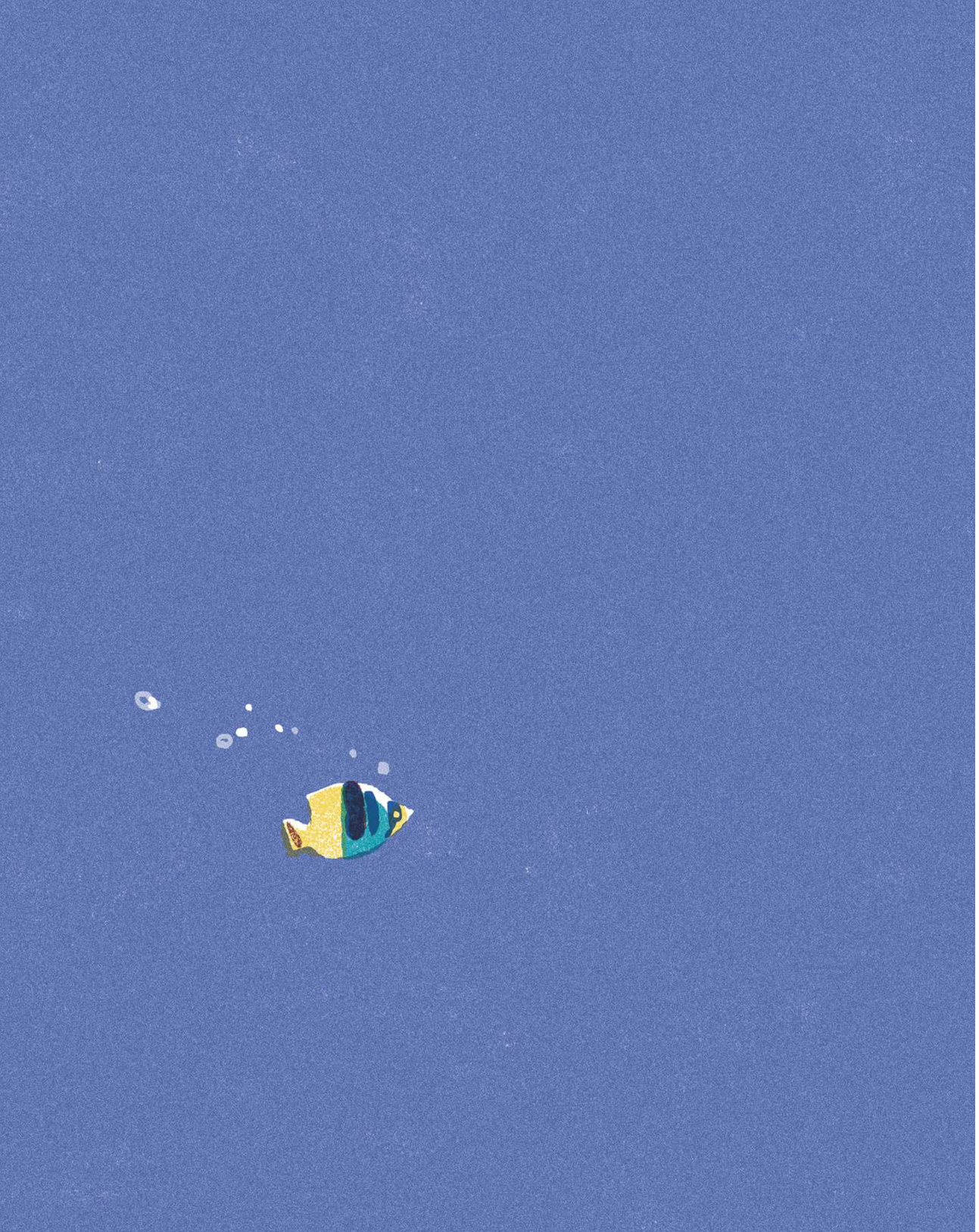

DAVID BARRIE
SUPER NAVIGATORS
HOW ANIMALS FIND THEIR WAY
ADAPTED BY REBECCA STEFOFF · ILLUSTRATED BY QU LAN
YOUNG READERS EDITION

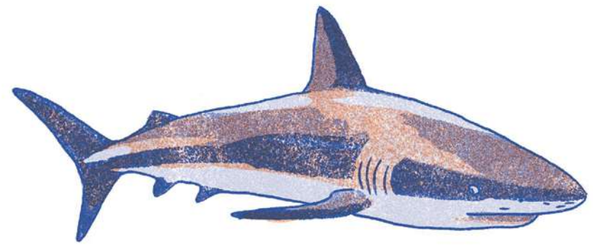




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LOST

You've gone to a park with some friends. It could be a national park, a state park, even a big city park. It's covered in forest, and it's big enough for you to wander around on hiking trails for a few hours, chasing each other, climbing trees. You start getting tired, or hungry, and someone says, "Let's head back." That's when it hits you: you're lost!

The trails wind and twist and cross each other. You and your friends aren't sure exactly how you reached your present location, or how to get back to the picnic area by the parking lot where your parents are waiting. The afternoon is half over, and you do not want to be lost in the woods when it gets dark.

"Wait a minute," you say, thinking shadows are getting longer. The trees are so thick that you can't make out exactly where in the sky the sun is, but you can see where the rays of sunlight are coming from. You point in that direction and say confidently, "That's northwest," because you know that, in the middle of summer in the part of the world where you live, the sun sets in the northwest at the end of every day.

Once you know one direction, you know the others. But that doesn't help if you don't know which direction to take. For that you need to know two things: where you are, and where your destination is. A mapping app in a phone could tell you—but when you check your phones, no one has a signal.

A couple friends have run further along the trail. Now one of them calls back, "Hey, come here!" Good news—they've found a big sign. It's a park map. A red circle is labeled "You Are Here." Green lines show the trails. A yellow X marks the parking lot. To decides which trail to follow, you need to know which way you're facing. With the sun's help, you can do that! So now it's not to hard to navigate—that is, to know your location and to set a course and follow it—to your desired destination, the picnic area.

"That wasn't so bad," says one of your friends. No, but it could have been, if you hadn't found that handy map. Since long before maps were invented, people have been finding their way, and sometimes getting lost, too. Navigation is a vital skill, and people have developed many ways of doing it.

Half an hour later, as you step out from the trees, you hear a chorus of honks from high above. Looking up, you see a line of geese flying overhead. The birds look like they know exactly where they're going. If so, how do they find their way?

In the unlikely event that you and your friends were hiking on Mt. Everest, those birds might have been bar-headed geese. These birds spend the summer feeding on grasses in Central Asian areas such as Mongolia and Tibet, where it gets really cold in the winter. Then they fly south for hundreds of miles to warmer places such as India. Twice a year, they cross the Himalayas—the highest mountain range in the world. Even though they sensibly avoid going over the highest peaks, they still must fly at great heights, where the air is very thin.

The Himalayas had not yet risen when the ancestors of today's bar-headed geese began making their migratory journeys. Scientists think that as the mountain chain slowly rose, over many generations the geese adapted to be able to fly in the oxygen-poor air.

We humans aren't the only creatures who need to find their way in the world. Many animals, from tiny insects to majestic whales, navigate with amazing accuracy across distances small or great. Scientists are finding fascinating answers to the question: How do they do it?.

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LIFE ON THE MOVE

Right now, a crow is flying past my window, heading off on some mission known only to itself. A bumblebee moves from flower to flower in my garden. A cat walks along the path and slips into the undergrowth. Meanwhile, an airliner packed with people crosses the sky above. Just look around you. Animals are on the move everywhere. Large and small, human and non-human, their journeys span the globe or criss-cross a tiny neighborhood. But whether an Arctic tern is winging from one end of the earth to the other, or a desert ant is dashing back to its nest with a dead fly in its jaws, animals must be able to find their way. It is a matter of life and death.

WHY ANIMALS MOVE

Most animal movements are not random. Animals move with purpose. They have a destination, or a reason for choosing one direction over another. They may be looking for food, or a mate, or just heading home. Or they may be taking part in a special kind of movement called migration.

What is Migration?

Migration is the regular movement of animals from one place to another. Often it happens over large distances and in response to seasonal changes. Sometimes migrating animals travel together in large numbers and sometimes they travel alone. The purpose is usually to obtain new sources of food or to visit breeding sites. Many people are familiar with one kind of migration: the seasonal flights of birds between summer and winter territories. Those honking geese on their way to warmer lands in the fall (or back to cooler ones in the spring) are just one example.

Amazing Bird Migrations

North America used to have one of the largest bird migrations in the world. Each spring and fall the skies over the eastern and central United States would darken, sometimes for days on end, as billions of passenger pigeons moved between their nesting areas around the Great Lakes and their wintering areas near the Gulf of Mexico. The passenger pigeon was hunted to extinction by about 1900, but many other bird species around the world, from huge sandhill cranes to tiny glittering hummingbirds, still migrate twice each year.

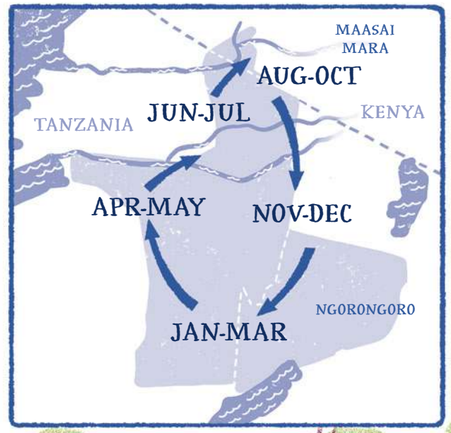


Funny Theories About Migration

Birds' regular migration flights seemed mysterious for a long time. The ancient Greek philosopher Aristotle thought that redstarts, a type of bird he saw each summer, were the same birds as the European robins he saw in winter. They didn't go anywhere, he said—they just changed their appearance. We now know that these are separate species. They migrate in opposite directions and simply change places with the seasons. As late as 1703, an Englishman wrote that storks, large birds that disappeared every winter, spent the cold months on the Moon! In reality, they flew off to warmer weather in southern Europe and North Africa.

The Great Migration in Africa

The natural world offers some dramatic migrations. In Africa, many of the large grassland animals called wildebeests make a huge circular journey each year through the nations of Tanzania and Kenya, traveling from one good grazing and watering ground to another. The females give birth along the way, and other grazing animals, such as zebras and gazelles, make the same journey. This awe-inspiring spectacle, with its plunges through crocodile-infested rivers, has come to be called the Great Migration. An equally majestic migration unfolds each year in Alaska and northern Canada, where caribou migrate north to the coast in spring to give birth to their calves, then back to their winter ranges in the interior.



TINY MIGRATIONS IN THE OCEAN

Some migrations involve much, much smaller creatures. The oceans, especially around the Arctic and Antarctica, are full of tiny plants and animals that together are called plankton. Many types of plankton are too small to see with the naked eye, but they exist in vast numbers. They are the basis of the food chain in the oceans. Although plankton drift where the ocean currents carry them, they are far from passive. To find food (or to avoid becoming food themselves), many animal plankton migrate up and down every day. At dusk they rise from the dark depths to the surface. At dawn they sink back down. Some plant plankton plunge downward to avoid damage from too much sunlight.

Supernavigators

When a wasp flies off on a hunting expedition, how does it find its nest again? After a sea turtle has circled an entire ocean, what guides her back to the beach where she was born to lay her eggs? When a homing pigeon is released hundreds of miles from its loft, in a place it has never been near before, how can it find its way home? Animal supernavigators perform feats of wayfinding far beyond anything most humans could accomplish. Now scientists are learning how they do it.

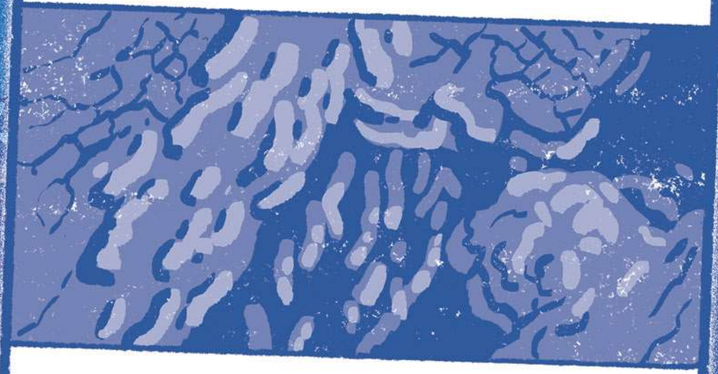
The Earliest Animal Navigators

The first life forms that emerged on our planet were very small. They were also the pioneers of animal navigation.

Earth was formed more than 4.5 billion years ago. By about 3.9 billion years ago, the oceans were home to the earliest forms of life, including bacteria. These single-celled organisms are so small that we need microscopes to see them. To survive, bacteria have ways of moving toward things they need, such as food, and away from things that are dangerous to them, such as excessive heat. How do the bacteria decide which way to move?



For some types of bacteria, the earth's magnetic field is the key. These bacteria contain tiny particles of a magnetic material. When joined end-to-end, the particles act like compass needles, which point toward earth's magnetic poles. By making the bacteria line up with the planet's magnetic field, these microscopic "needles" help them navigate to where they flourish: the lower, oxygen-poor layers of the water or sediment in which they live.



The fossil remains of bacteria like these have been found in rocks that are hundreds of millions, maybe even billions of years old. Bacteria were probably the earliest magnetic navigators in the history of our planet.