wings, it creates a small updraft that lifts the bird behind. As each bird passes, they add their own energy to the stroke, helping all birds maintain flight. By rotating their order through the stack, they spread out the exertion.

A group of researchers at Stanford University think that passenger airlines could realize fuel savings by adopting the same tactic. The team, lead by Professor Ilan Kroo, envisions scenarios where jets from West Coast airports meet up and fly in formation en route to their East Coast destinations. By traveling in a V shape, with planes taking turns in front as birds do, Kroo and his researchers think aircraft could use 15% less fuel compared with flying solo.