Video/ Slide show

Watch the video “Science Copies Nature’s Secrets”.

See more and get to know more about biomimicry:
https://www.youtube.com/watch?v=ZODvr_GzNc4
https://www.youtube.com/watch?v=FBUpnG1G4yQ

Observing

The students look at some maple seeds and think about the solutions they have inspired in aviation.

Nature has equipped the seeds of some plants with tools that allow them to fly. Thanks to their small wings or petals these plants (e.g. maple or pine seeds) can glide or fly off in a spinning motion in search of a place where they can germinate. Engineers have used these properties of plants as models for designing gliders and paragliders, as well as in the construction of the helicopter rotor blade.

Video/ Slide show

Watch the film and talk about the living organisms that provided the inspiration for the first planes.

How do planes mimic nature?

The oldest technical designs of biomimetic machines come from Leonardo de Vinci. He made anatomical studies of birds' wings as well as the first flying machines inspired by these wings. Unfortunately, none of this great visionary's designs were actually built. However, they did provide inspiration for later inventions.
Otto Lilienthal, who lived in the second half of the 19th Century, was the first person to manage to fly in the air with the help of a glider he had built himself. His study of the structure and of how birds' wings work had a huge influence on the construction and appearance of aircraft wings.
The arrangement of the feathers at the ends of certain birds' wings provided the inspiration for the tips of passenger aircraft wings. The distinctive bend of the wing tips helps reduce air turbulence, which in turn lowers fuel consumption during a flight.
Gilders make use of air currents in exactly the same way as soaring birds do. There are some species of birds whose basic mode of movement is flying with stationary wings. These birds make use of air currents. Gliding is not possible when the air is stagnant. Vast rising air currents form when air heats up. Hot air is lighter than cold air, and as a result it begins to rise, ascending in large spirals. By "riding" these spiraling currents birds rise upwards together with the air current until they reach a great height. They then glide along the distance separating them from the next upward current. They then rise upwards once more, flying in a circle as before.
Squids move by jet propulsion. They take water into their mantle cavity through one opening, and expel the water through another. The water is expelled on one side and the squid swims in the opposite direction. The phenomenon of jet propulsion is used in rockets to help them fly upwards.
When the smallest bird in the world – the hummingbird, - suspends itself in the air (in order to drink nectar from flowers) its wings move at a speed of 269 miles an hour. A similar skill – hovering in the air – is by possessed by helicopters.

See more:

Short history of aviation

Clicking play will redirect you to YouTube website.

See how birds' wings work and how they provided the inspiration for the wings of aircraft

Clicking play will redirect you to YouTube website.

Experiment

The students carry out a simple experiment to see how vehicles move across the surface of water. What living organisms provide them with inspiration?

When they move across the surface of water pond skaters make use of surface tension .
Surface tension is a phenomenon in physics where at the point of contact between a liquid and a solid, a gas or another liquid a surface forms that behaves like an elastic membrane (surface membrane).
In the experiment with the paper clip, if it is dropped vertically onto the surface of the water it will penetrate the membrane and fall to the bottom of the cup. If it is placed on the water very gently and horizontally rather than vertically the paper clip will float.
Another reason why pond skaters are able to float on water is their anatomy: they are small and light in weight, the second and third pairs of their legs are set wide apart and to the side (which spreads out the insect's body mass). Most importantly, they have microscopic hairs that cover the underside of their body and the underside of their feet. The structure of these hairs resembles a needle with distinctive grooves. When air penetrates between the hairs it forms a structure that makes the skater's legs more resistant to the water. This allows it to "submerge" its feet up to a depth of 4 mm, without piercing the surface membrane.

Puzzle/quiz

The students take part in a quiz and see examples of biomimicry applied in different areas of life.

In what areas of life are bionics used?

Bionics make use of different branches of the natural sciences, such us botany, zoology and chemistry. In turn, bionic research is used in computer science, medicine, medical engineering, environmental protection and various fields of technology.

Today, bionics consists of a number of separate areas of research:

- biokinetics: mobile robots and equipment;
- bioaerodynamics: flying machines;
- biohydrodynamics: floating machines;
- bionics of structures: materials modelled on the structure and surfaces of living organisms;
- bionics of construction: machines and equipment modelled on solutions used by living organisms;
- bio-architecture – an architectural feature is modelled on existing biological structures.

SHARK SKIN AND SWIMSUITS – at first glance shark skin appears smooth. But if you were to touch it, moving your hand from the tail to the head of the fish you would notice that it is as rough as sand paper. Materials with the properties of shark skin have many applications. For example, scientists have managed to create a swimming costume whose outer surface imitates the texture of shark skin. This helps increase the speed of a swimmer by a few percent.

TERMITE MOUNDS AND THE SELF-VENTILATING SKYSCRAPER – termite nests, known as termite mounds, reach up to several meters in height and are so durable that you would need explosives to destroy them. It is a perfectly ventilated construction created by small termites from a mixture of water, clay and saliva. Thanks to their many corridors, tunnels and ventilation shafts, termite mounds ensure their inhabitants the ideal temperature and humidity. This in turn enables it to endure droughts and high temperatures and it also creates the conditions for, e.g. cultivating mini-gardens inside the termite mounds. This is where termites grow fungus, which provides the basis for their food. Termite mounds have provided the inspiration for some buildings that protect against the sun, regulate temperature and humidity. One such example is Eastgate in Harare in Zimbabwe – a complex with porous walls, which help ventilate the building and maintain a constant temperature throughout the year.

THE WEBBED FEET OF A FROG AND THE FLIPPERS USED FOR SWIMMING – The flippers used by swimmers were inspired by the webbed hands and feet of animals, such as frogs. They perform the same function – they make it easier to move in the water. When we observe frogs we notice that when they move their legs backwards the toes spread wide and the elastic webbing creates a large surface that scoops up water – this results in the animal moving rapidly forward.

A WOODPECKER'S SKULL AND THE MODERN BIKE HELMET – a woodpecker can strike a tree 22 times a second and without causing any damage to its brain. This is possible thanks to a number of features that "cushion" its body, such as a strong and flexible beak, its hyoid apparatus and sponge-like bone structure in the skull. The structure of the woodpecker's skull has provided the inspiration for modern bike helmets, which are designed to cushion the head against mechanical shocks.