Vicky Wong

Biomimetics

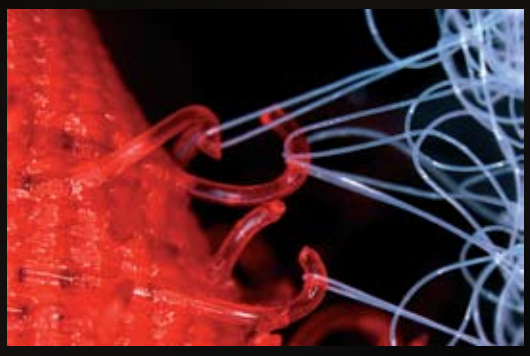
What do burrs on a dog's back, a pinecone, the skin of a shark and a water lily have in common? They have all provided the stimulus for the design of useful products by biomimetics.

Biomimetics is 'design inspired by nature.' It looks for inspiration in the natural world for solutions to a variety of problems.

Velcro

One of the earliest modern examples of biomimetics began over 60 years ago when George Mestral examined the burrs which stuck to the fur of his dog under the microscope. He saw hundreds of tiny hooks which latched into the soft fur of the dog. He discussed this with weaving experts and eventually a pair of cloth tapes were produced which, when pressed together, fastened in a similar way to a teasel and fur. The idea was patented by Velcro in 1952.

The hooks on the fruit of the burdock were the inspiration for Velcro.



Velcro consists of two fabrics, one with hooks and the other with loops.

Military fabric

Pinecones are a more recent example of an inspiring plant. When the cones are hanging on a tree they are firmly closed but, as they ripen and fall to the ground, they open in order to release the seeds. The cones respond to levels of moisture in the air and open as the scales dry out. This happens because the scales are made of two materials which react differently to humidity. As the cone dries out, one side expands more than the other and so the scales bend.

Scientists used this idea but reversed it, creating a fabric which contains lots of little flaps which open in high humidity. If a person wearing such a fabric gets very hot and sweats then the flaps will open and cool them down. As the level of sweat reduces, the flaps will close again. The military are particularly interested in this type of product for soldiers serving in desert locations which can be very hot during the day but cold at night.

As the scales of a pine cone dry out, they open to release the seeds.

Swimmers in shark skin

Shark skin is so rough that when dried it can be used as sand paper. It is covered with little v-shaped bumps which are made from the same material as the sharks' teeth. This rough surface reduces friction as the shark swims through the water and makes the shark a far more efficient swimmer than would be expected. After studying the shark skin, scientists tried covering boats and aircraft with little perpendicular ridges and found that they significantly reduced drag. Fabrics have also been produced which mimic shark skin and these have been used to make swimwear for competitions. The idea is so successful that 27 out of 33 medals at the Sydney Olympics were won by swimmers wearing the new shark skin style swimsuits.

Shark skin has pointed scales which reduce drag as the shark moves through the water

Swimsuit fabric designed to mimic shark skin

Michael Phelps of the USA was one of the successful swimmers at the Sydney Olympics – he wore a 'sharkskin' racing swimsuit.

Lotus leaves

The lotus plant (or water lily) lives in muddy water but manages to remain clean. This remarkable ability has been known about for many years, but recently scientists have looked more closely at the structure to find out why. The surface is superhydrophobic which means that it is extremely good at repelling water. You might expect that such a surface would have to be particularly smooth, but in fact it is made of a hydrophobic (water repelling) wax which is arranged in little ridges. This repels water effectively.

The rough surface also reduces the area for both dirt and water to be in contact with the leaf which significantly reduces how well they stick to the leaf. When water droplets fall on the leaf, they roll off the water-repellent surface, taking with them any dirt particles which are on it. This means that the lotus effectively has a self-cleaning surface.

This idea has led to the development of new paints and coatings which are self-cleaning. The photo shows a wate droplet on a self-cleaning coating. This contains tiny nanoparticles which make the water droplet form a near-spherical shape which collects dirt as it rolls off the surface. This self-cleaning and waterproof property is known as the 'lotus effect' after the same properties found on the lotus leaf. Materials covered with this coating are able to withstand corrosion and stay clean.

A lotus leaf, showing its superhydrophobic property.

A water droplet resting on a water-repellent coated surface

Look here!

For a video explaining what happens to water on very hydrophobic leaves: *http://tinyurl.com/ykw4dt7*