LEVELED BOOK • Z1

Biomimicry

MULTI LEVEL Y • Z1 • Z2

Written by Rus Buyok

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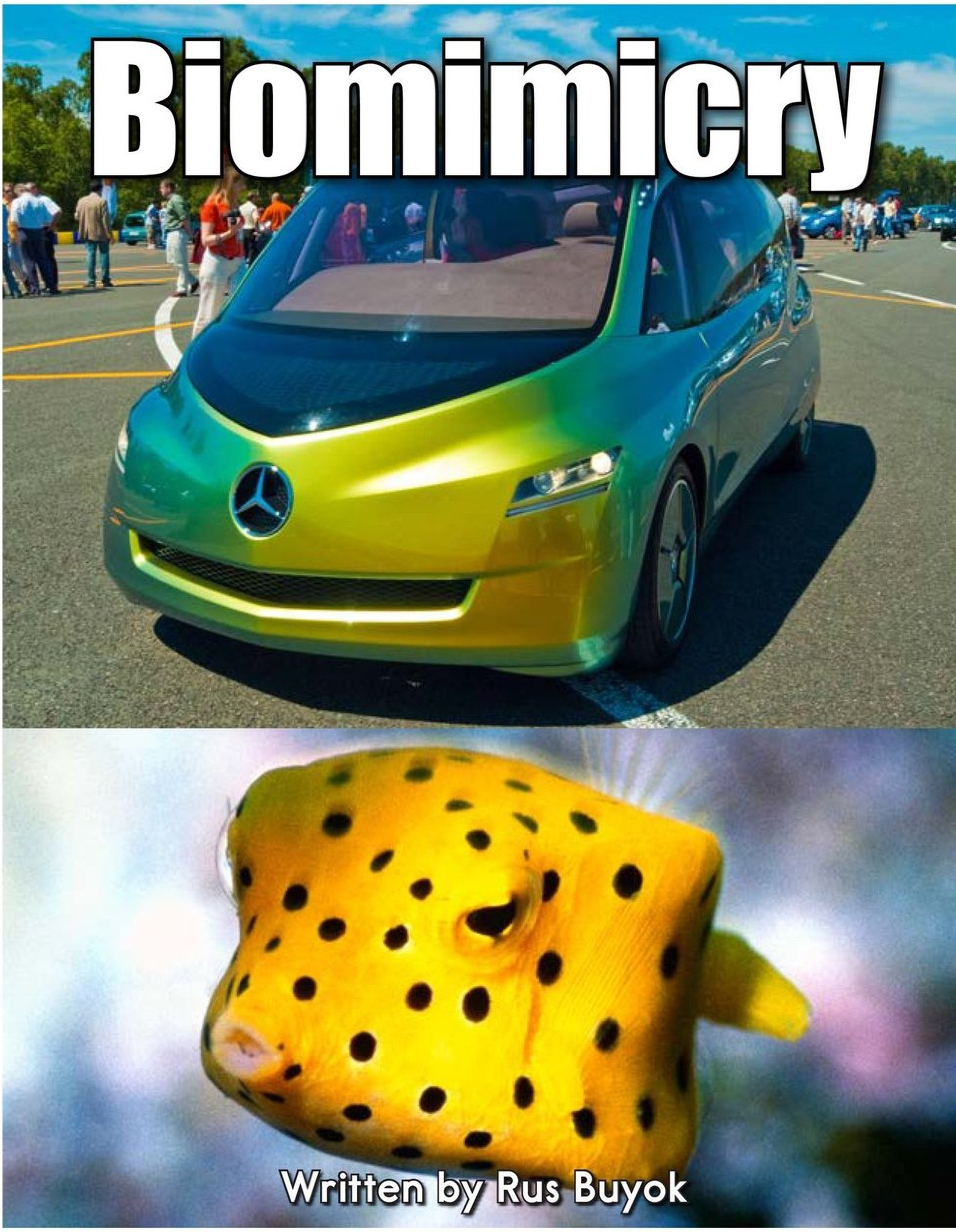
Biomimicry



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Focus Question

What important lessons have we learned from biomimicry?

Words to Know

adapted	fossil fuels
antifreezes	glare
biologists	greenhouse gases
contaminating	microorganisms
ecosystem	resources
efficient	sustainable

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Biomimicry
Level Z1 Leveled Book

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Correlation

LEVEL Z1	
Fountas & Pinnell	W–X
Reading Recovery	N/A
DRA	60

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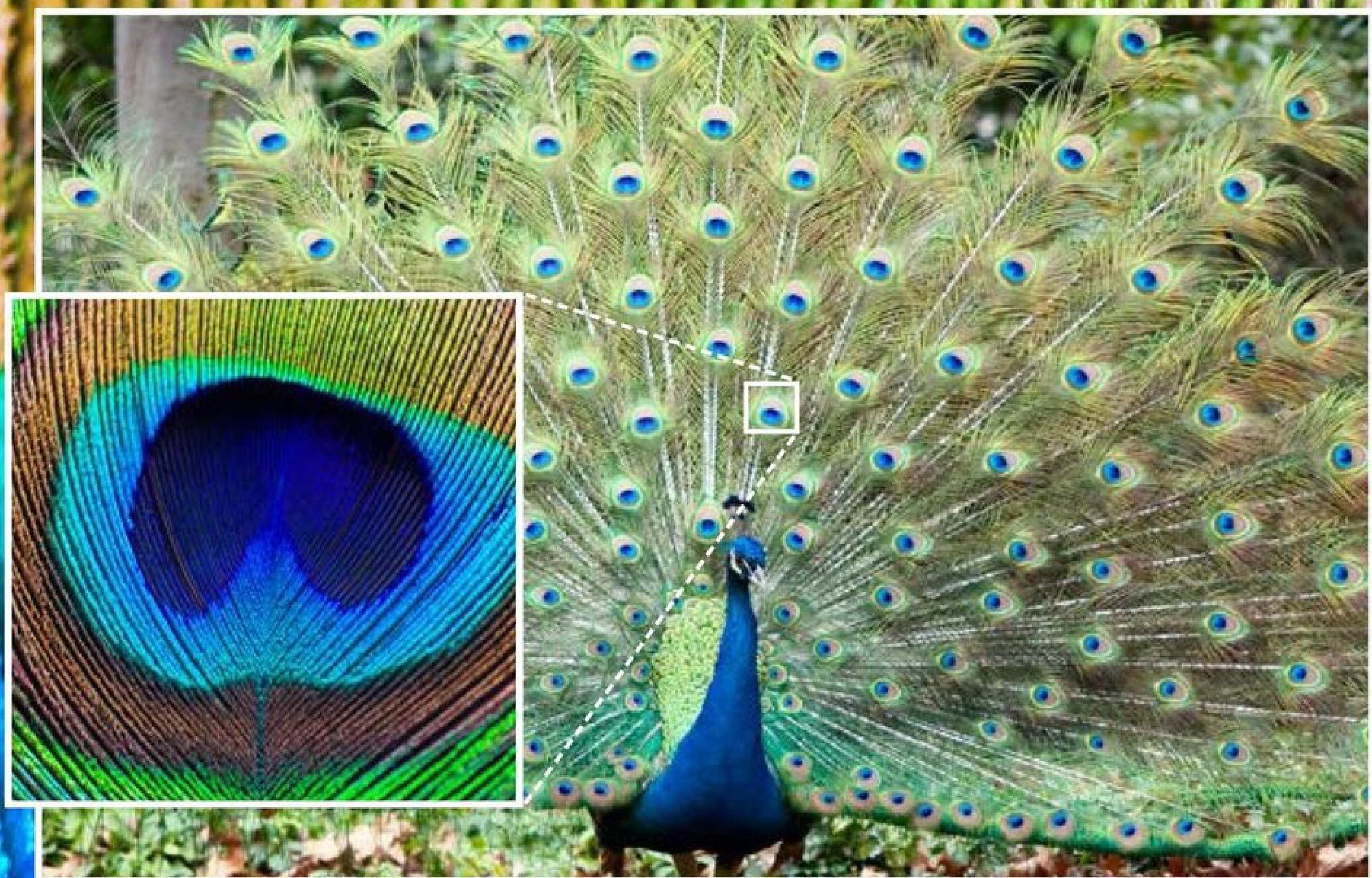


A male peacock displays his feathers to attract mates.

Introduction

Did you know that a peacock's feathers have little color? What we see is actually the special shape of the feathers bending light so it looks like color. Did you know that locusts never run into each other because a special part of their brain notices and reacts to something in front of them much faster than our brain can?

Nature is filled with a vast number of living things like these, each with its own abilities that help it survive. As humans, we have spent many years learning about nature and how it works. Now a science called *biomimicry* is developing that focuses on how we can apply lessons from nature to our own lives.

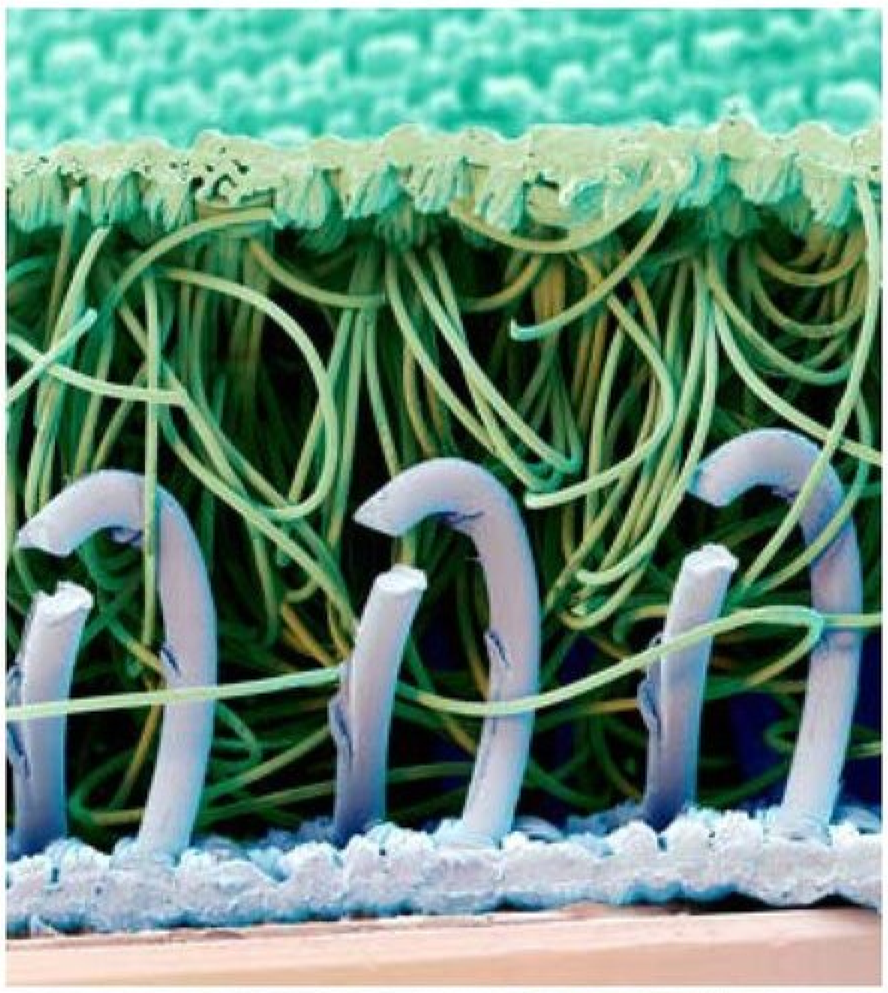
A biologist studies a manatee in Florida.

What Is Biomimicry?

The word *biomimicry* comes from two words: *bio*, meaning “life,” and *mimic*, meaning “to copy.” This new field of study, also known as biomimetics, is the science of copying life. Sounds simple, right? The idea behind this science is pretty simple. Organisms in nature have had to face many different challenges, so over many thousands of years, living things have **adapted**, or changed, to better survive in their environments. **Biologists**, scientists, designers, engineers, and others look at how organisms have adapted to solve the challenges they face. They then look at the challenges we as humans face and see how nature’s adaptations can help us find solutions. The important part to remember is that biomimicry doesn’t *use* living things—it *learns from* them.

The idea of biomimicry is nothing new. People have been turning to nature to solve problems for hundreds of years. For example, Leonardo da Vinci, a scientist, inventor, and artist who lived from 1452 to 1519, designed many flying machines based upon his observations of birds—though none of those machines actually worked. You can also see biomimicry at work in the shape of boats, as well as in some other things you might not expect.

A self-portrait by Leonardo da Vinci (main) and his drawing of a flying machine (inset)



Velcro under a microscope (left), a burr (inset), and a boy wearing a Velcro suit hanging from a Velcro wall (right)

That Comes from *What*?

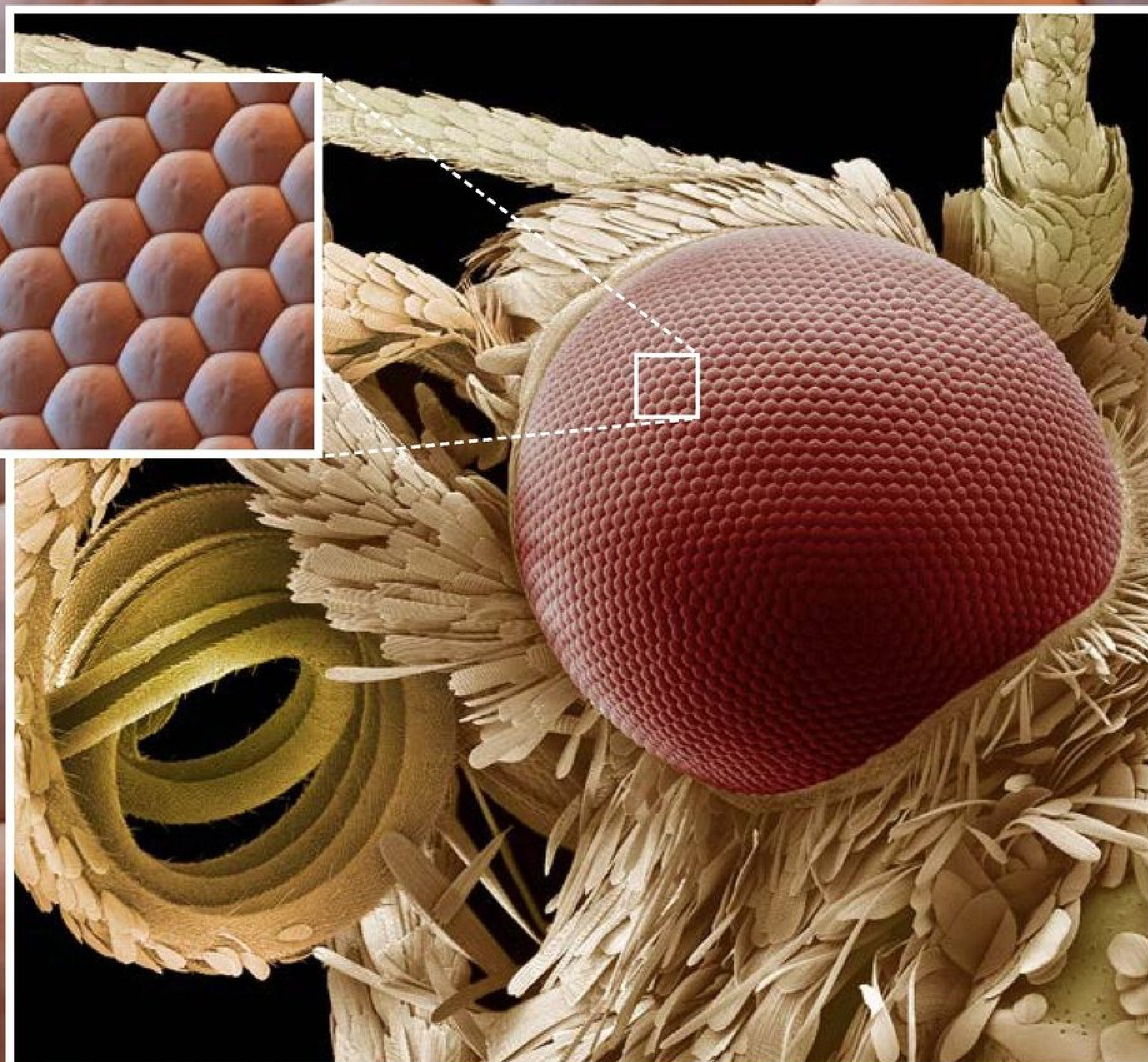
Velcro

Have you ever gone running through a field and had to pick burrs off your pants and socks afterward? That's what happened to Swiss engineer Georges de Mestral and his dog one day in 1941. He wondered how these little seeds managed to stay attached so well. Looking at them under a microscope, he noticed that parts of each burr had little hooks that would catch on fibers, such as hair. From this observation, he created Velcro, which uses two fabrics, one with hooks and the other with loops, to temporarily attach things together. The adaptation that helped these little seeds travel all over has been used in hundreds of different ways to make our lives easier—and it even helped us go to the Moon.

A cat's eyes reflecting light (main), and a Cat's Eye in Yorkshire, United Kingdom (inset)

Reflectors

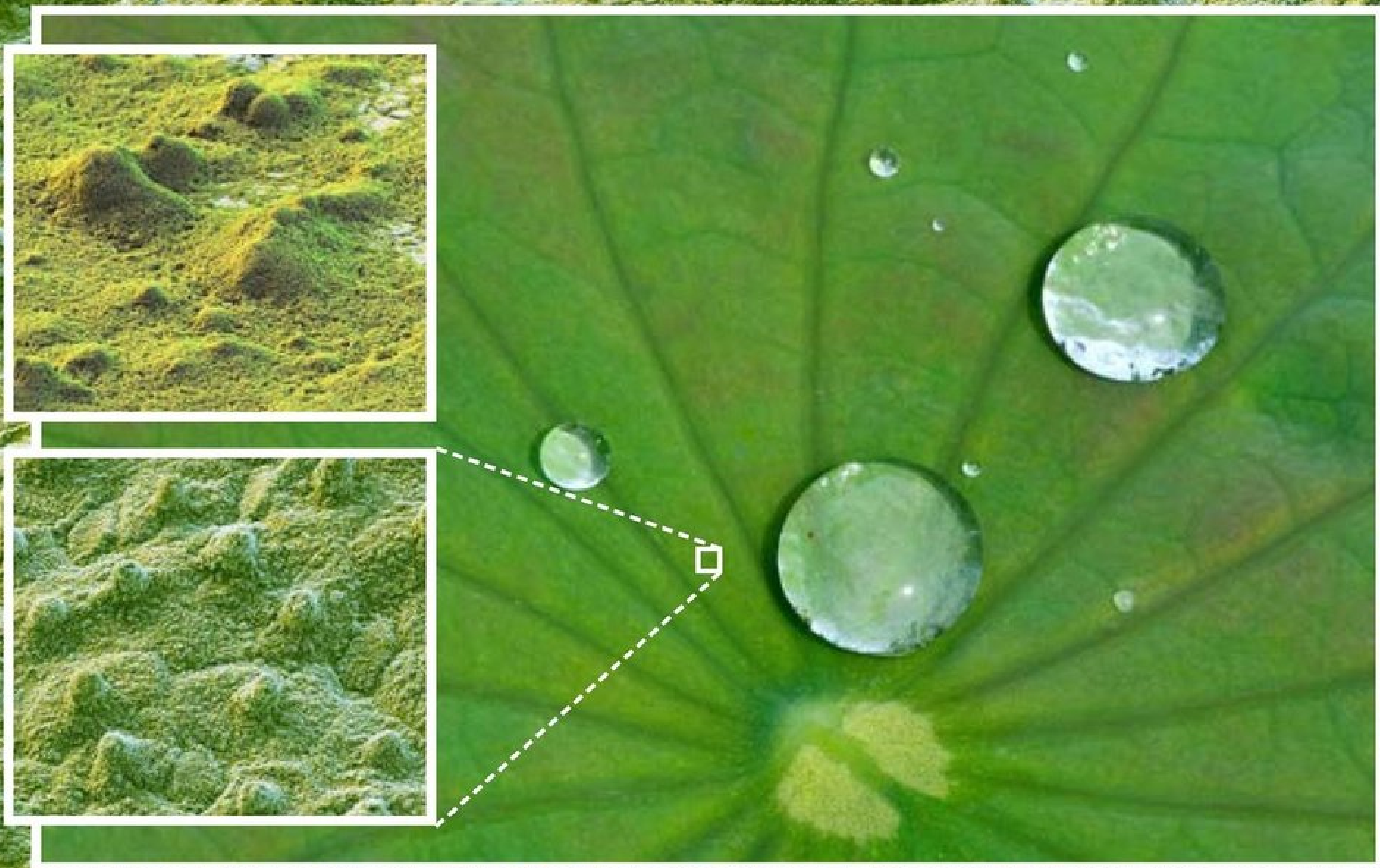
You've probably seen light reflected off the plastic things spaced out along the middle and sides of the road at night. These reflectors are common all around the world. Percy Shaw invented the first version of these. He was driving through foggy weather one night in 1933 when suddenly he saw a pair of cat eyes reflected in his headlights. Cats' eyes have a highly reflective layer of cells at the back, which is what makes them glow when light shines on them. That was all Percy Shaw needed to create the Cat's Eye—two highly reflective spheres set into the center of a road. The Cat's Eye has changed over the years, but the idea that those two reflecting eyes sparked has helped countless people get home safely when driving at night or in fog.



This microscopic view shows the antireflective surface of a moth's eye.

Antireflective Screens

Scientists have been studying insects for many years. In the 1960s, they discovered that the surface of a moth's eye, as well as that of certain species of flies, reduces reflection. It took almost forty years, but human technology finally developed to the point at which lasers could create screens that mimicked the surface of a moth's eye. These new screens, which can often be found on computers, greatly reduce **glare** and make working and playing much easier on our eyes.



These microscopic views show how self-cleaning paint (top) mimics the surface of a lotus leaf (bottom) and causes water to bead and roll off (right).

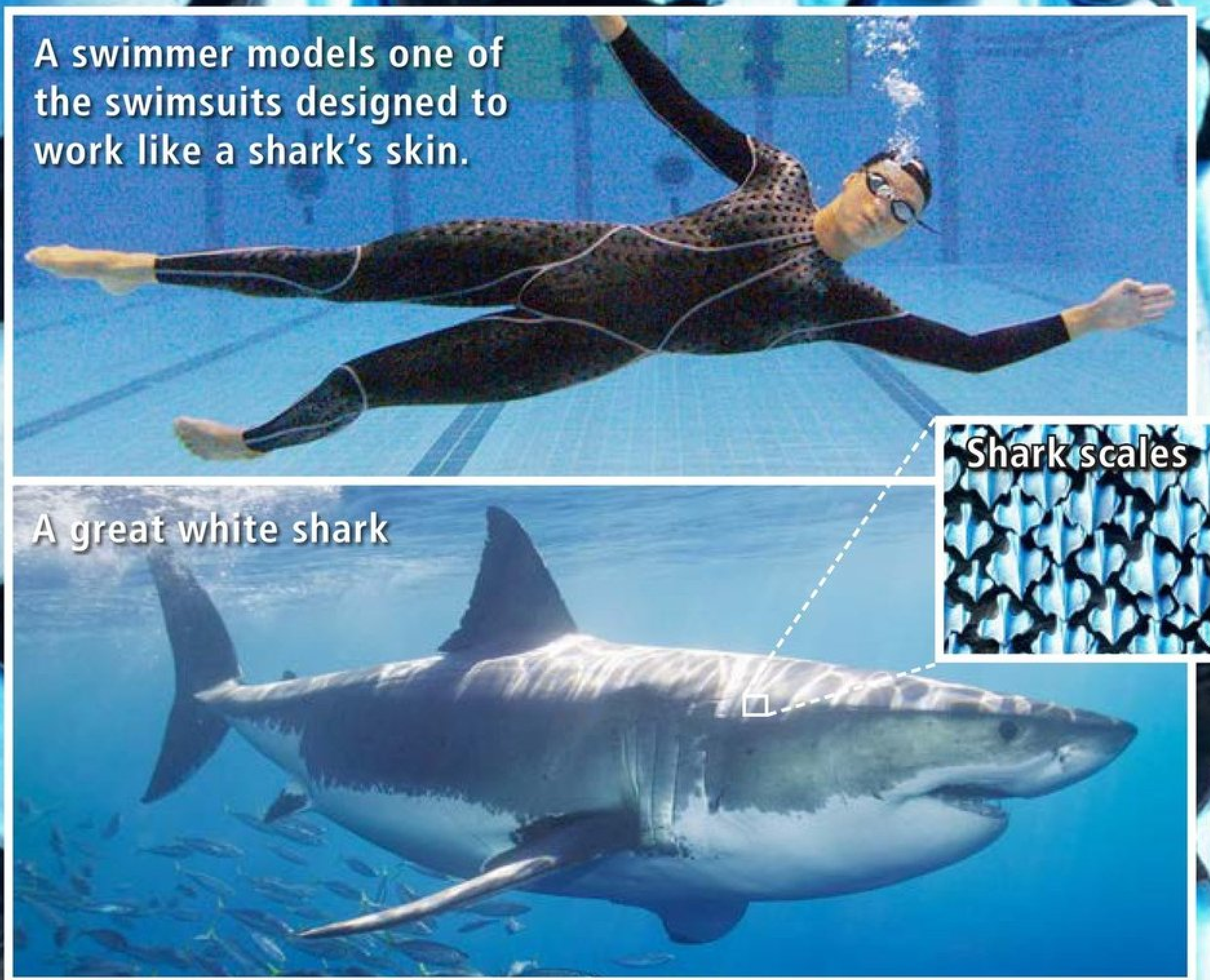
Self-Cleaning Paint and Roof Tiles

The lotus leaf is pretty amazing. Lotus plants grow in ponds and rivers where they can easily become covered with dirt and mud. No matter how dirty a lotus leaf gets, however, a light sprinkling of rain completely cleans its surface! When water lands on the lotus leaf, its special surface causes the water to bead up and roll off. While the water is rolling off, it picks up all the dirt and cleans the leaf. A group of scientists and engineers noticed this interesting feature and created paints and roof tiles with surfaces that mimic the surface of a lotus leaf. As a result, every time it rains, the outsides of houses with these paints and tiles are cleaned.

The newly designed Shinkansen train pulls into a Tokyo train station in 2010.

Shinkansen Train

Japan's Shinkansen train, also known as the bullet train, used to have a rounded nose, which worked great until it went into a tunnel. Because the train was moving at speeds up to 210 kilometers per hour (130 mph), the pressure of the air around the train when it left the tunnel made a booming noise. To fix this problem, the designers of the train looked to the kingfisher, a small bird with a uniquely shaped beak and head that allow it to dive for fish without making a big splash. The designers based a new nose for the train on a kingfisher's beak. It not only solved the noise problem but also made the train faster and more **efficient**.


A swimmer models one of the swimsuits designed to work like a shark's skin.

A great white shark

Shark scales

Swimsuits

Sharks have been swimming in the ocean since before the time of the dinosaurs, so they're pretty well adapted to moving in water. One strong piece of evidence is their skin. It looks smooth, but if you were to run your hand over it, it would feel similar to sandpaper. That's because a shark's skin is actually made up of tiny grooved scales. The special shape of these scales helps the shark move through the water easier and faster. At the 2000 Sydney Olympics, a number of companies showed off swimsuits that were designed to work like a shark's skin, and 80 percent of the swimmers who wore those suits won medals.

The Eastgate Centre (left) releases hot air through vents along the sides and top of the building like a termite mound (right).

Cooling Systems

Some species of termites build huge mounds in which to live. Biologists discovered that although the temperature outside might be very hot, the insides of the termite mounds stayed at a constant, cooler temperature. The termites keep their mound cool with a complex system of tunnels and vents that run from deep in the ground to the top of the mound. Because warmer air rises, the heat inside the mound escapes through the top, while cooler air comes up from below, keeping the mound at a constant temperature. The Eastgate Centre in Harare, Zimbabwe, was built with these same ideas in mind. It uses heat-resistant materials and special vents at the top to keep the large building cool—without air conditioning. Consequently, it uses only 10 percent of the energy that a normal building of the same size would use.

The Moss Landing power plant in California (right) was one of the first to turn carbon dioxide into cement using a process similar to one that corals use (left).

Building Materials

You might have heard that carbon dioxide is one of the **greenhouse gases** that causes climate change. When we burn **fossil fuels** to create electricity or drive our cars, we put more and more carbon dioxide in the air. Some living things, like coral, actually use carbon dioxide to build structures. Scientists studied how these living things used carbon dioxide and then came up with a way to copy their process. It's now possible to take some of the carbon dioxide made by burning fossil fuels and create materials similar to concrete that we can use to build new things.

Why Is Biomimicry So Important?

People are great at making the things we want and need. In the many thousands of years that humans have existed, we have advanced from living in caves and hunting for food to sleeping in homes and shopping at stores. Our recent development has forced us to face some pretty tough challenges, and one of those is how we go about producing all the things we use.

To make the things we want and need, such as food, homes, plastic bottles, cars, and video games, just to name a few, we use great quantities of **resources** and produce large amounts of waste materials and pollution. Often, the energy used to make and run these things comes from fossil fuels, which cause greenhouse gases to build up in the atmosphere. Also, we create many artificial chemicals that may harm the environment, while the things themselves often end up in landfills when we're done using them. The buildup of all the greenhouse gases, garbage, and other waste materials is starting to cause problems for us. Our climate is changing because of pollution, we're running out of fossil fuels and other resources, and our garbage and other waste materials are **contaminating** the Earth in a variety of ways. So what do we do?

A truck dumps garbage in a landfill near a small village in the United Kingdom.

One thing we can do is to learn from nature. Nature is great at making the things it needs to survive, too—and it does so very simply and with little waste. A clam creates its shell with nothing but seawater and food, and the tallest tree in the world can move water from its roots to its top branches with energy from the Sun and no water pump. Any waste becomes a resource for another organism, such as a dead tree becoming food, shelter, and energy for hundreds of living things. All the different parts of an **ecosystem** work together in a **sustainable** way without using up or damaging resources. It has taken many thousands of years to create these sustainable environments, and each living thing—and its adaptations—plays a certain role.

Mushrooms and moss grow on a fallen tree.

Through the science of biomimicry, we have a chance to see how these sustainable environments survive and how the organisms within them work together. Through them, we can learn and adapt how we live and make the things we use to help solve our challenges and live in more sustainable ways.

Solar Ivy (right) acts like artificial leaves, turning sunlight into energy as a tree does (left).

The Future of Biomimicry

Artificial Leaves

Trees use sunlight to produce energy through a process called *photosynthesis*. Scientists are working on creating artificial trees with leaves that use sunlight and wind to produce electricity. One day, these trees could produce enough energy to allow us to burn less fossil fuels.

This microscopic view of a spider spinning silk (inset) shows how spiders, such as the funnel spider (main), create their webs.

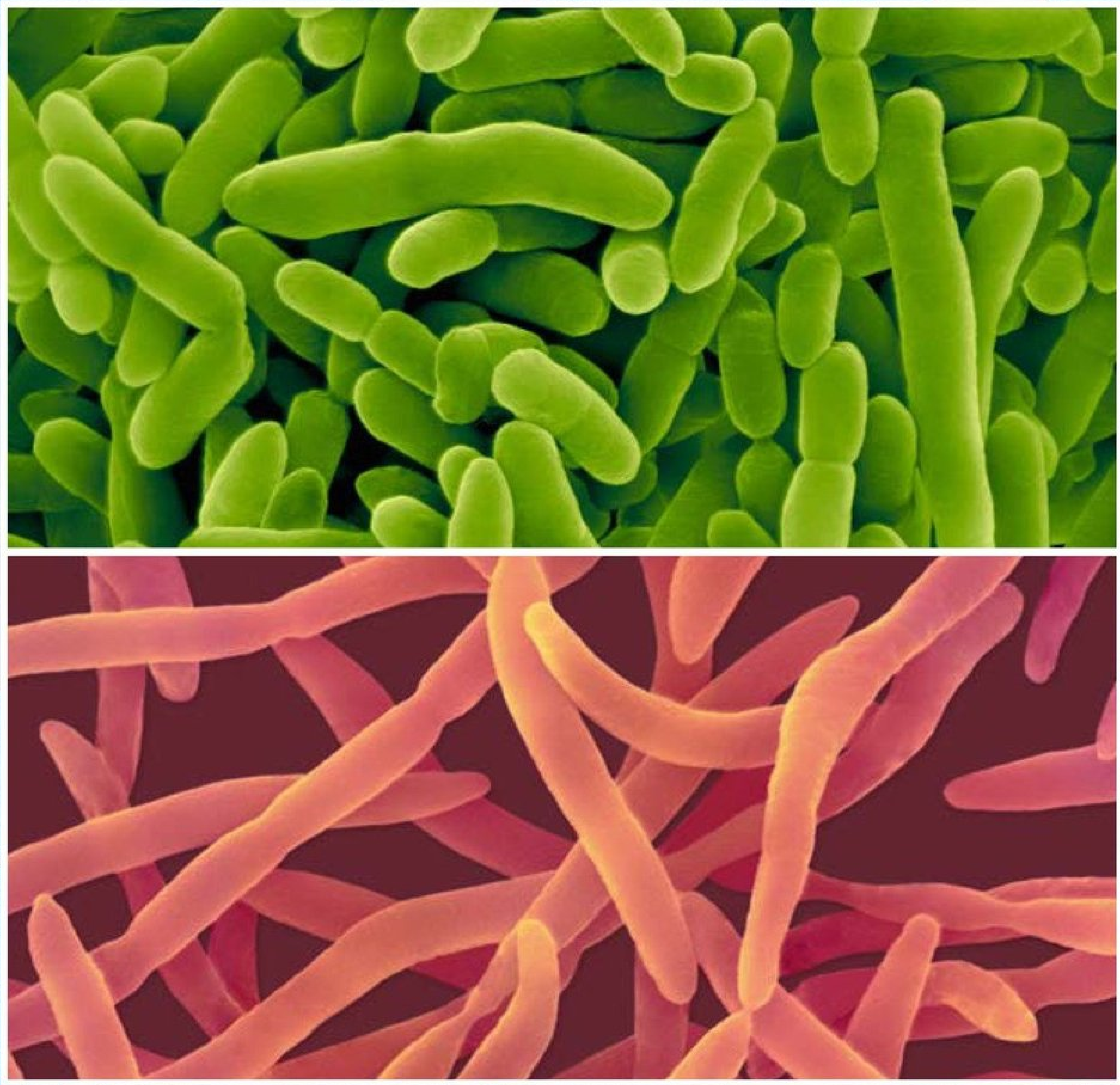
Spider Silk

If you've ever accidentally walked into a spider's web, you know how sticky and strong the silk is. In fact, scientists have proven that spider silk is about three times as strong as steel. Now they're trying to figure out just how a spider makes silk (it's not a simple process) and then create it themselves. The artificial spider silk would be an incredibly strong, light fabric that's natural and could have many different uses.

Antarctic ice fish survive in waters below freezing because of a natural antifreeze in their blood. They can also take in oxygen through their skin!

Fish Antifreeze

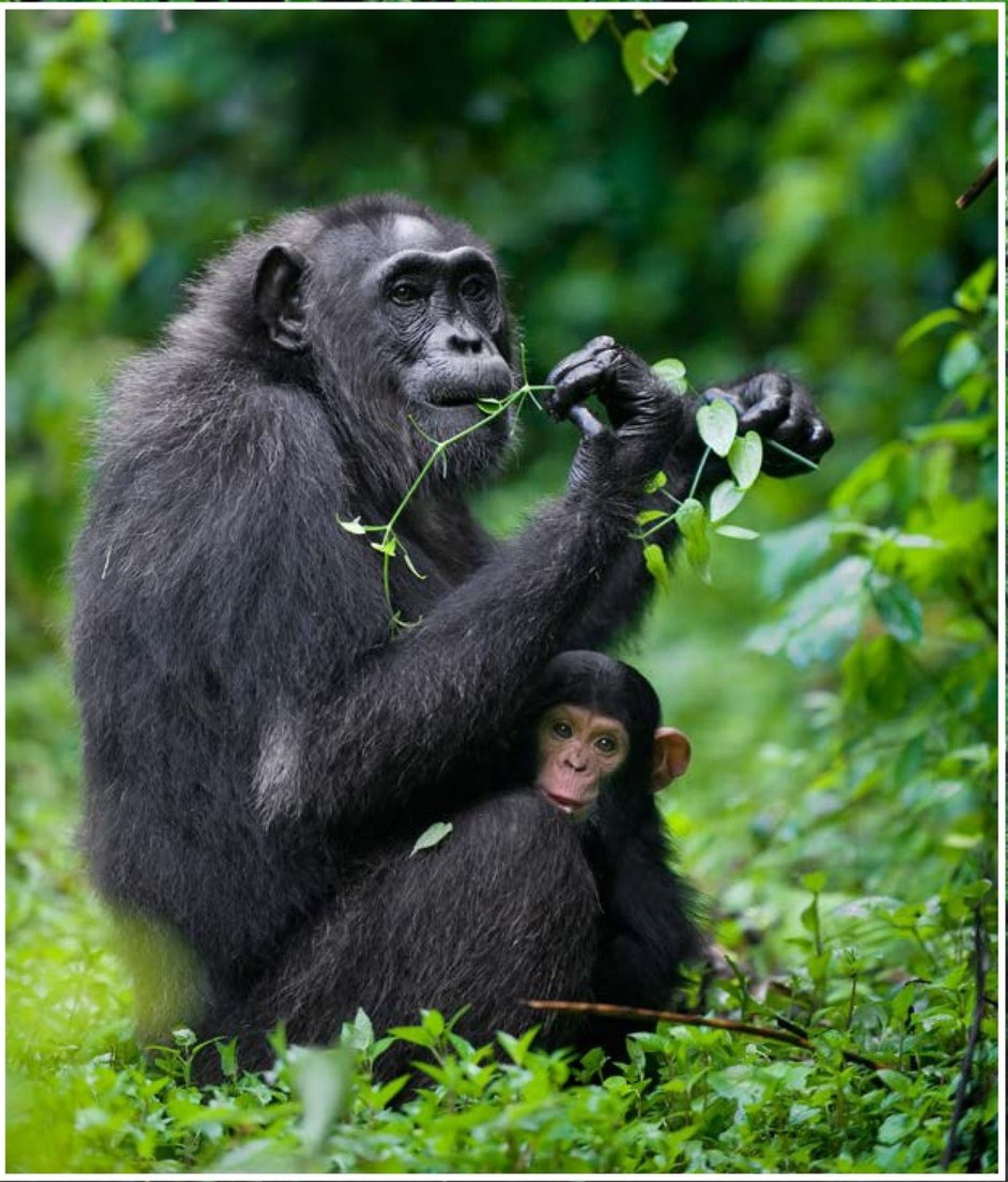
Many species of fish, such as those living in the Antarctic and at the bottom of the ocean, can live in temperatures below freezing. While this extreme cold would kill most creatures, these fish survive thanks to different kinds of **antifreezes** in their bodies. If scientists can determine how these antifreezes are made and work, they could discover a variety of uses, including organ transplants and ocean exploration.



These microscopic views show two types of microorganisms that produce natural plastics.

Natural Plastics

People use tons of plastic every year, and the way we make plastic uses great amounts of energy and creates huge amounts of waste. However, scientists have found that some kinds of **microorganisms** make the building blocks of plastics in their cells. If scientists can figure out how these microorganisms begin to make plastics, they can mimic that process and make plastics using less energy and with much less waste.



A chimpanzee and her baby eat medicinal plants.

Medicine

Other animals have been surviving in the wild for thousands of years, and like us, they sometimes get sick. By seeing which plants and other things that animals, such as chimpanzees, use to treat themselves, we can discover new medicines and treatments for our own illnesses.

Two children examine a dragonfly.

Conclusion

We still have a lot to learn about nature and how it can help us create new and better things as well as sustain life—not only ours, but that of every other life-form on Earth. Humans as a species are facing many challenges, some easy and others very difficult. As we try to solve these problems, it might be helpful to take a look outside. The next time you're playing in a park, walking in a forest, or doing anything in nature, stop and take a look around. Notice the many living things, each with its own special role to play in making every part of the environment work—including yourself. The most interesting and efficient solutions to our challenges may be right under our noses, waiting to be discovered through the science of biomimicry.

Glossary

adapted *(v.)* changed to fit a new or specific situation or environment (p. 5)

antifreezes *(n.)* things added to lower the freezing point of a substance (p. 20)

biologists *(n.)* scientists who study living things (p. 5)

contaminating *(v.)* making something unusable or unsafe by adding a harmful or unwanted substance (p. 16)

ecosystem *(n.)* a community of living things together with their habitat (p. 17)

efficient *(adj.)* making good use of time or resources (p. 11)

fossil fuels *(n.)* energy sources, such as coal, oil, and natural gas, that are taken from the ground (p. 14)

glare *(n.)* a bright light, usually reflected off something (p. 9)

greenhouse gases *(n.)* gases in Earth's atmosphere that trap heat and contribute to global warming (p. 14)

microorganisms *(n.)* microscopic organisms, such as viruses or single bacterial cells (p. 21)

resources *(n.)* supplies of very useful or valuable things (p. 16)

sustainable *(adj.)* able to be used in a way that does not completely use up or cause permanent damage to a resource (p. 17)

Biomimicry

A Reading A–Z Level Z1 Leveled Book
Word Count: 2,084

Connections

Writing

Which plant or animal adaptation do you think has provided the most important lesson for humans? Write a persuasive essay using information from the book, as well as outside resources, to support your answer.

Science

Research other examples of biomimicry not found in the book. Choose one and write an informational paragraph about it. Create a poster that includes your paragraph to share with your class.