

PATHFINDER EDITION

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NATIONAL GEOGRAPHIC

# Explorer

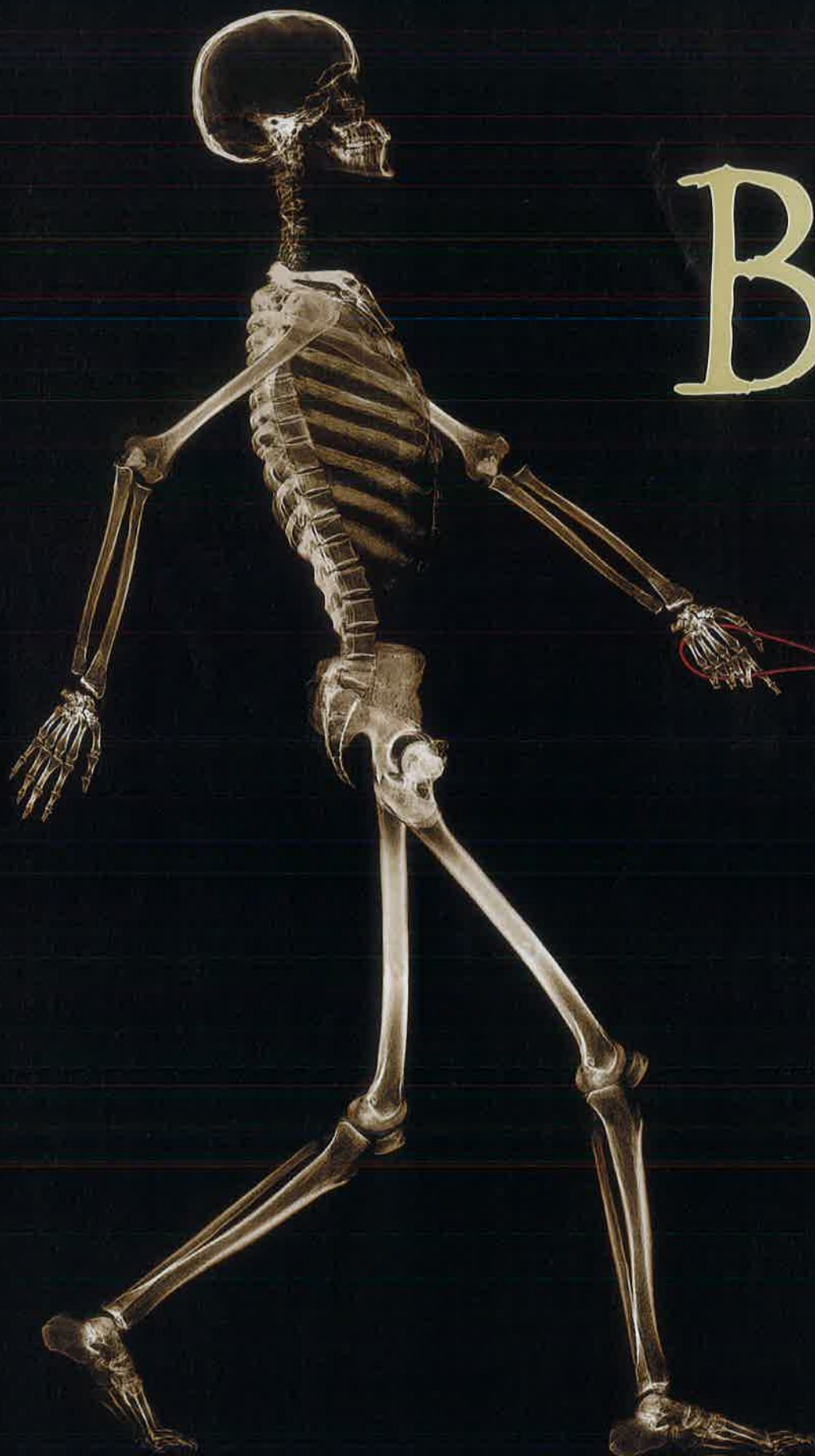


# No Bones About It

8

Bare Bones **2**

Hurricanes **16**



Bar





As you read, ask questions about the main ideas. Then look for the answers.

# e Bones

Find out how your skeleton supports, protects, and moves your body.

by Brenna Maloney



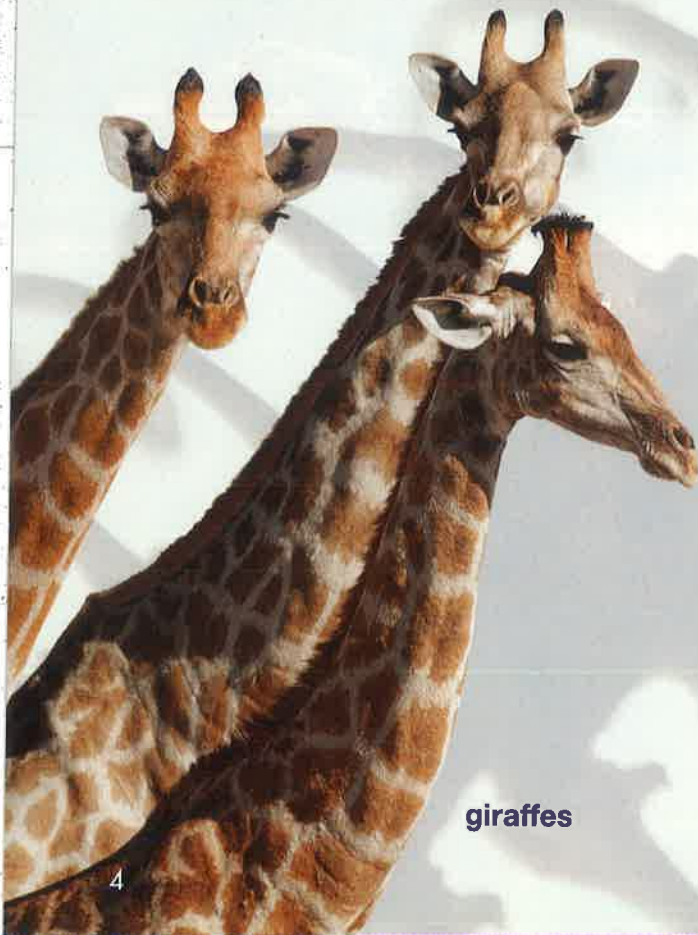
**H**ere's a puzzle for you. Which living thing has more **bones** in its neck? Your choices are a giraffe, a mouse, or you.

You might think it's the giraffe. After all, it is one of the tallest animals on Earth. Its neck can measure 1.8 meters (6 feet) long.

That's a good guess, but not quite right. Believe it or not, this is a trick question. The giraffe, the mouse, and you all have the same number of neck bones. The giraffe's bones are bigger, but it has only seven neck bones. That's the same number as a mouse or you have.

Neck bones make up part of your **skeleton**. A skeleton supports your body from the inside. Just imagine your body without neck bones. You couldn't keep your head up without them.

Bones also protect your internal organs. Bones do one more thing, too. They help your body move.



giraffes

## Bone Basics

Let's look at some of the bones that support and protect your body. We'll start with the skull.

When you're born, your skull is made up of 22 bones. Not all these bones are connected. As you grow older, your bones change. Some grow together. Bones can do this because they are made of living tissue.

The skull bones come together to form a hard shell around your brain. This keeps your brain safe. Your skull also protects your eyes.

Not all skulls are alike. An elephant's skull is large and thick. It supports the elephant's heavy trunk and tusks.

A tarsier's skull is small and thin, but its eye sockets are huge. The eye sockets are bigger than the space that holds its brain. That's because a tarsier is active at night. It needs its large eyes to hunt in the darkness.

## Lending Support

Now let's move down from the skull to the backbone. A backbone supports and protects. Without one, you couldn't even stand up.

Your backbone, or spine, is made up of linked bones called vertebrae. That's why animals with spines are called **vertebrates**. Some animals, like snakes, can have more than 100 vertebrae. Humans have 33.

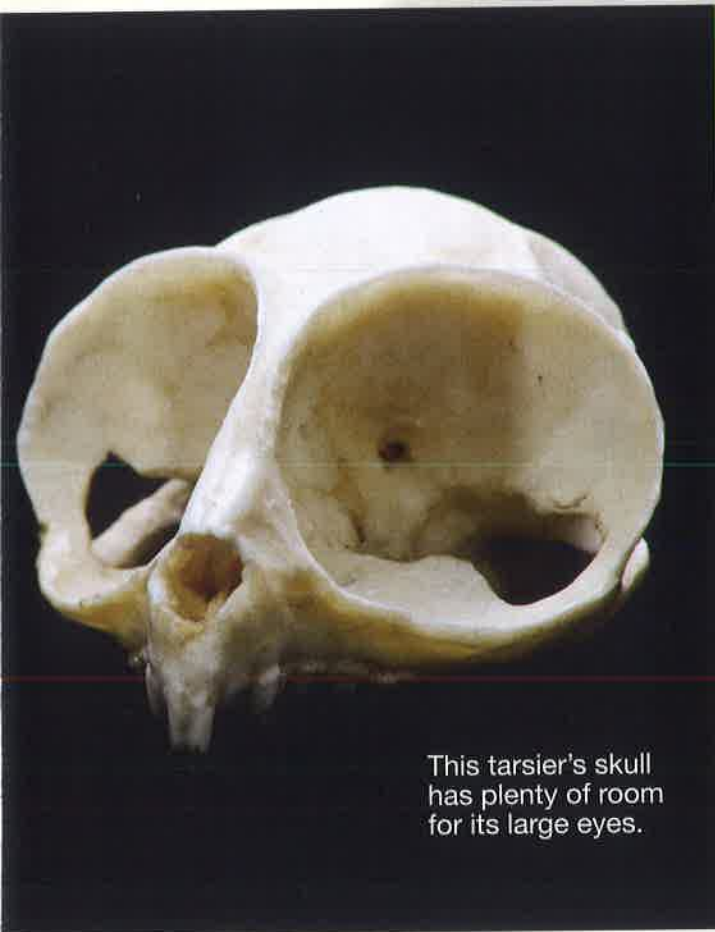
Together, these vertebrae form a tunnel. This tunnel protects your spinal cord. A spinal cord is a bundle of nerves that send messages to and from the brain. Nestled inside the backbone, the fragile spinal cord is shielded from harm.

## Under Your Skin

Now let's take a look at your ribs. Ribs protect and support, too. They protect your heart, lungs, and internal organs. These flat, curved bones start at the spine. Then they wrap around your body to make a cage in your chest to hold these organs.

Many vertebrates have ribs, but not all of them are like ours. A turtle's ribs don't make a cage. Instead, they grow into the turtle's backbone. The ribs support the turtle's shell.





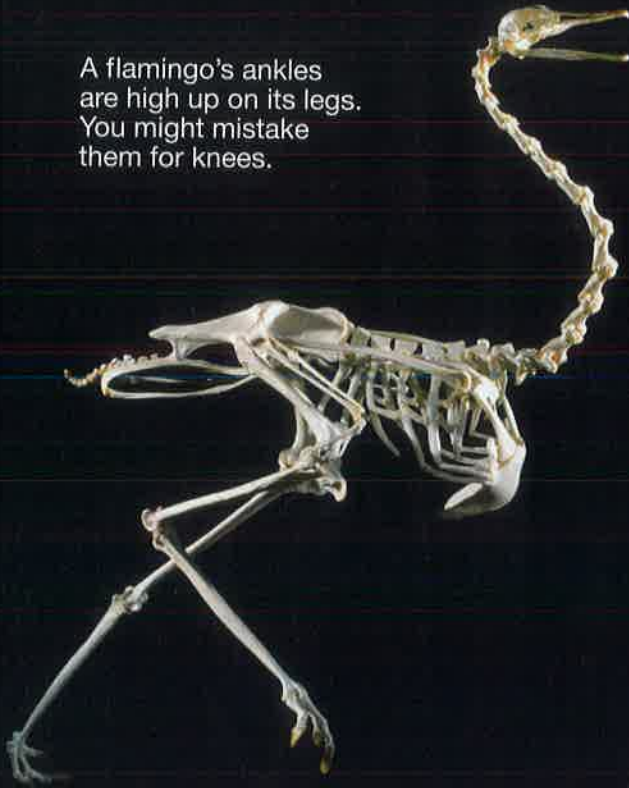
This tarsier's skull has plenty of room for its large eyes.



This sea turtle's ribs are part of its shell.



A flamingo's ankles are high up on its legs. You might mistake them for knees.



## Bodies in Motion

We know that bones support the body and help protect organs. They do something else, too. Bones work with **muscles** to get your body moving. Muscles pull bones. They cannot push them. So muscles work in pairs to move bones.

For example, the muscle in the front of your upper arm bends your elbow. To straighten your elbow, you have to relax this muscle. At the same time, you have to tighten the muscle at the back of your upper arm. Every time you move, your bones and muscles work together.

The place where two bones meet is called a **joint**. Joints also allow bones to move. Yet different kinds of joints let them move in different ways.

Some joints work like door hinges. Try bending your knee. It can bend or straighten. Now move your ankle. It works the same way.

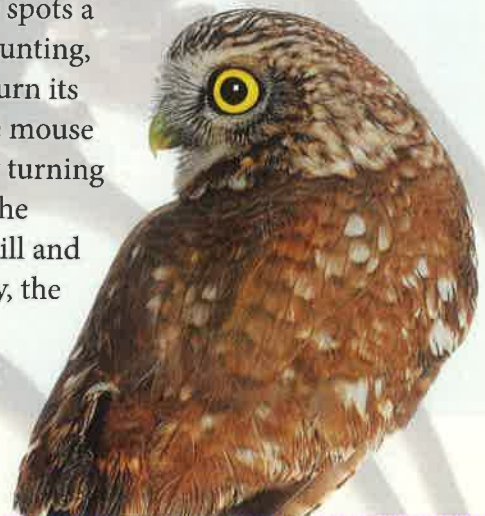
You can see this hinge at work on a flamingo. As the flamingo bends each leg to step forward, it looks like its knees are bending backward.

## Bending and Turning

Don't be fooled. Birds' knees do not bend backward. The part that looks like a knee is actually the bird's ankle. Its knee is hidden under feathers close to its body. Both knee and ankle work like hinges, though.

Other joints help bones pivot, or turn. You can turn your head left and right, and move it up and down. An owl can turn its head almost all the way around. This is important for the owl because it cannot move its eyes.

So if an owl spots a mouse while hunting, the owl must turn its head to see the mouse as it moves. By turning only its head, the owl's body is still and silent. That way, the mouse doesn't know it's being watched.





## Putting Bones to Work

Some joints allow bones to move in a circle. Try rolling your shoulders. You use that joint to jump rope or throw a ball.

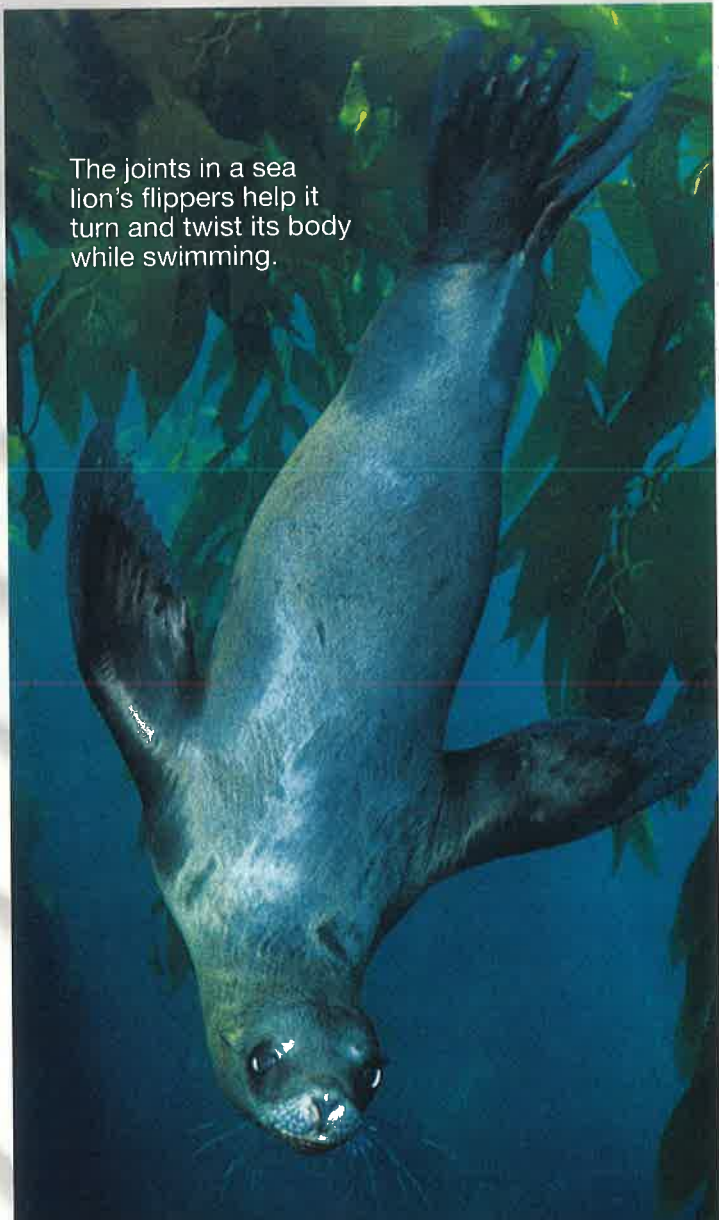
A sea lion uses that same joint to dive and swim. The sea lion can move its flippers to twist and turn its body. It can spiral its way through seaweed while hunting for fish.

All vertebrates have bones, but they use them in different ways. How a skeleton is put together determines how an animal lives.

For example, cheetahs have springy spines and long, thin leg bones. This allows a cheetah to take longer steps and cover more ground when running.

Think about birds. Most birds have air pockets in their bones. This keeps a bird's skeleton lightweight. That's pretty important for flying.

Now you know a little more about skeletons. Remember, bones give bodies support and strength. Bones also keep bodies on the move.



The joints in a sea lion's flippers help it turn and twist its body while swimming.

## Wordwise

**bone:** a hard body tissue that gives strength to the skeleton

**joint:** any part of a skeleton where two or more bones meet

**muscle:** a type of body tissue that can be tightened and relaxed to cause movement or exert force

**skeleton:** a strong framework that supports the body

**vertebrate:** an animal with a backbone





## Life Science

### COMPREHENSION STRATEGY:

Before reading, scan the subheads and photos to predict what each section is about.



# No Bones



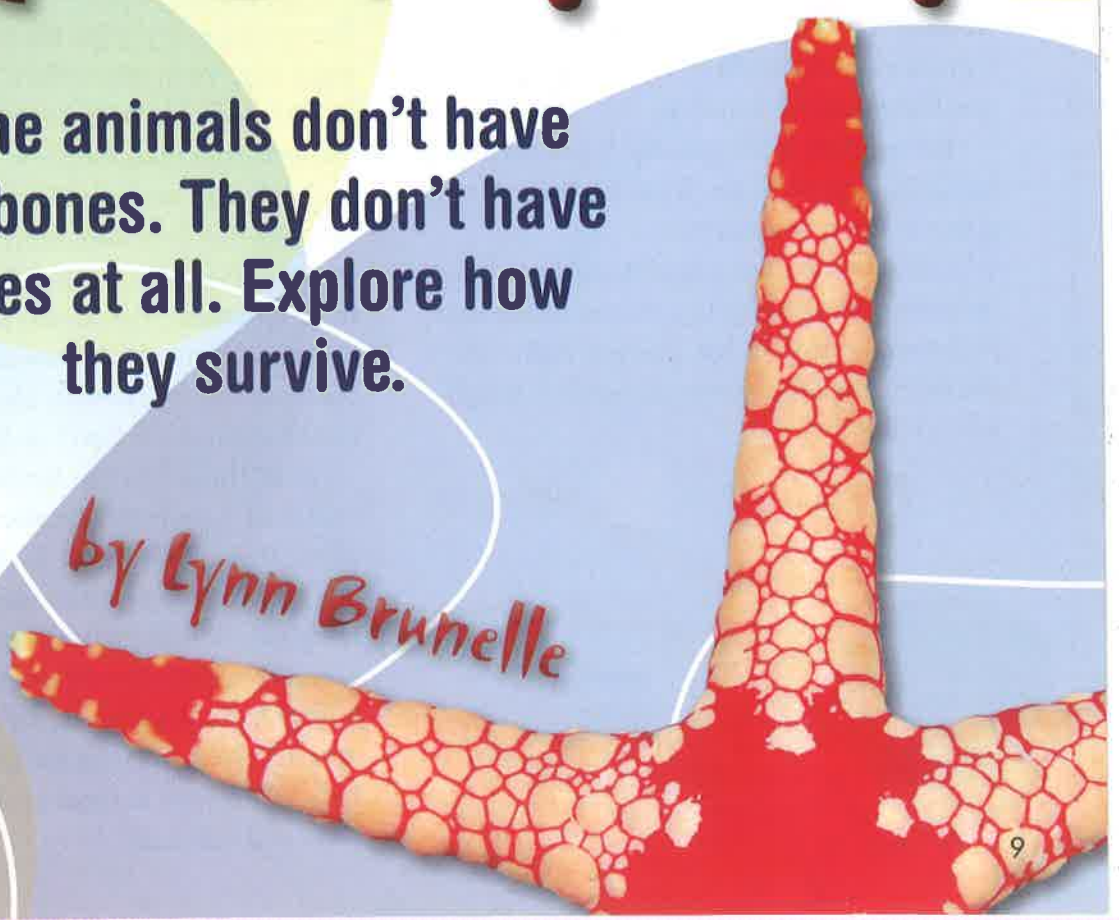




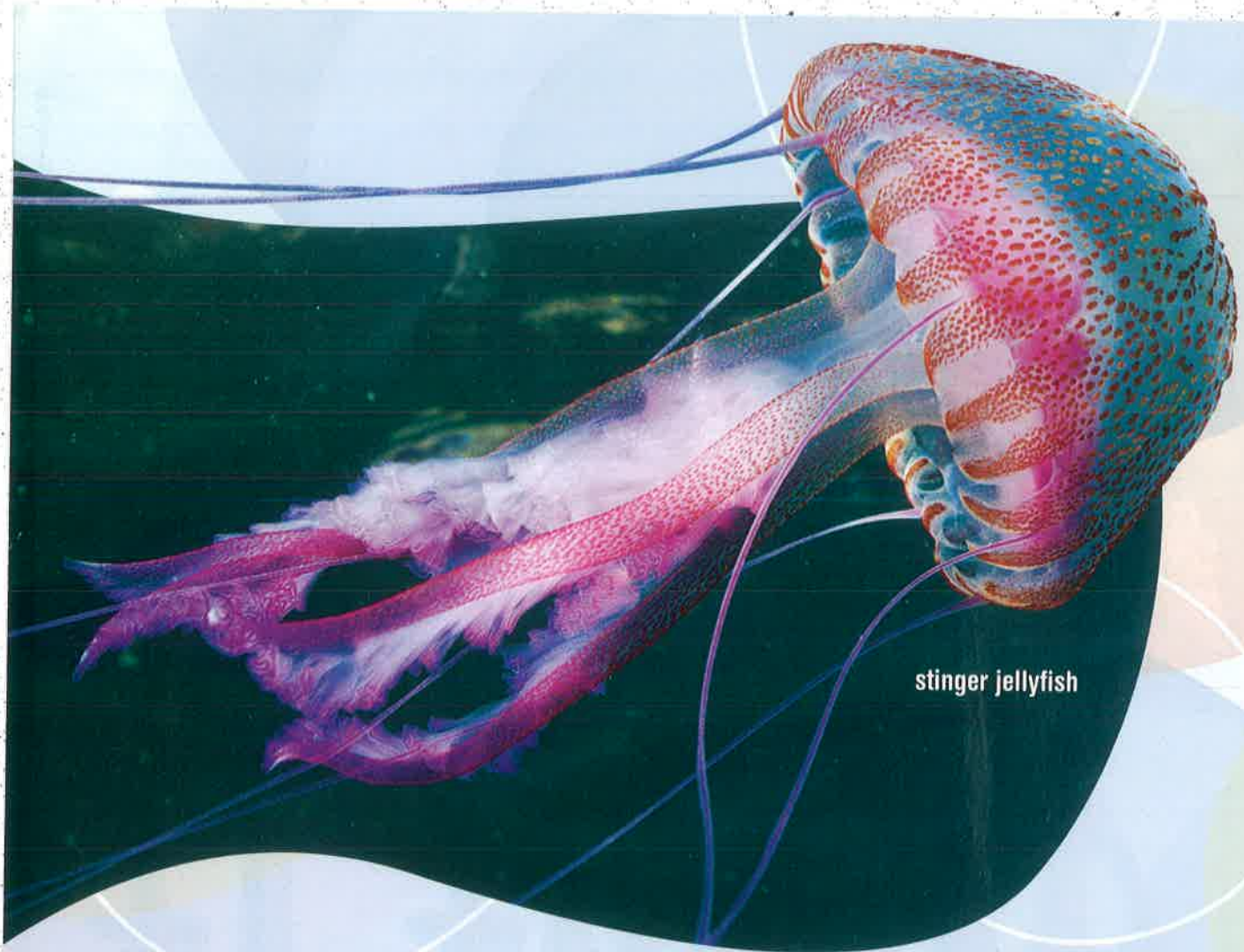
# About It

**Some animals don't have backbones. They don't have bones at all. Explore how they survive.**

*by Lynn Brunelle*







stinger jellyfish

**A flash** lights up the dark sea. This fluttering light dances through the water. It's a jellyfish. Its body is shaped like a bell. Wispy tentacles trail beneath its body. It pulses with sparkling color as it swims.

The jellyfish looks ghostly. It has no heart, no lungs, and no brain. It has no bones. It bobs along in the ocean current.

Half a world away, a spider seems to hang in midair. It's clinging to a thread of silk that is almost too thin to see. The sun lights up the fuzzy hairs that cover the spider's tough, armored body.



cucumber spider

## All in the Family

The spider easily grips the silken thread with its eight legs. With little effort, it climbs. It reaches its web and sits down to wait. Its eight eyes scan the web, watching for prey.

A jellyfish and a spider are very different animals. Yet they have more than one thing in common. For example, they are both **invertebrates**. That means that neither animal has a backbone. It also means these animals are **cold-blooded**. Scientists **classify** 95 percent of all the animals on Earth as invertebrates.

You'd think that not having a backbone would be a problem. Yet these critters are some of the best survivors on Earth.

Each kind of invertebrate has a body suited for survival. Scientists put invertebrates into groups based on the **characteristics** their bodies have. A jellyfish and a spider are both invertebrates, but they are in different groups. Let's take a look at some and see how they are alike and different.



## Going With the Flow

A small tube curves up from the ocean floor. It's about the size of your finger. It looks as if it's been woven out of glass. White threads hold it to a rock. This tube is one of the simplest animals on the planet. It's a sponge.

For hundreds of years, scientists thought sponges were plants. They are rooted like plants. They have stiff structures that look like stems. Yet sponges are really invertebrates.

More than 5,000 different kinds of sponges live in the ocean. These sponges don't have heads, eyes, or mouths. They don't have stomachs, muscles, or bones. They don't need them. Tiny holes cover their bodies. As water flows through these holes, food and oxygen pass through the sponges. The water also carries away waste.

Some sponges look like trees or bushes. Others look like fans or cushions. The breadcrumb sponge looks like a rug. It gets its name because it crumbles into pieces when touched.

Some sponges are as small as a grain of sand. Others are much larger. For example, you could fit inside a giant barrel sponge. Sponges can be squishy or hard as a rock. No matter their size or shape, most sponges stay rooted in place.



red finger  
sponge



yellow tube  
sponge



## The Big Sting

Wedged between two rocks in the ocean sits a giant sea anemone. It looks like a flower. What looks like long petals fan out from its center. The petals sway gently in the ocean current.

Don't be fooled. These are not petals. They are tentacles, and the anemone is not a flower. Anemones are invertebrates—and they sting.

A small fish zips by the anemone. The anemone's tentacles whip forward. They sting the fish. This paralyzes it. Then the anemone scoops the fish into its mouth.

The anemone belongs to one of the larger groups of invertebrates. Most of the animals in this group have stinging tentacles. Each of these invertebrates has a single opening where the food comes in and waste goes out.

Some of the animals in this group of invertebrates might look strange. The sea pen is a kind of coral, but it looks like a quill pen. The bottom end of the pen is rooted to the ocean floor. The upper part flutters in the current. Its feathery tentacles catch passing food.

The by-the-wind sailor is a tiny jellyfish. It has a flat body and short tentacles. It has a small sail on its back that catches the wind. It blows across the ocean. It drifts in swarms and gobbles up small sea animals.



white-spotted anemone



sea pen





cushion sea star

## Slow but Fierce

A blue mussel sticks to the side of a rock underwater. An orange sea star creeps along the sandy seafloor. It is hunting the mussel.

The sea star's five arms reach the mussel. The sea star pulls, pries, and pushes the mussel's shell open. Next, the sea star ejects its own stomach into the shell. Its stomach digests the mussel. Soon nothing but an empty shell remains. The sea star pulls back its stomach and moves on.

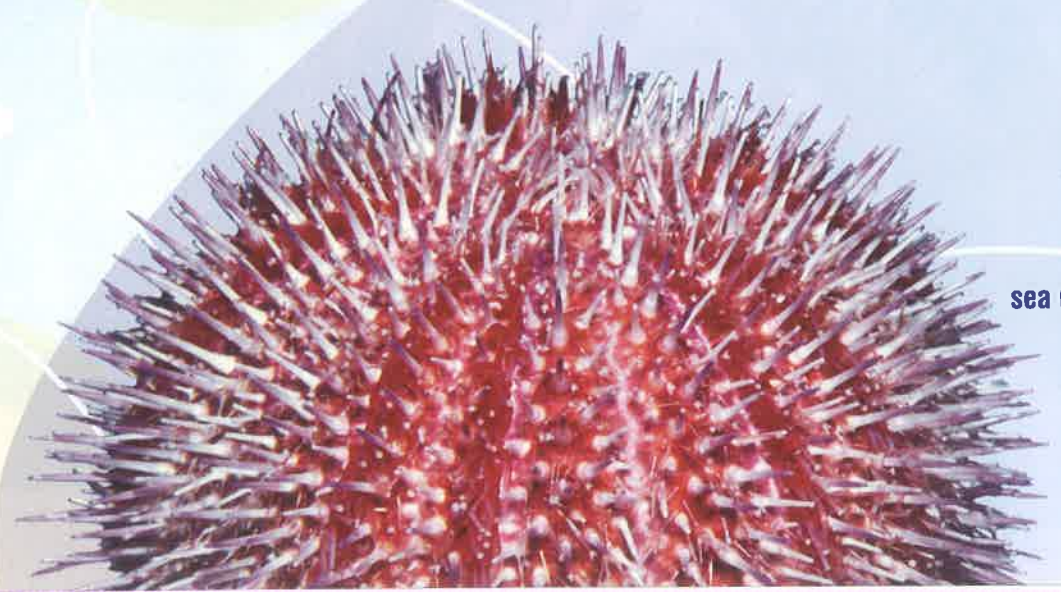
Both the mussel and the sea star are invertebrates. Yet they belong to different groups. A sea star belongs to a group with hard, spiny skins. Its skin protects its soft body.

## Fantastic Five

The animals in this group are the only animals with bodies based on the number five. Many of them have five arms, five legs, or five sets of mouthparts.

Take the sea urchin. Sea urchins have round bodies covered in spines. Their mouths are on the underside of their bodies. Five pointed teeth ring their mouths. These teeth scrape algae from rocks.

Sea cucumbers also belong to this group. They are shaped like sausages. Five double rows of tube-like feet help them slink across the seafloor. A set of frilly tentacles helps them collect food.



sea urchin





banana slug

## Land, Not Sea

Not all invertebrates live in the ocean. Many live on land. A banana slug moves slowly through a forest. It's hard to miss. It's bright yellow. The slug's muscles ripple, pushing it forward. It glides over and under crispy brown leaves on the forest floor.

The slug pauses. Two pair of soft tentacles stretch out from the top of its head. The top pair is its eyes. The bottom pair acts like a nose, helping it sniff out food. It smells a rotting mushroom. The slug crawls toward it and nibbles away.

## A Shell for Shelter

The slug belongs to a group of invertebrates with soft bodies. Unlike a slug, a hard shell protects many members of this group. For example, a snail carries its shell on its back. The shell protects it from danger.

Octopuses belong to this group, too. Most do not have shells, but the argonaut octopus does. The female argonaut makes a thin, brittle shell. Then she climbs inside.

She holds it with two arms. Then she lays her eggs inside it. Tucked inside the shell, the mother and the eggs drift through the ocean. When the babies hatch, they swim off.

The violet sea snail uses its shell in another way. This snail is one of the world's great ocean travelers. It lives in warm waters and drifts far out to sea.

The sea snail has a shell as thin as paper. To help it stay afloat, the snail makes a raft of bubbles. The bubbles ride on the surface of the water and the shell stays underwater. The snail spends its whole life upside down floating through the ocean.



golden tortoise beetle



## Outside Armor

Few invertebrates spend time climbing trees, but the robber crab does. It's one of the largest crabs in the world. The robber crab can weigh more than 4 kilograms (9 pounds). It has a thick shell called an **exoskeleton**. Its jointed arms and legs help it move and climb.

The robber crab might look rough and tough, but it mostly eats plants. It likes coconuts best.

To find a good coconut, the crab clings to a palm tree's bark and climbs up. When it gets to the top, it reaches out and pinches a coconut free with one snip of its claw. The coconut falls to the ground with a thud.

The crab climbs down the tree to find its supper. It pierces the coconut with one of its pointed walking legs and scoops out the insides.

Crabs are members of the largest group of invertebrates. This group includes lobsters, spiders, centipedes, and insects. The animals in this group look different from each other, but they all have exoskeletons, jointed legs, and segmented bodies.

Hundreds of thousands of different kinds of insects fall into this group of invertebrates. Of these, one beetle has an exoskeleton that looks like gold. The color of the golden tortoise beetle's shell is an optical illusion.

The clear shell sparkles like gold when sunlight bounces off it. This shell is pretty, but it also protects.

## No Backbone? No Problem!

Crabs and other invertebrates come in different sizes, shapes, and colors. Some stay put. Some burrow. Many float. Others swim, glide, climb, or skitter.

Some are among the smallest animals in the animal kingdom. Others weigh hundreds of kilograms. Yet they are all invertebrates. Not having a backbone is not an issue for these animals.

# Wordwise

**characteristic:** a feature or quality

**classify:** to put into groups

**cold-blooded:** using the sun's warmth to control body temperature

**exoskeleton:** a tough external covering for the body of some invertebrates

**invertebrate:** an animal without a backbone

robber crab







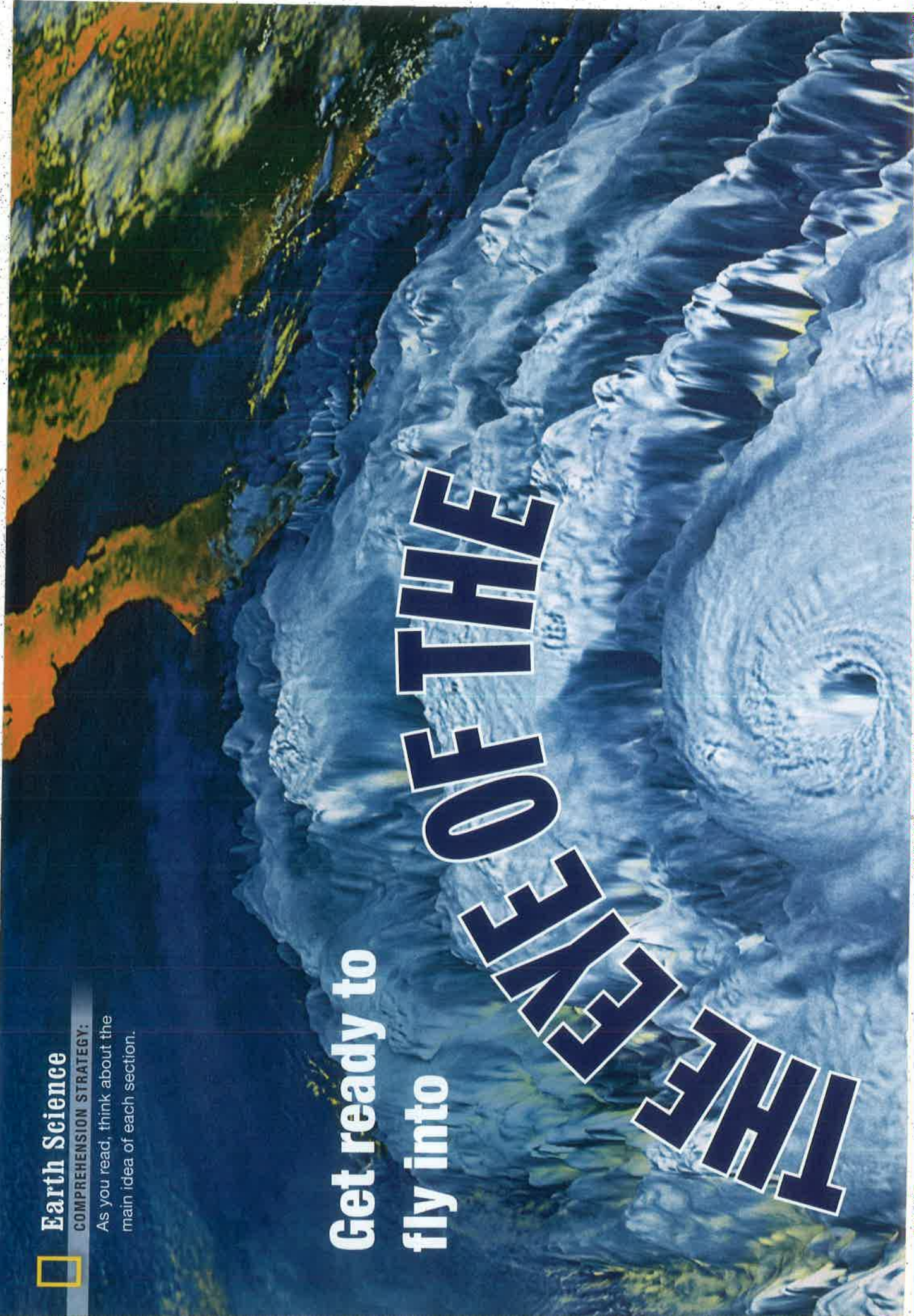
## Earth Science

### COMPREHENSION STRATEGY:

As you read, think about the main idea of each section.

Get ready to  
fly into

# THE EYE OF THE HURRICANE





An aerial photograph of a rugged, mountainous landscape, possibly a volcanic region, with a strong blue color cast. The terrain is characterized by deep valleys, ridges, and numerous small craters or depressions. The lighting creates strong shadows, emphasizing the topography.

# WORLD STORIES

by Glen Phelan