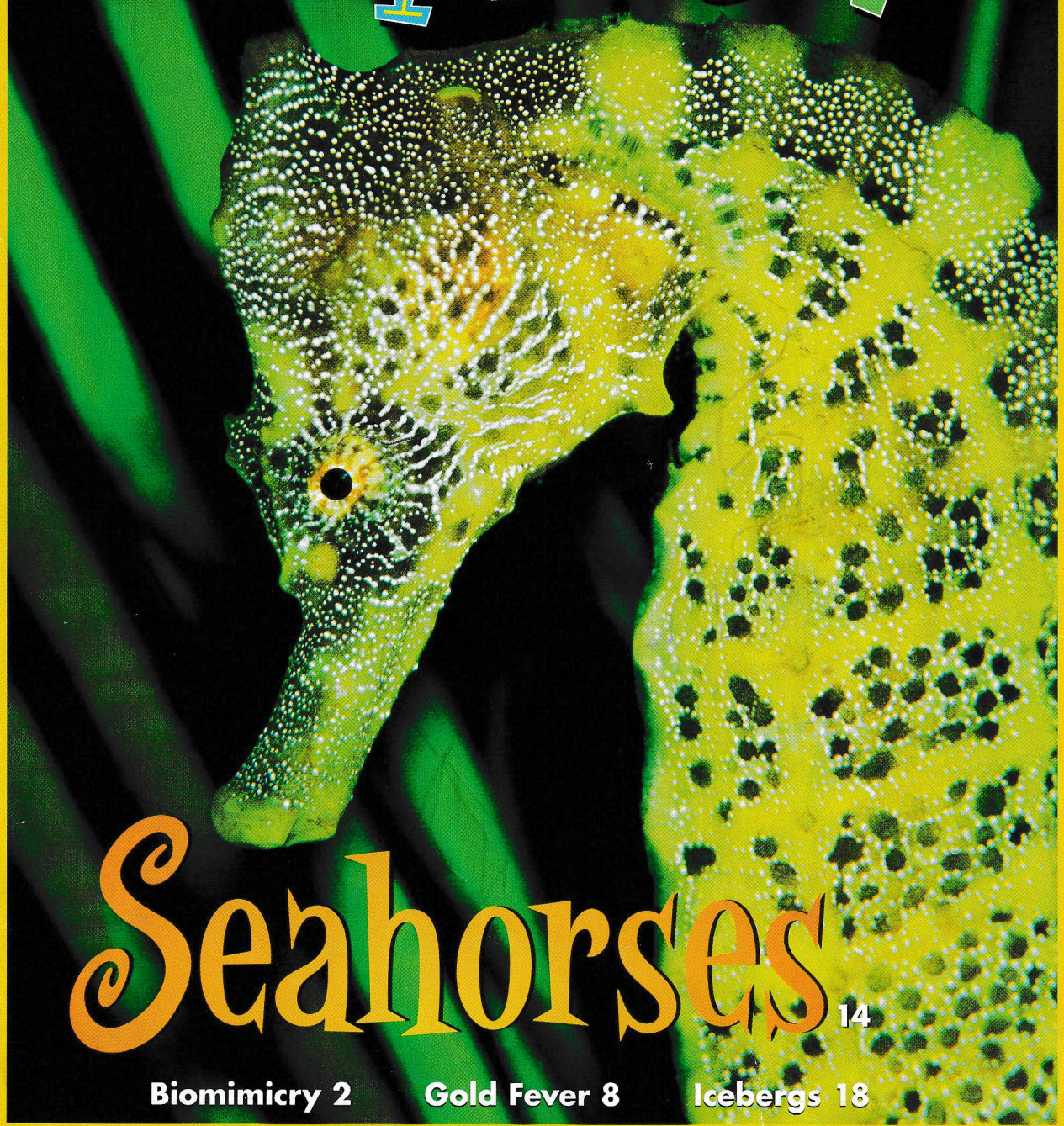
PATHFINDER EDITION NGPATHFINDER.ORG JANUARY–FEBRUARY 2009

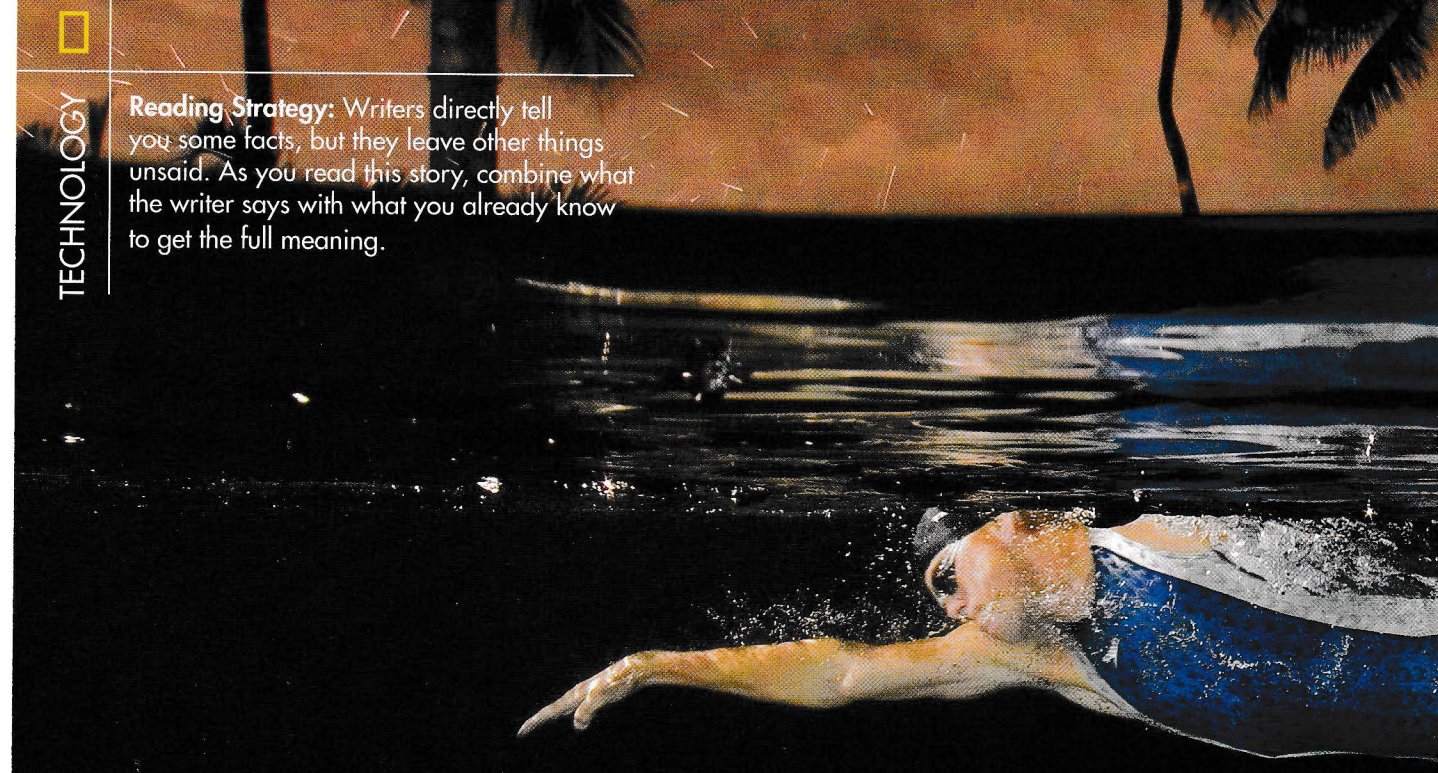
NATIONAL GEOGRAPHIC Explorer!



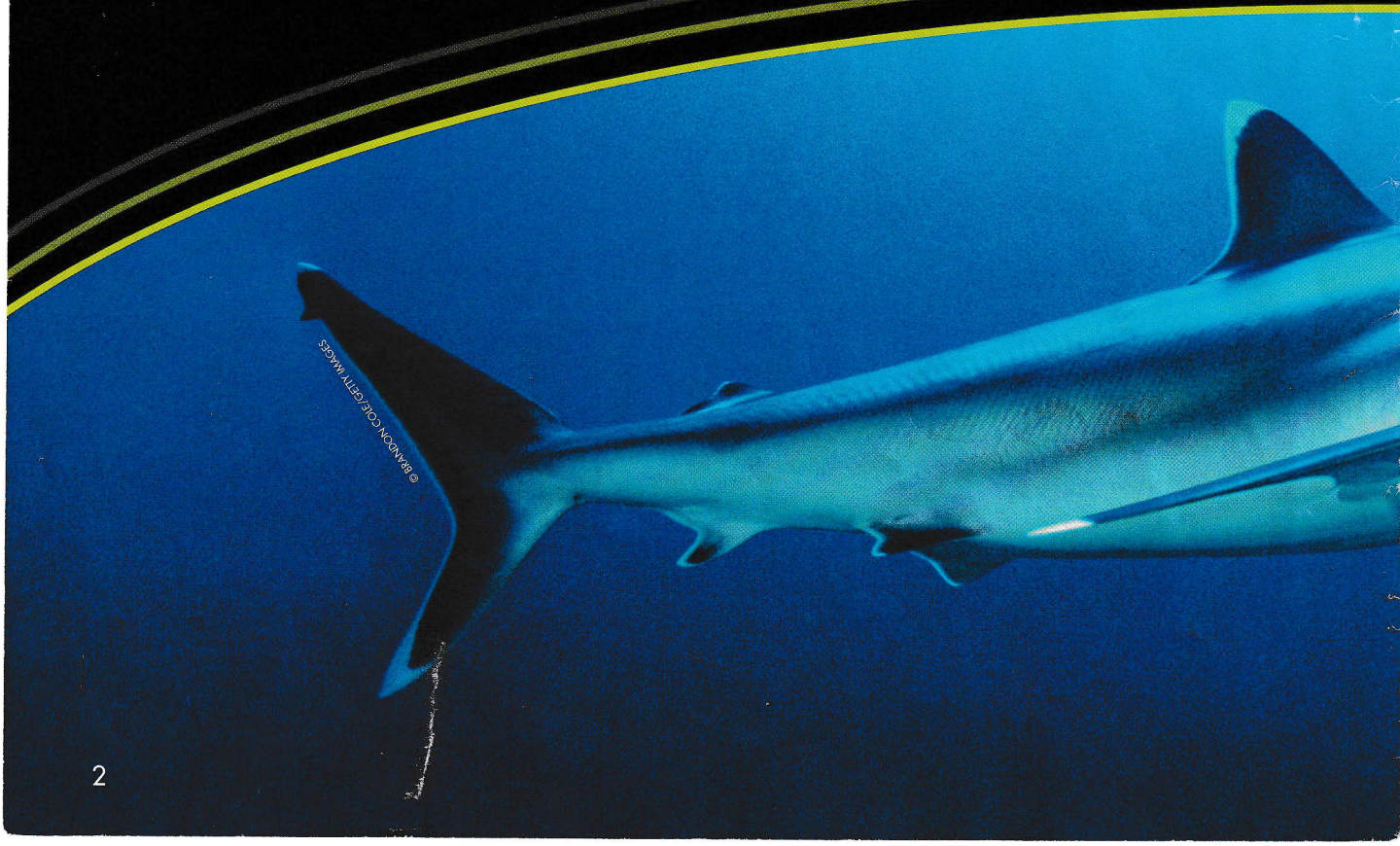
Seahorses 14

Biomimicry 2 Gold Fever 8 Icebergs 18

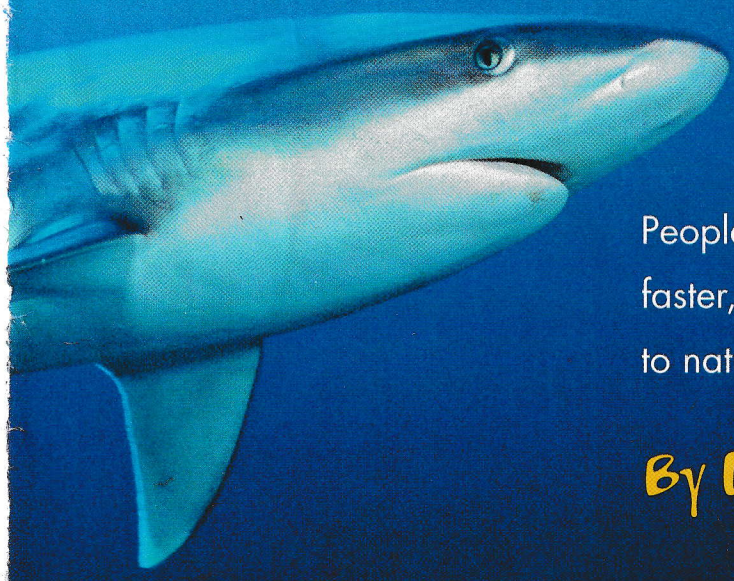
Reading Strategy: Writers directly tell you some facts, but they leave other things unsaid. As you read this story, combine what the writer says with what you already know to get the full meaning.



Nature's



Solutions



People like to make things work better, faster, and cleaner. Luckily, they can turn to nature for some great ideas.

By Leslie Hall

We can learn a lot from nature. Just think about it. Nature always seems to work well. Plants and animals don't waste energy, and they usually don't harm the environment. So engineers are turning to nature for some solutions to everyday problems.

Problem: How can we help athletes swim even faster?

Solution: Look closely at a shark's skin.

Even the sports world has solved problems by imitating nature. To help athletes swim faster, people used **biomimicry.** They took a close look at some of nature's very best swimmers—sharks.

It turns out that a shark's skin is covered with scales shaped like teeth. These "teeth" have tiny grooves between them. Water flows through the grooves, instead of passing over or around them. Water moves freely over sharkskin like a wide, fast-moving river.

With this in mind, engineers created a new type of swimsuit. Swimmers who wore the suits swam faster than they had ever swum before.

Bird Beaks and Bullet Trains

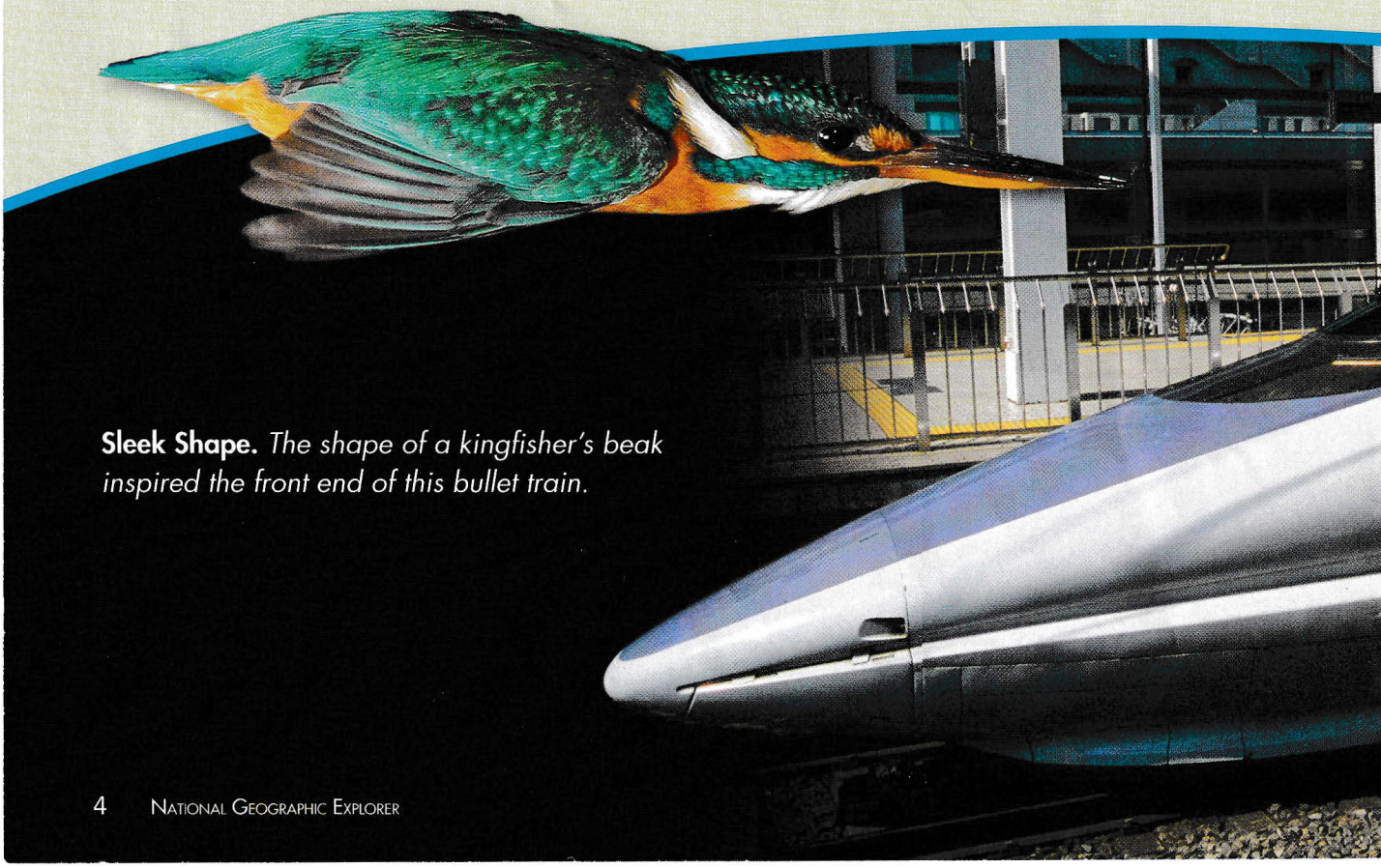
Problem: How can we build quieter and more **efficient** trains?

Solution: Copy the shape of a bird's beak.

Kingfisher birds eat fish. To capture their prey, they plunge headfirst into lakes and rivers. The birds dive so neatly that when they enter the water, there's almost no splash.

This gave a Japanese engineer named Eiji Nakatsu an idea. He helped design the Shinkansen bullet train. It is one of the fastest trains in the world. The bullet train zooms along at speeds up to 300 kilometers (186 miles) per hour. The speed is a great thing. What wasn't great was the noise the train made when it came roaring out of a tunnel.

Nakatsu used what he knew about the kingfisher bird to solve the problem. He knew how smoothly a kingfisher is able to enter the water, with its long, sharp beak. So Nakatsu redesigned the front of the train. He used the beak as a model and gave the train a new front end. With its new shape, the train moves more quietly. It also uses less electricity!



Sleek Shape. *The shape of a kingfisher's beak inspired the front end of this bullet train.*

Gecko Grip

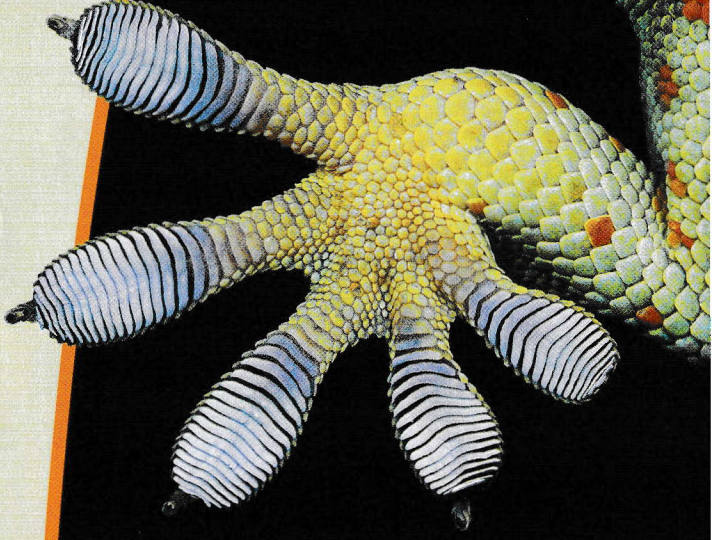
Problem: How can we build machines that climb walls or move across ceilings?

Solution: Study a lizard's tiny toes.

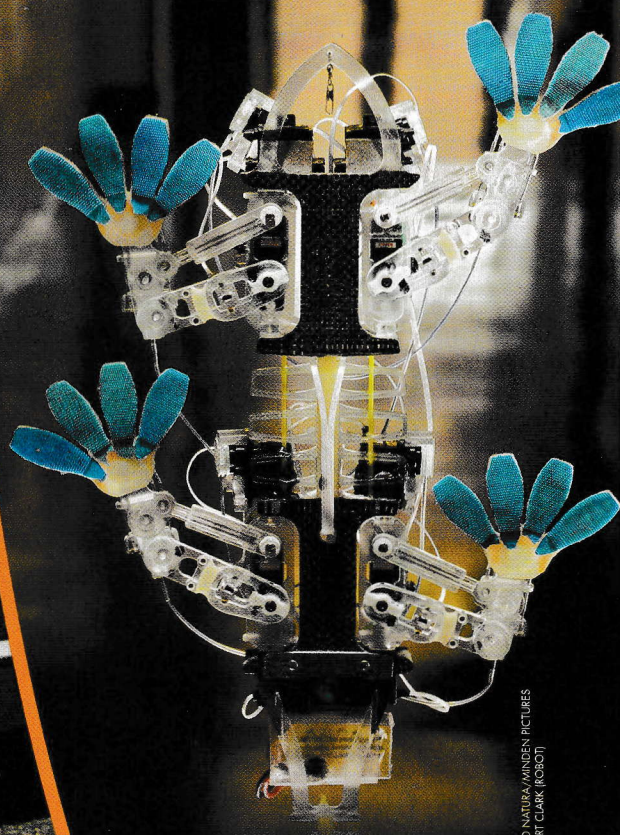
Geckos are pretty amazing lizards. They can run up and down walls. They can also hang upside down from ceilings. It doesn't matter if the ceiling is rough or smooth, wet or dry. Nothing keeps geckos from sticking around.

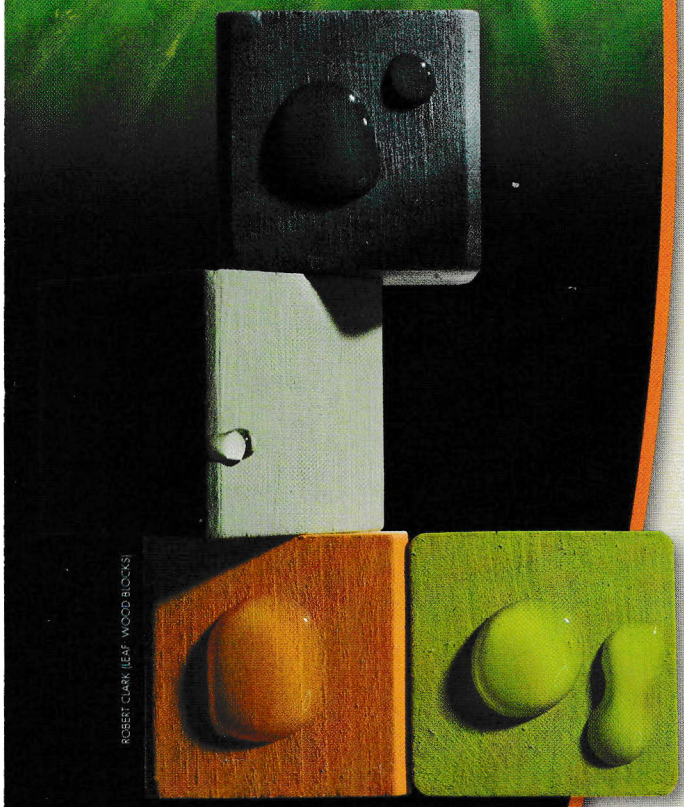
Their sticky secret isn't super strength. It isn't even super glue. The secret is the tiny hairs that cover their feet and toes. Each hair splits between 100 to 1,000 times. This means that geckos can hold onto a surface at a billion different points! Geckos have another secret tool. The ends of the hairs are shaped like spoons. This spoon shape gives the lizards an iron grip.

Engineers studied these terrific toes to make a robot called Stickybot. Stickybot uses a material like the hairs on the gecko's toes. It can climb up walls. It is not nearly as fast as a gecko. Yet people hope that one day the robot will help with search-and-rescue missions.



Fancy Feet. *Scientists studied geckos' toes to make a robot that can climb up walls.*





ROBERT CLARK (LEAF, WOOD BLOCKS)

Keeping Clean. *Engineers used what they knew about lotus leaves to make a new type of paint.*

Ideas Taking Flight. *Engineers are studying bombardier beetles to build better jets.*

Lessons From Leaves

Problem: How can we keep the outside of buildings clean?

Solution: Study how rainwater rolls off a leaf.

The leaves of a lotus plant look waxy and smooth. But they aren't. When you look at the leaves under a microscope, you see tiny bumps all over them. These bumps are the plant's secret tool for staying clean and dry.

How does it work? When a raindrop falls on the leaf, the bumps help in two ways. They keep most of the water from ever touching the surface of the leaf. The bumps also make the water drop bead up into a ball shape, instead of spreading out. The drop can't stick to the leaf and rolls right off. Dust, dirt, and bacteria also roll off with the water, leaving behind a clean leaf.

Engineers studied the way lotus leaves keep themselves clean. They created a type of paint that can clean itself. Dirt rolls right off the paint the same way it rolls off a lotus leaf.

Engineers are also trying to copy the way the leaf stays waterproof. Someday, we may be able to thank the lotus leaf for helping us keep ice off airplane wings and car antennas. Lotus lessons are even being used to keep clothes dry.

Beetle Juice

Problem: How can we re-start a jet engine while the plane is flying?

Solution: Do what some beetles do.

It may seem odd, but a tiny beetle has helped jet engineers. That's because clever engineers figured out how to make a better jet engine by studying what bombardier beetles do.

The beetles shoot hot liquid at predators such as ants. It all starts with the **gases** in the beetle's abdomen. When a beetle feels threatened, the gases move into a small chamber in its abdomen.

In the chamber, the gases create heat and pressure. When the pressure is great enough, boiling-hot liquid and steam shoot out of the beetle's body.

So what does this bug have to do with jet engines? At high **altitudes,** jet engines sometimes shut down. Engineers want to build engines that pilots can easily turn on again in mid-air. That's where the beetle comes in.

Engineers are studying the beetle to see how it makes and shoots out the hot spray so quickly. The bitty beetle is also inspiring new types of car engines and even better fire extinguishers.

Fuel-Saving Fish

Problem: How can we build cars that use less gasoline?

Solution: Look closely at the shape of a fish.

Engineers wanted to figure out how to make cars that use less gasoline. The solution? They studied the boxfish. The fish's shape lets it move through water smoothly. So engineers built a car with the same shape. The shape makes the car **aerodynamic,** so it uses less fuel.

Would you like to build a better car, or a faster swimsuit, or a quieter train? Do what the animals do. These examples of biomimicry are just the beginning. Get out in the natural world. Look around. Ask questions. Then search for solutions. Which creatures will inspire you?

Wordwise

aerodynamic: shaped in a way that moves smoothly through the air

altitude: height above the ground

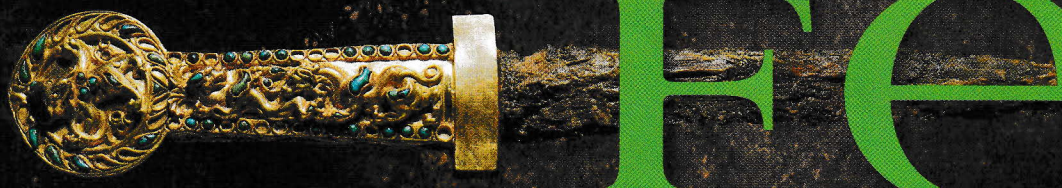
biomimicry: imitating nature to solve problems

efficient: does not waste energy

gas: something that is neither liquid or solid

Reading Strategy: As you read each section, stop and ask yourself: "What is the most important information I read?"

Gold Fev



ld
er

BY
Ruth Kassinger

Gold. People moved mountains to find it. Armies conquered faraway countries to control it. Find out how this glittering, shimmering metal has shaped history.

Don't touch that! It will make you crazy! **Bill Adair ignored his boss's warning. He was 19, and it was the first night of his new job at the museum. He opened the dusty box and touched the thin layers of gold foil that lay inside. With that one touch, he caught gold fever. Forty years later, there seems to be no cure in sight.**

Adair has devoted his life's work to gold. He has covered thousands of picture frames in gold. He has perched on rooftops to gild the domes of buildings. He has put gold leaf on walls, and ceilings, and even statues of winged horses. What drives him to do this? Gold's glittering beauty.

Born in Earth

The gold Adair loves so much formed deep in Earth billions of years ago. Scientists believe that volcanoes may have heated underground water, which melted the gold. Liquid gold then flowed with the water into cracks between rocks. The shiny yellow metal cooled and hardened. In some places, the new **veins** of gold reached close to Earth's surface.

At the surface, the rushing water wore away the rock below. Over time, a vein of gold showed through, revealing the treasure. Tiny gold nuggets broke loose and settled at the bottom of the stream. There they'd lie, waiting to be discovered. And discovered they were.

About 5,000 years ago, people found bits of beautiful gold in Egypt. It didn't take long for them to catch gold fever. Since then, gold has been discovered at different times all around the world. With each discovery, the fever spikes. And each time the fever rises, the love of gold drives people to do almost anything. Let's look at some golden moments in history.

Old Money: *This gold coin is more than 2,000 years old. It shows a chariot on one side.*

The Fever Spreads

Egypt, 3,000 B.C. The pharaohs of Egypt surrounded themselves with gold. They ruled from golden thrones and gilded their chariots with gold. They wore gold crowns and jewelry. They even buried mummies in golden masks.

The pharaohs' hunger for gold grew and grew. Soon, small bits of easy-to-find gold were not enough. They wanted to follow veins of gold, deeper and deeper into Earth.

Gold mining was dangerous work. Miners used fires to crack the rocks. The heat was fierce. Poisonous fumes filled the air. The tunnels were so narrow, miners had to lie on their backs. Small rocks fell on them. Large rocks crushed them. The pharaohs forced slaves to do this risky job. Often, the slaves were captured in war and brought from faraway places to work in the mines.

Egypt traded its gold for valuable items from other countries. Precious wood came from Lebanon. Horses came from Babylonia. Jewelry and other golden objects traveled along the Silk Road. It was a series of trade routes stretching from Egypt all the way to China. Gold was the one thing everyone wanted. That's how gold and gold fever spread.

Gold Coins

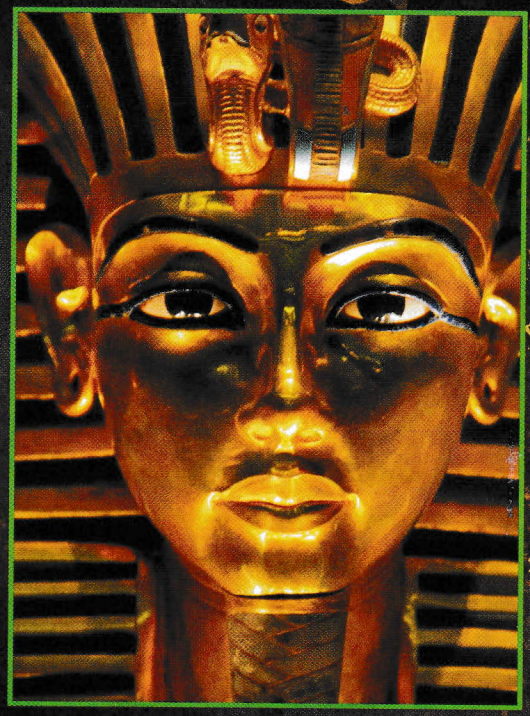
Turkey, 560 B.C. King Croesus ruled ancient Lydia, which is now western Turkey. He played an important part in spreading gold fever. He came up with a new idea: to **mint,** or make, coins made of pure gold.

The coins made buying and selling much easier. Gold was the perfect metal to use. It lasts a long time. It's rare, so it's worth a lot. And it's soft, for a metal. People could mold gold into shapes. That's just what Croesus did. He created coins that were the same size, weight, and value. The coins had a lion and a bull stamped on them.

Persia attacked Lydia. Croesus lost his kingdom. But his golden money idea spread across the world, bringing gold fever with it.

© JOHN SPAULDING

Ancient Art. *Bill Adair caught gold fever when he was a teenager. Now he puts gold leaf on picture frames.*



© ELVELE IMAGES/ALAMY

Famous Face. *This gold mask was found on King Tut's mummy.*

NATIONAL MUSEUM OF AFGHANISTAN/© MUSÉE GUIMET/THIERRY OLLIVIER

Crowning Touch. *This crown belonged to a nomadic princess. She could fold it flat for quick travel.*

Gold in the Americas

Colombia, 1500s In the 1500s, word of an ancient **ceremony** spread across Europe. The story was told like this: *The Muisca king glittered as brightly as the sun. Fine gold dust covered his body. He stood on a raft, piles of sparkling gold at his feet. At the center of the lake, he dropped the gold into the water. Then he dove in to wash the gold off his body. This would make the Muisca's god happy.*

Gold hunters asked: Did the golden man have a golden city? The story grew. This city, they thought, had streets paved with gold. They called it El Dorado. Gold fever had struck again.

As a result, Spanish explorers raced to South America. They searched for El Dorado. No luck. But it wasn't all bad news—at least for the explorers. They discovered many South American tribes had gold. They had golden jewelry and art. The explorers wanted that gold badly. They killed or captured many thousands of people just to get it.

Atahualpa was an Inca leader, known as the Sun King. In 1532, Spanish gold hunter Francisco Pizarro found the Sun King's city. Pizarro came with 300 soldiers. The Sun King welcomed Pizarro and his men. Music played. When Pizarro gave a signal, his soldiers fired their guns. They shot 2,000 men and captured the king. Pizarro said he'd set the king free in exchange for a roomful of gold. Pizarro got his gold. Yet he broke his promise and killed the Sun King. Pizarro would do anything for gold.

California, 1848 In 1848, a man saw flecks of gold in a stream in California. "GOLD MINE FOUND!" screamed a newspaper headline. The tiny flecks changed the United States forever. Gold fever took over the country.

Tens of thousands of Americans dropped everything and headed west in search of fortune. They left their families. They moved rocks, dug in mud, and waded in freezing streams. Some got hurt or sick. Others got lucky and found gold. The gold seekers kept coming, hoping they'd be next to strike it rich.

Gold's Global Grip

Worldwide, 2009 Today, finding gold is harder than ever. In most mines, workers find specks of gold so small, 40 can fit in the period at the end of this sentence. Miners have to dig up 30 tons of rock just to find enough gold for one ring. Mining has left gashes in Earth. The holes are so big, they can be seen from space! In 1990, gold was discovered in a volcano on an island in Indonesia. Now, the volcano has disappeared. Miners took it apart, rock by rock.

The work in a gold mine still can be deadly, just as it was for Egyptian slaves. Today, many miners use a dangerous liquid called mercury to separate gold from rock. The mercury can poison people and the environment.

Even so, the desire for gold keeps growing. In 2007, people around the world bought 2,500 tons (5 million pounds) of gold jewelry!

Today, gold is in demand for more than its shimmering beauty. It's used in computers, cell phones, and telescopes. Astronauts wear **visors** coated with a thin layer of gold. It protects them from the sun's rays. Doctors are studying ways that gold might help them fight cancer.

The ancient Egyptians may never have dreamed of using gold in these ways. Many years separate the pharoahs from today's miners, scientists, and artists, like Bill Adair. Yet one thing unites them all: gold fever.

Wordwise

ceremony: special actions and words used to celebrate an important event

mint: to make, or manufacture, coins

vein: narrow layer of mineral that forms in the crack of a rock

visor: shield on the front of a helmet that protects the face

Buried Treasure. *These gold-plated arms were found in a burial site in Peru. Today, Peru is one of the world's biggest producers of gold.*

Golden God. *The Incas called gold "the sweat of the sun." They used gold to make this sun god.*

Sun Shield. *This is a model of an astronaut's helmet. A thin layer of gold protects the astronaut from the sun's rays.*

Spectacular Seahorses

By Twig C. George

What has a head like a horse's, a tail like a monkey's, and swims? A seahorse! Imagine how happy I was to be standing in a lab full of them. Inside the room, water pumps hummed. Bubblers gurgled. I smelled something like a mix of marsh mud and salt water.

A scientist at the National Aquarium in Baltimore had offered to show me his lab. There, Jorge Gomezjurado cares for hundreds of these unusual fish. Raising seahorses in a lab gives him a close-up view. Seahorses are difficult to study in the wild because they are hard to spot. Camouflage helps them blend in with other things in the ocean.

From every tank in the lab, seahorses stared at me. At least, some of their eyes did. That's because seahorses can roll their eyes in two directions at the same time. One eye looks one way while the other eye looks a different way. This lets seahorses look for food and watch for approaching danger—such as hungry crabs or bigger fish.

With all those seahorses staring at me, I wasn't sure where to look first! "You might want to start over here," Gomezjurado said. He nodded at a tank. "Look at the pot-bellied seahorses." Their heads were bent down. Their tiny fins fluttered. The fish looked like little wind-up toys as they moved around the tank.

Dads On Duty

One seahorse's big belly caught my eye. "His belly is larger than usual because he's pregnant," my guide explained. Did I hear that right? Yes, *he's* pregnant. In the world of seahorses, the males give birth. They are the only male animals that do so.

I learned that when a female is ready to lay eggs, she picks a mate. Then she lays her eggs in his brood pouch. He carries the eggs until the baby seahorses are ready to be born.

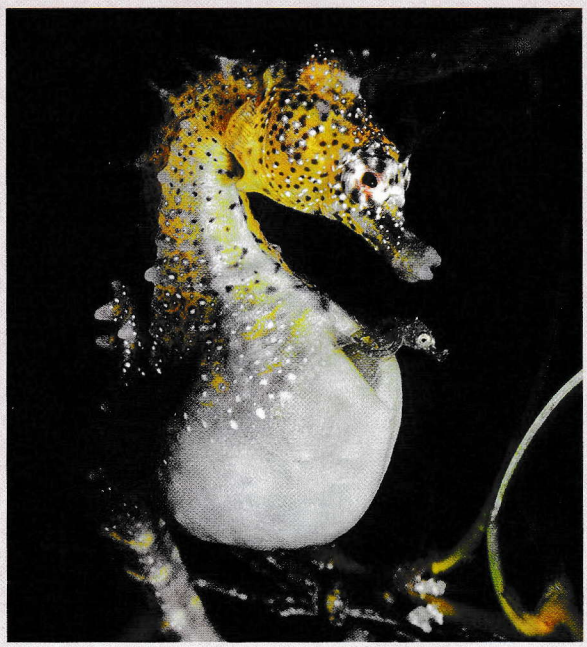
For the next two to four weeks, the female visits her mate each morning. The two fish curl their tails together and "dance." As they dance, the seahorses turn bright colors. Some turn deep red or fiery orange.

The number of babies varies. When the male gives birth, the offspring look just like their parents, only much smaller. Young seahorses are tiny. The young of some **species** are so small, they could fit on a penny. As soon as they're born, young seahorses are on their own. The parents do not take care of them.

After the male gives birth, the female rushes back to him with more eggs. The male and female remain a couple throughout the entire **breeding season.** Some types of seahorses even mate for life. The lifespan of a seahorse can range from one to five years, depending on the species.

Reading Strategy: As you read, stop now and then to sum up what you learned.

Hidden Horse. *This Pacific seahorse changes colors to match its surroundings.*



Mr. Mom! *Some male seahorses give birth to hundreds of babies at a time.*

Unusual Animals

Males having babies is really unusual. At the lab, I learned that seahorses are unusual in other ways. They have no jaws, no teeth, and no stomachs. Instead of jaws, seahorses have long **snouts.** The snout is shaped like a straw. At the end is a mouth.

I got to see those mouths in action. I saw a cloud of tiny shrimp-like creatures swim by some seahorses. The seahorses aimed their snouts. Whoosh! They sucked up all the food, and the cloud disappeared.

Seahorses are experts at "fast food." Since they cannot chew, they swallow their prey whole. I watched one young seahorse eat. It **digested** its meal so quickly that some animals came out the other end still alive.

Then there is the seahorse's unusual tail. Most fish use their tails to move through the water. Seahorses don't have a powerful fishy sort of tail. So they use their back and side fins to move. They use their tails to stay in place.

Seahorses have **prehensile** tails that curl and grab like a monkey's. The tail anchors the seahorse in place by wrapping around corals or grasses. That way, the fish aren't swept away by waves or currents.

Fish in Demand

Watching seahorses at the lab was great fun. I could have stayed there forever. As I headed home, I thought about what it would be like to have my own tank filled with these colorful, quirky fish.

I later discovered that lots of people have had the same thought. Each year, people around the world buy millions of seahorses. They buy live ones for aquariums. They also buy dried ones to use as decorations or to grind up into traditional medicines.

To feed that global appetite for seahorses, fishing crews catch huge numbers of them. That's causing trouble for these little fish. Their numbers are decreasing.

Scientists formed a group called Project Seahorse. It teaches people about seahorses—and the threats they face, such as loss of habitat and overfishing. The project helps people find ways to catch other kinds of fish without accidentally killing seahorses. Hopefully, the scientists' work will keep seahorses living and dancing in the seas around the world.

You can learn more about seahorses at **NGPathfinder.org**

Wordwise

breeding season: time of year when an animal has its young

digest: to break food down into a useful form

prehensile: able to grasp things

snout: long, front part of an animal's head

species: type of plant or animal

Hold Fast. *A Longsnout seahorse uses its tail to hold onto coral and grasses.* ▼

© CONSTANTINOS PETRINOS/NPL/MINDEN PICTURES

REINHARD DIRSCHERL/PETER ARNOLD INC.

▲ **Hide and Seek.** *Look closely to tell where the Pygmy seahorse ends and the coral begins.*

Tiny Dancers. *Some seahorses mate for life. This pair wraps their tails together and dances.*

© GEORGETTE DOUWMA/JUPITER IMAGES

Reading Strategy: As you read, compare the writer's ideas about icebergs with information you have from other things you've seen and read. Decide how the ideas go together in a way that is new to you.

Ic

Wild Ride. *Adelie penguins catch a ride on an iceberg in Antarctica.*

Icebergs

By Luc Desjardins
Senior Forecaster, Canadian Ice Service

Icebergs are massive and can sink ships. No wonder scientists watch them closely!

On the west coast of Greenland, huge glaciers inch their way to the sea. At the water's edge, a glacier growls. Then it moans. A crack as long as a football field rips across the ice. A huge chunk of ice splits from the rest of the glacier.

The massive chunk leans forward. Crrrreeeek. Then, splash! The chunk breaks away. It falls into the sea. It is now an iceberg, or a large chunk of ice floating in the sea. Whenever a new iceberg appears, I keep an eye on it. That's because I track icebergs for the Canadian Ice Service. To do my job, I need to know as much about icebergs as I can.

All Sorts of Sizes

One of the first things I learned is that there's no such thing as a typical iceberg. An iceberg can come in almost any size. It can be as small as a person. It can be as big as a house or as big as a shopping mall. An iceberg can even be as large as an entire U.S. state.

The biggest iceberg ever recorded was called B-15. It **calved,** or broke away, from the ice sheet in Antarctica. That was back in March 2000. B-15 was larger than the states of Rhode Island and Delaware put together!

Icebergs in the open ocean are constantly melting. Size plays a part in how long they last. Smaller icebergs, called growlers, usually melt fast. Larger icebergs can float around in the ocean for several years before completely melting. The temperature of the air and ocean also affects how quickly an iceberg melts.

Strange Shapes

Another thing I learned is that icebergs keep changing. Pounding wind and strong waves carve holes in icebergs. They can sculpt an iceberg into spectacular shapes.

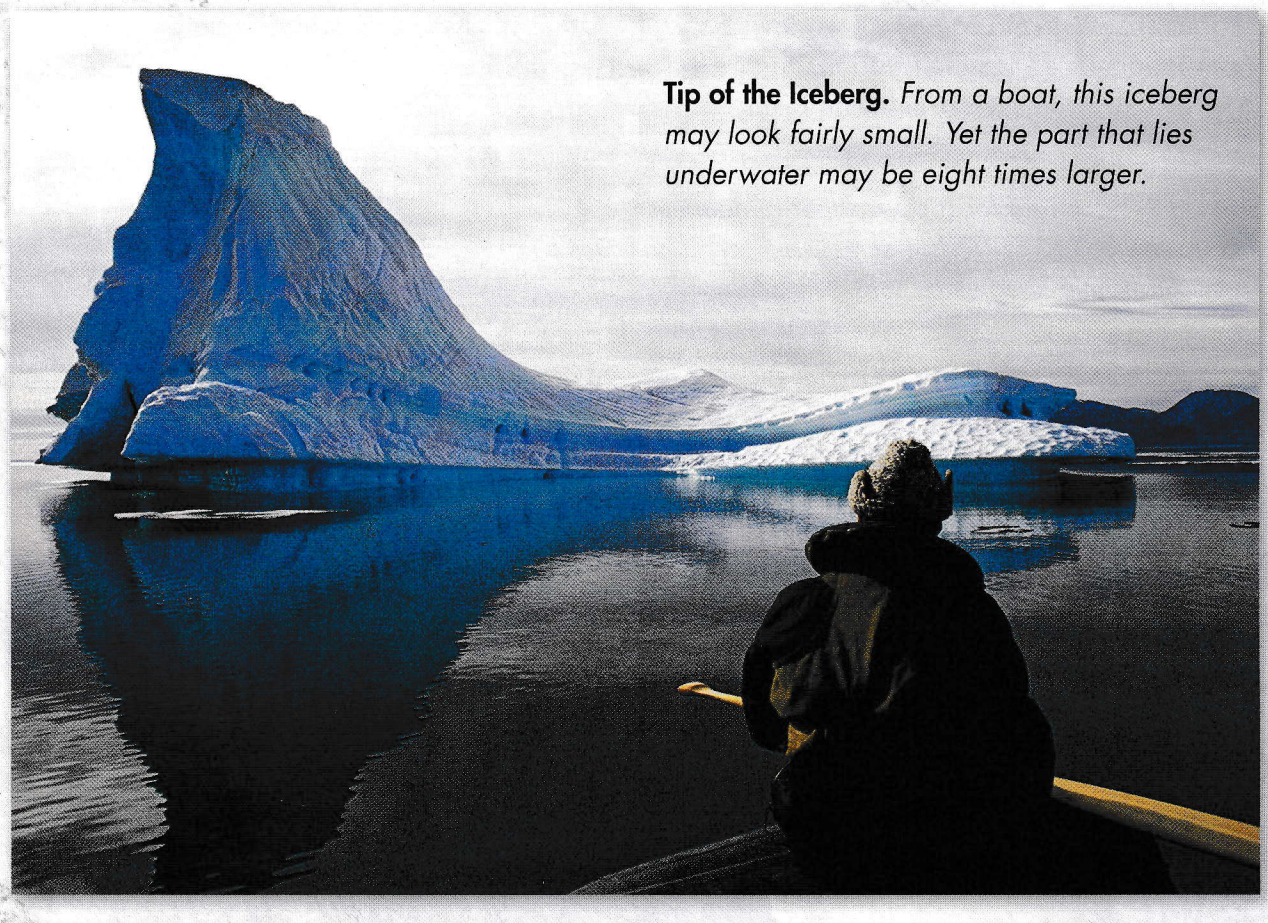
Every spring, tourists come to Northeast Canada to see icebergs shaped like castles, dinosaurs, and shells. They also see lots of sea life. That's because melting icebergs release soil into the ocean. The soil is rich in minerals, attracting sea life. Large numbers of shrimp, seagulls, and whales keep close to icebergs.

No matter what their size or shape, all icebergs have two parts. The **sail** is what sticks out of the water. The **keel** is everything else. The keel is usually about eight times the size of the sail. It is also the more dangerous part of an iceberg. Sailors can't see the keel. So they may steer a ship too close. That can cause trouble.

RALPH LEE HOPKINS/NATIONAL GEOGRAPHIC STOCK

Ice Sculpture. *This iceberg formed in Antarctica. Wind and water carved it into a unique shape.*

Birth of an Iceberg. *This iceberg is calving, or breaking away, from a glacier in Argentina.*



Tip of the Iceberg. *From a boat, this iceberg may look fairly small. Yet the part that lies underwater may be eight times larger.*

Tragedy at Sea

The most famous example of an iceberg causing big trouble is the story of *Titanic.* It was a ship. But not just any ship. *Titanic* was the largest, grandest ship of its time. The ship was a proud symbol of people's imagination.

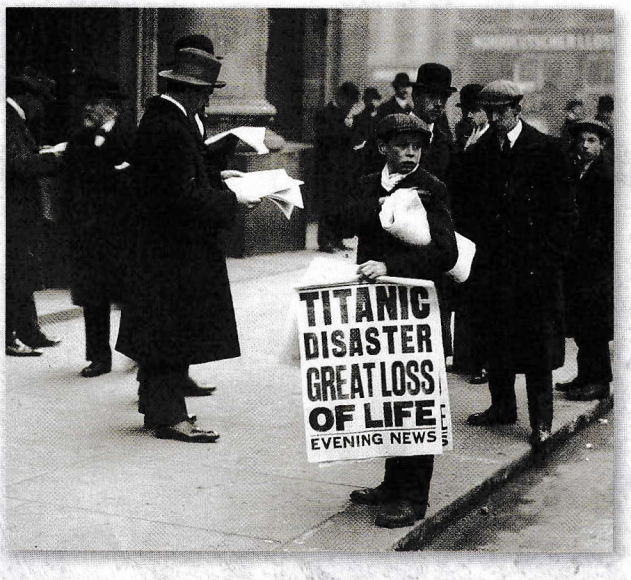
A little before midnight on April 14, 1912, *Titanic* was steaming across the North Atlantic Ocean. A watchman stood high up in the **crow's nest.** He stared at the glassy sea. A ghostly shape appeared in the distance. The watchman rang warning bells and called the ship's crew. He spoke words no sailor ever wants to hear: "Iceberg right ahead!"

The ship turned hard. The iceberg towered over the ship's right side. Below the waterline, the keel pressed hard against the ship.

The pressure opened six small holes in the ship's side. Seawater poured in. *Titanic* began sinking. Two hours and 40 minutes later, the ship was gone.

More than 1,500 people lost their lives that night. It was one of the worst ocean accidents in history. News of the disaster shocked people around the world. It also inspired them to take action. That's where I come in. I work with the International Ice Patrol to try to make sure a tragedy like *Titanic* never happens again.

Sinking Ship. *An ad for a newspaper announces the sinking of* Titanic. *Today, scientists track icebergs to help keep ships safe.*



Keeping Ships Safe

No one wants another *Titanic* disaster. Yet it's always a possibility. That's because the North Atlantic is a fairly crowded place. Every day, hundreds of fishing vessels, passenger ships, and cargo ships share the ocean. The farther south you go, the more ships you find.

Lurking in the same water, of course, are icebergs. The icebergs crash and collide into one another. Pulled or pushed by ocean currents, they can travel long distances. The iceberg that sank *Titanic* probably floated 1,600 kilometers (1,000 miles) or more from where it first calved.

People have tried almost everything to keep ships safe from icebergs. They have bombed large icebergs. They have cut icebergs into pieces. They have even tried towing them out of the way.

Now people realize that the best thing to do about an iceberg is just to move out of its way. The Canadian Ice Service and International Ice Patrol try to help people do just that. We study pictures taken by satellites and airplanes to track the icebergs. We listen to eyewitness reports. We try to figure out exactly where icebergs lie.

Each day, we add what we've learned to a large database. Using a computer program, we figure out where the icebergs might go. Then we send out reports. These reports let ships know where the iceberg is and where it is not. Then ships can plan a safe course. That helps ensure that stories like *Titanic* remain where they should—as part of history.

WORDWISE

calve: to break away from a glacier or ice sheet and become an iceberg

crow's nest: lookout spot high on a ship's mast

glacier: large body of ice moving across land

iceberg: large chunk of freshwater ice floating in the sea

keel: part of an iceberg that is below water

sail: part of an iceberg that is above water

What Lies Beneath

This photo illustration shows the two main parts of an iceberg.