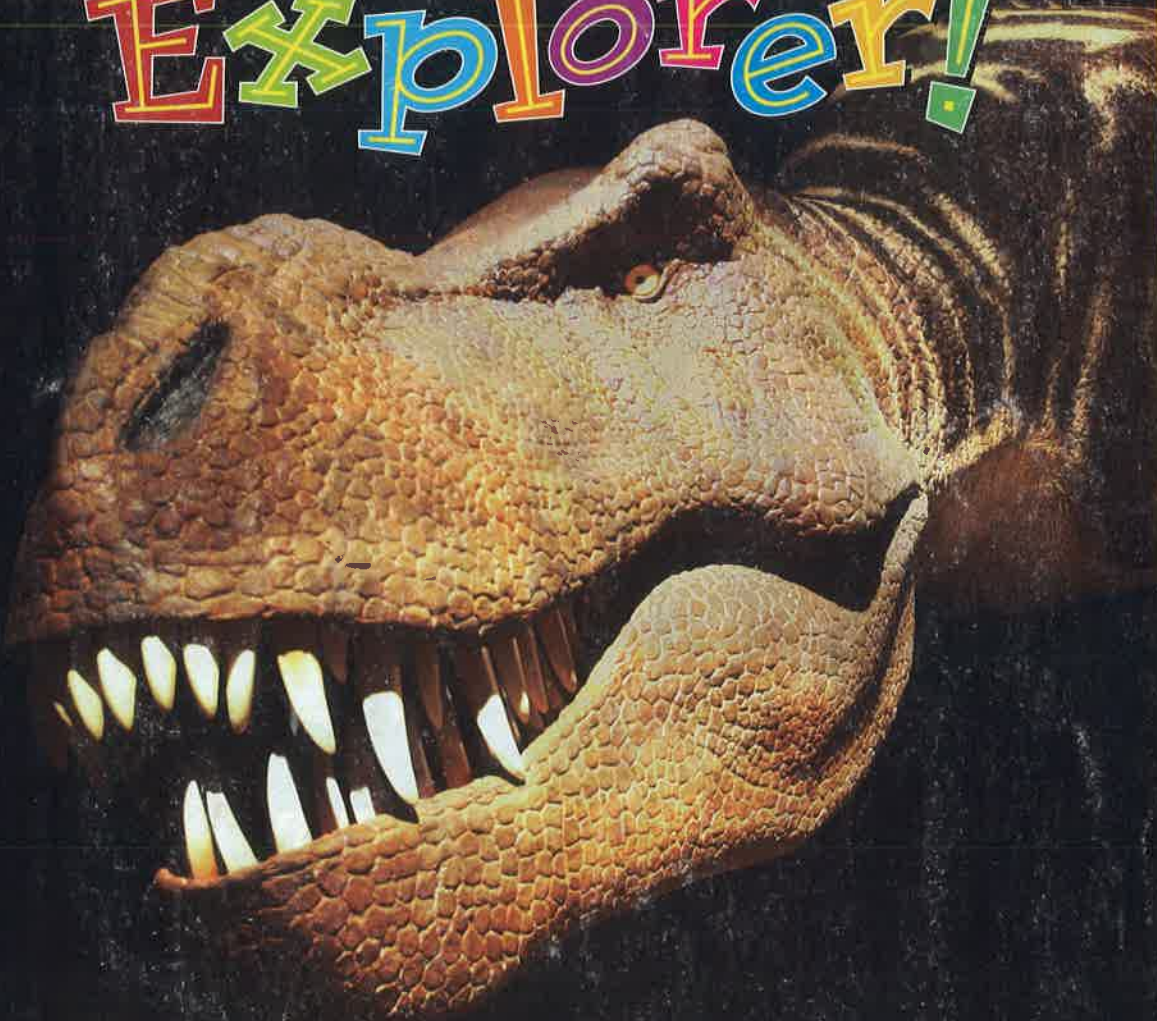


PATHFINDER EDITION

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MAY 2009

NATIONAL GEOGRAPHIC *Explorer!*



Dinosaurs in Motion ²⁰

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Return to the MOON

By Dottie Raymer



Reading Strategy: As you read this story, ask yourself these questions: What are the key words? What information do I want to remember?



Big Steps. Neil Armstrong took this photo of Buzz Aldrin. They were the first two people to walk on the moon.



Huge flames erupt beneath your rocket as it blasts off. The engines roar. The spacecraft shakes. Drops of sweat line your brow. Will you make it to the moon? And will you make it back alive?

Several days later, the answer seems to be no. A red light glows on the control panel. It warns: Low on fuel. You have to land soon. Or crash.

You think fast, looking out the window at the moonscape. You need a safe place to land. But rocks the size of trucks loom ahead. At last, you see a clear area. Can you reach it in time?

Yes. You brace yourself for a rocky landing, then touch down. The landing is gentle. Even so, your heart starts to pound. You're on the moon!

A Bold Plan

If this sounds like a video game, guess again. It really happened. Between 1969 and 1972, NASA successfully sent 12 people to the surface of the moon. Now, it hopes to go back—and beyond.

NASA is making plans for this great adventure. The plan has three phases. They add up to NASA's biggest, boldest mission ever. It is called the Constellation Program.

Phase one of the plan is to get astronauts to the moon and back safely. NASA wants to send a manned mission to the moon by 2020. The goal is to learn more about our nearest neighbor in space.

That's not all. The moon may have formed from material that was once part of Earth. So learning about it could help us understand our own planet better. Astronauts may also find valuable minerals or gases. Moon gases could possibly fuel rockets to other points in space.

Phase two of NASA's plan is to build a space base on the moon. So far, people have only visited for a few days at a time. With a base, astronauts could stay for months. That would give them time to study the moon in depth.

Phase three is the boldest of all. It is to use the moon as a launch pad for sending rockets to Mars. After Mars, who knows? Space is the vast final frontier.

Lunar Express. In the 1960s and 1970s, Saturn V rockets blasted people to the moon.



NASA

Phase 1 - Blastoff Times Two

NASA has already started working on the first phase of its great mission—getting people to the moon and back safely. At the heart of the plan are two spacecraft, Altair and Orion.

The moon mission starts when a huge rocket blasts Altair into space. At this point, Altair only has equipment on board—no people. Altair then orbits Earth until it can meet up with Orion.

Next, four astronauts strap themselves into Orion. A second, smaller rocket carries Orion and its brave passengers into space. If the timing is just right, Orion links with Altair. They orbit Earth together. Then both spacecraft blast out of Earth's orbit toward the moon.

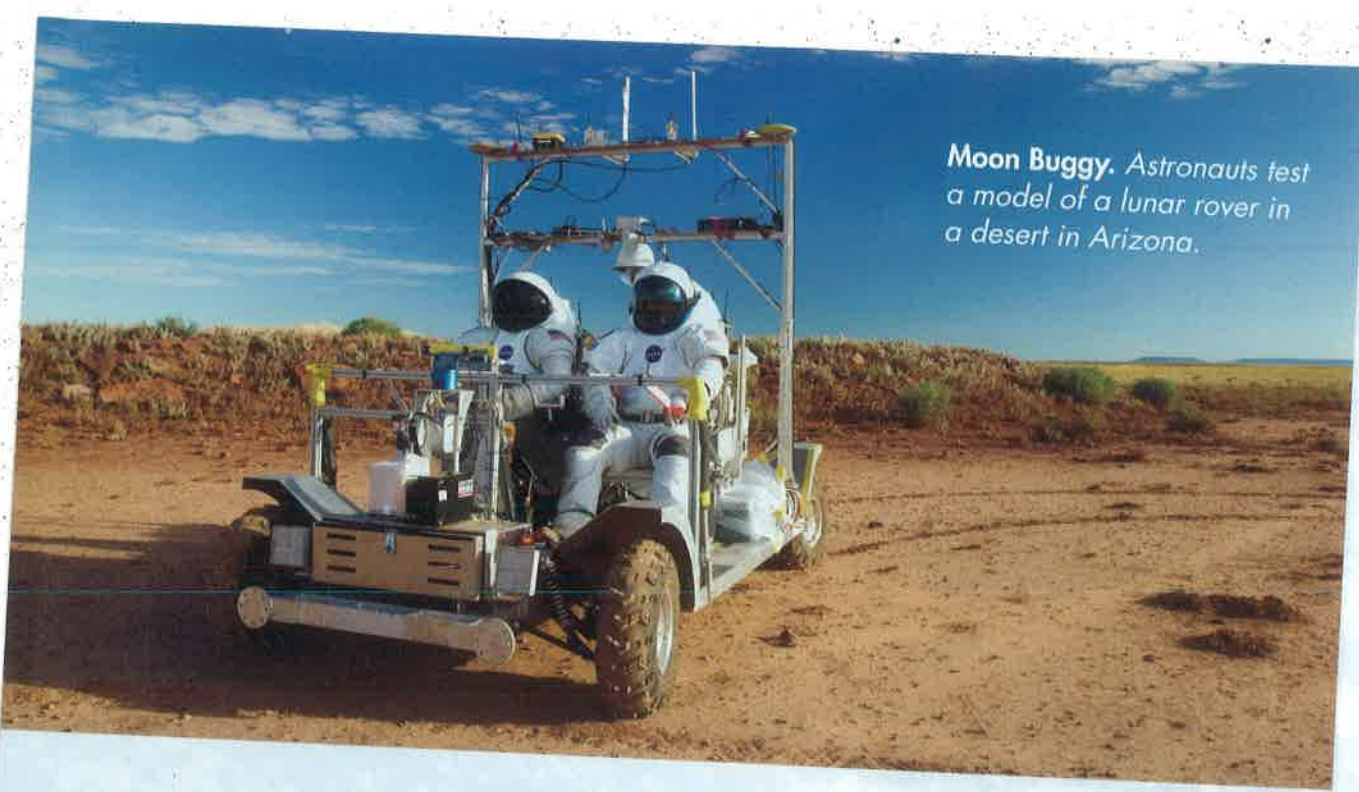
Once Altair and Orion are near the moon, they begin to orbit it. Then the astronauts crawl from Orion into Altair. They prepare to journey to their next stop. It is the stark, airless surface of the moon.

Altair takes the astronauts and all their equipment down to the surface. Orion keeps circling the moon. The astronauts spend a week probing unexplored places. Then they climb into the top part of Altair. It blasts them off the moon and back up to Orion. Orion then carries the crew back toward Earth. Altair remains in space.

Next comes one of the most heart-pounding parts of the journey. That's when Orion reenters Earth's atmosphere. The **friction** between the spacecraft and the air produces life-threatening heat. The temperature may soar to 2,600° Celsius (4,800° Fahrenheit). To protect the astronauts during this bumpy ride, NASA is developing special shields for Orion.

Orion descends toward Earth. Parachutes billow open. They slow the craft down, so it doesn't smash into the ground. Huge air bags inflate. They help Orion touch down gently.

NASA/ANGIEV RESEARCH CENTER (BACKGROUND)



Moon Buggy. Astronauts test a model of a lunar rover in a desert in Arizona.

Phase 2 - Life on the Moon

On the moon, astronauts begin the next phase. It's a huge challenge. Piece by piece, they build a space base. Future astronauts will be able to live and work there for months. Imagine building a town from scratch. Only this town is in a place 385,000 kilometers (239,000 miles) away!

NASA is still figuring out how to get this jumbo job done. But engineers have some ideas. One idea is to use unmanned rockets to carry **modules** to the moon's surface. Modules are large pieces of the space base. Think of each module as a high-tech RV camper. The space base is something like a town of campers.

Another idea is for the space base to use **solar panels** for power. The moon has no clouds and gets plenty of sunshine. That means lots of free energy for the space base.

Astronauts need more than a base, though. To explore, they need a way to get around. NASA is already working on a new design for a **lunar rover**. The new rovers allow astronauts to venture much farther than they could by just bouncing around on foot.

NASA is trying out ideas for airtight cabins. Astronauts wouldn't have to wear their bulky space suits inside. If they did wear their space suits, the cabin would protect the suits from damaging moon dust.

Phase 3 - From the Moon to Mars

The third phase is the most challenging part of the mission. NASA wants to use the moon as a launch pad for Mars. The red planet has attracted a lot of interest lately. Scientists found it belches methane gas. This could be a sign that tiny organisms live beneath the surface. There may be alien life on Mars!

It makes sense to use the moon as a launch pad. There, gravity is much weaker than on Earth. So rockets can blast off moon's surface more easily than they can take off from Earth.

Someday, changing rockets on the moon may seem as ordinary as switching planes in an airport. But that someday is far in the future. From Earth to Mars is a long journey. Getting there won't be easy. NASA faces great hurdles. But NASA has one key thing on its side. It's the human drive to solve problems and explore.

Wordwise

friction: rubbing of one thing against another

lunar rover: buggy that travels on the moon

module: unit that can be linked to other units

solar panel: tool that turns sunlight into electricity

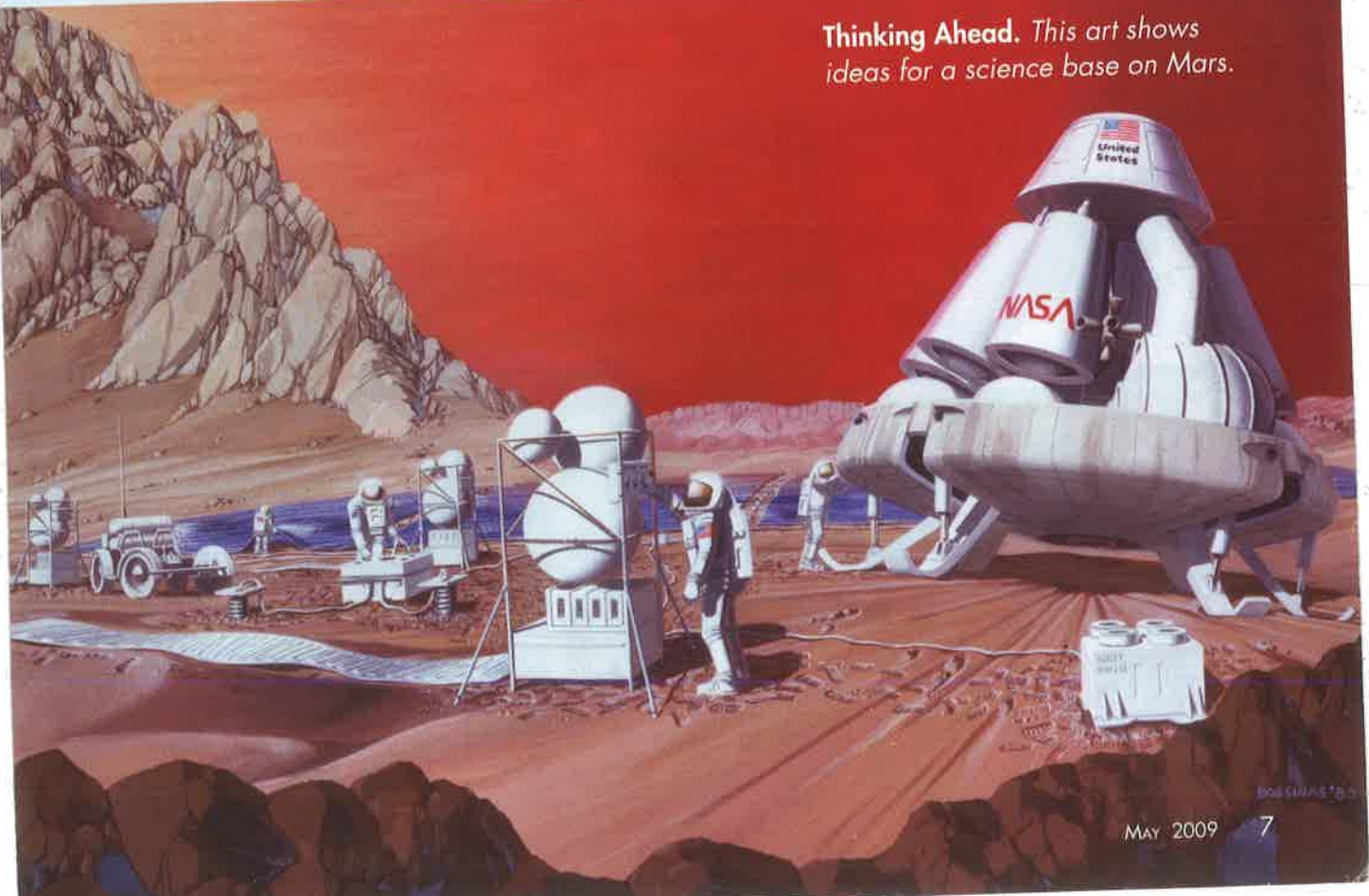


Next Stop? People may one day travel from Earth's moon to Mars.

NASA/GLENN RESEARCH CENTER

NASA/GLENN RESEARCH CENTER

Thinking Ahead. This art shows ideas for a science base on Mars.



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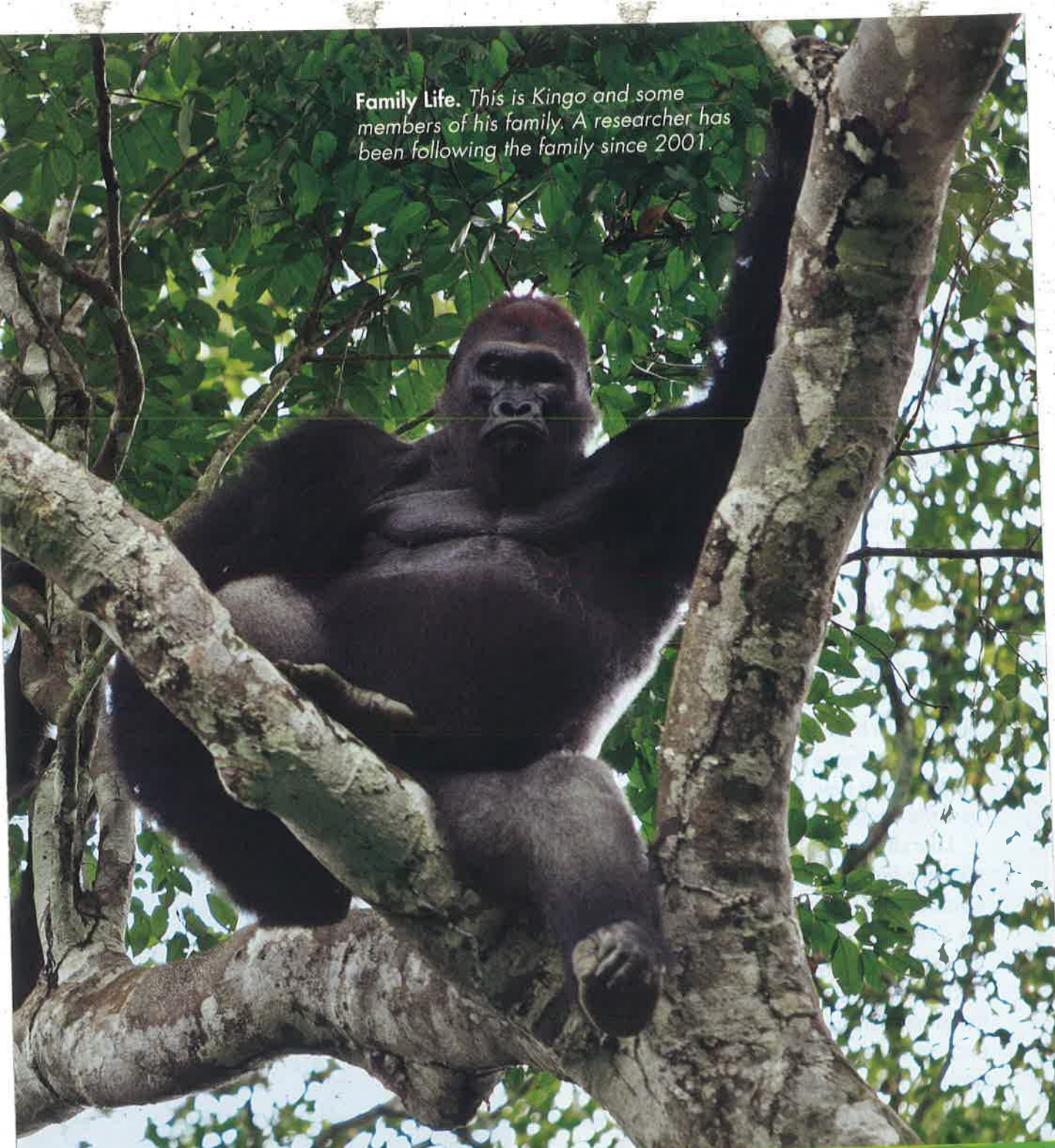
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Reading Strategy: As you read each section of this story, write down important things you learn.



A Glimpse of Gor

A large gorilla is perched on a thick, light-colored tree branch. The gorilla is looking directly at the camera with a neutral expression. Its dark fur is visible against the background of green leaves and branches. The scene is set in a dense forest with sunlight filtering through the canopy.

Family Life. This is Kingo and some members of his family. A researcher has been following the family since 2001.

IAN NICHOLS/NATIONAL GEOGRAPHIC STOCK

By Gary Miller

Western lowland gorillas are shy and peaceful. They usually stay hidden from people. Yet thanks to Diane Doran-Sheehy, you can come face-to-face with a gorilla family.

illias

It's not easy to study gorillas. A team of scientists follows a guide through the hot rain forest in Africa. They brush away bugs. They scramble over tree roots and duck under hanging vines. They're hot, sweaty, and tired.

Suddenly the guide gives the signal to stop. Next, he makes soft clicking sounds. The sounds are a greeting to the animals in the jungle ahead. The animals know the greeting. It tells them that the group has come in peace.

The scientists step into an open area. Suddenly, they don't feel so tired. In fact, they're thrilled. They're looking at something few people have ever seen. It's a family of western lowland gorillas in their natural habitat.

Kingo's Clan

At the center of the clearing sits Kingo. He is the family leader. Kingo weighs almost 135 kilograms (300 pounds). He's about 25 years old and has huge arms and a strong chest. Kingo is in charge of keeping the family safe. Though right now, he's involved in his favorite pastime—eating.

Like all western lowland gorillas, Kingo goes ape for leaves, stems, and fruit. He enjoys a side dish of termites, too. Sitting quietly in the shade, he's taking leaves off a bush and munching on the stems.

In most gorilla families, a single male leads the group. The male usually has several "wives." Each wife usually has children. Kingo watches two of his wives, Beatrice and Ugly, feed their newborns. Kingo's other wives, Mekome and Mama, dig out termites from a rotting log.

Kusu and Ekendy, two young males, are in the treetops. They are playing a game of tag. Below them, another female gorilla appears. She's known as George. When George was young, researchers thought she was a male. She is the youngest adult female.


Normally, gorillas would not let people get this close. But there's a reason why these gorillas aren't afraid. It's thanks to the hard work of Diane Doran-Sheehy.

Finding the Family

Doran-Sheehy has been coming to Africa since 1995. She explored an area on the border of the Republic of the Congo and the Central African Republic. This area lies close to the **Equator**.

The thick jungle makes it easy for gorillas to hide. Before Doran-Sheehy could study gorillas, she first had to find them. She hired local trackers to help her. Trackers are people who can find animals.

Trackers know exactly what to look for in the jungle. They can find animals just by looking at a broken twig. They see footprints no one else would ever notice. Still, it took Doran-Sheehy and her team six years to find a gorilla family!



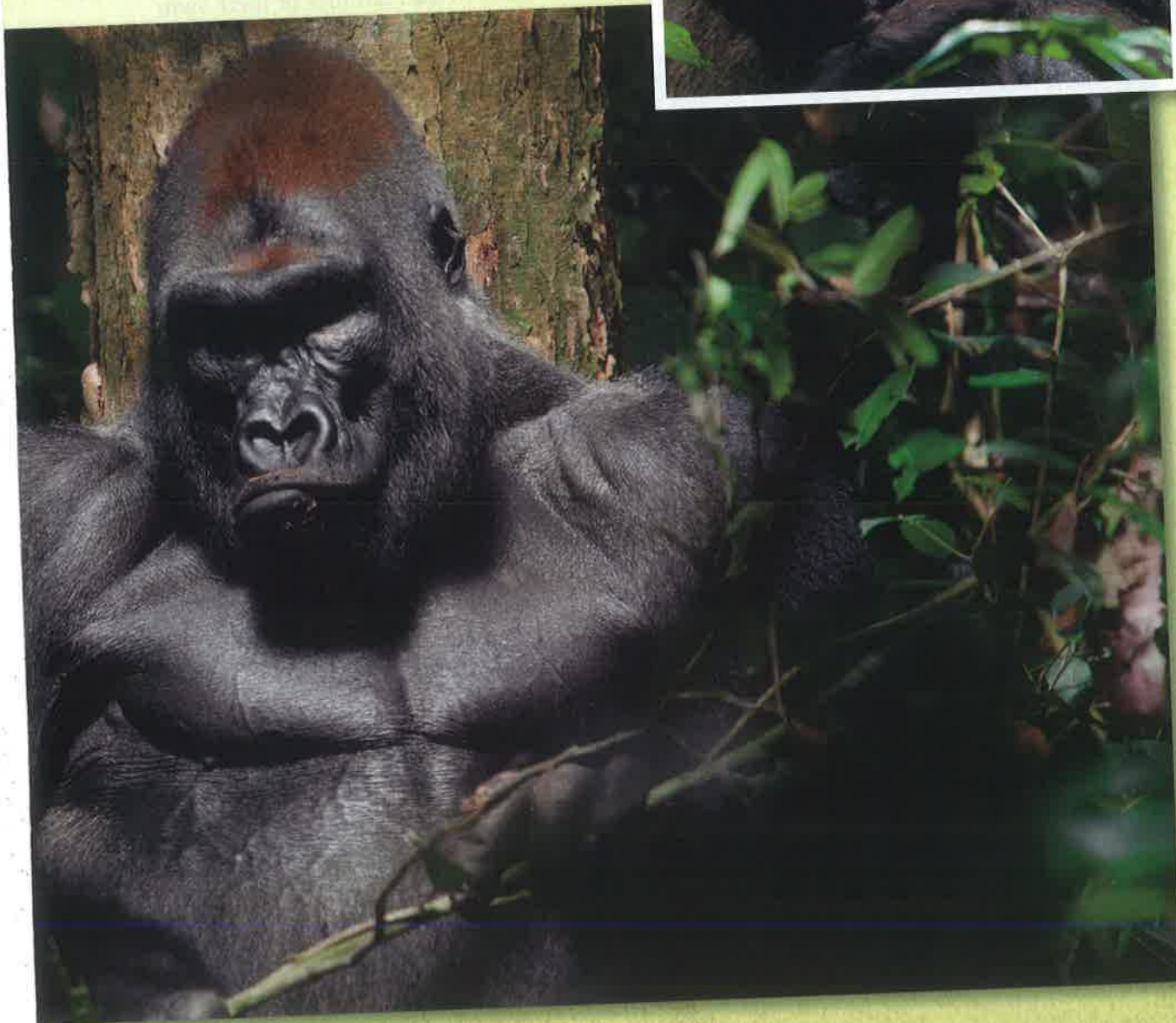
Kingo of the Jungle. Kingo, an adult male (right), leads a family made up of several "wives" and their children. One of his wives (above) holds her baby as she eats.

Close Contact

After the team located a family, it faced another challenge. The team had to get the gorillas used to being near people. So the trackers made up a special language.

Around the gorillas, the trackers made soft clicking sounds to signal each other. The gorillas heard the clicks, too. When they did, the gorillas knew members of the research team were nearby. Slowly, the gorillas got used to having people nearby.

After two years, the gorillas realized the people who clicked would not hurt them. Only then could the scientists get close to the gorillas. The team was ready to watch and learn more about these amazing animals.



Built for the Jungle

Back in the clearing, Kingo takes a nap. Soon, he rises and heads into the jungle to find food. For Kingo's family, the jungle is like a giant grocery store. Their **territory** is about 15 square kilometers (6 square miles). They walk about 2 kilometers (1.2 miles) a day looking for food.

Like other gorillas, Kingo often moves around by "knuckle walking." That means he bends over and walks on his knuckles and legs. He can do this because a gorilla's arms are longer than its legs. For Kingo, knuckle walking is faster than walking while standing upright.

Kingo has other **adaptations**, too. A short coat of hair keeps him from getting too hot. Like all adult males, Kingo has a silvery patch of hair on his back. So he's called a **silverback**.

Keeping the Peace

In a gorilla family, the silverback rules. He makes the decisions and the family follows. Kingo's family is no exception.

Kingo may look peaceful now. Yet when he's challenged, it's a different story. If faced with an intruder, Kingo stands on his back legs and pounds his chest. He roars loudly.

If this behavior doesn't scare the challenger, Kingo charges, or rushes forward. He doesn't usually need to attack, though. The charge is enough to scare off most challengers.

With no challengers in sight, Kingo is relaxed. Kusu and Ekendy stay close to Kingo. They copy his every move. This helps the young males learn new skills. Someday, they will need these skills to lead families of their own.

Snack Time. Here, Kingo is spending time in a muddy swamp, with plenty of food within reach.



Family Life

The gorillas walk a bit. Then they stop near a swampy pool. Kingo plops down in the middle of the muddy water. He starts to pull up plants. First he washes them. Then he slurps them all down.

George seems ready to join Kingo. She sticks a toe in the water. But Kingo doesn't want company. He gives a warning growl. That's enough for George. She skitters away.

Kingo's four wives all try to get his attention. The scientists noticed that Mekome seems to be his favorite. She eases into the swamp, hoping to get closer to Kingo. Ugly is his least favorite wife. She doesn't try to move closer. Instead, she goes off into the trees to rest, carrying her newborn.

An Uncertain Future

After eating, Kingo is ready for another nap. He leaves the swamp and finds a shady spot to rest. Mekome lies down at his side. Beatrice and Ugly feed their newborns. Mama and George take to the treetops. They begin to eat some leaves. Meanwhile, Kusu and Ekendy start another game of tag. It's family life, gorilla style.

For now, Kingo and his family look content. Yet they face an uncertain future. Western lowland gorillas are critically endangered.

What happened to the gorillas? Disease killed many of them. Predators such as leopards also killed some. Yet people are a bigger threat. Every day, loggers cut down trees in the rain forest for timber. This destroys gorilla habitat. It also opens the way for poachers. They illegally hunt gorillas for meat.

Yet there are also signs of hope. In 2004, Doran-Sheehy and others got loggers to give up the land where Kingo lives. It's now owned by a group that won't cut down the trees.

Last year brought even bigger news. Scientists in the Republic of the Congo found an undiscovered population of these amazing apes. The scientists think more than 125,000 western lowland gorillas live in the group. That doubles the number of known western lowland gorillas in the world! With ongoing human help, Kingo and other gorillas may survive.

Wordwise

adaptation: body part or behavior that helps an animal survive

Equator: imaginary line around the middle of Earth

silverback: adult male gorilla

territory: area an animal lives in

KATE THOMPSON/ALCONAS GEOGRAPHIC STOCK



Reading Strategy: Preview this story to get an idea of what you will be learning about bicycles. As you read, use a time line to help you track key events.

PEDESTAL WARRIOR

What is the quickest, easiest, coolest way to get from one place to another? One billion bike riders think they have the answer.

By Susan Blackaby

No matter where you look, bicyclists are on the go. In large cities, they pedal to work. In small towns, they ride to school. They pump up steep hills. They skid over wooded trails. They zoom for fun and zip for work.

People like bikes for many reasons. They're handy and fairly cheap. Even better, bikes are easy to use. Learning to ride a bike only takes about a week. However, learning to build today's modern bike took many years.

Bumpy Beginnings

Hobbyhorses were bikes from the early 1800s. They weren't easy rides. It was tough work to get them rolling. They didn't have pedals, so riders scooted forward by pushing their feet along the ground.

Coasting downhill was a breeze. But anything else was a struggle. On flat ground, it wasn't much different from walking! As you might guess, hobbyhorses didn't catch on—they were more trouble than they were worth.

Later, bike builders discovered that adding pedals could make the ride more enjoyable. Pedal pushing began around 1860. Pedals got the rider's feet off the ground and made the bike move faster.

Though pedals were helpful, bikes were still far from perfect. Early models were called velocipedes, meaning "fast foot." On cobblestone streets, these wooden bikes bumped and bounced back and forth. Riders nicknamed the bikes "boneshakers."

Bike designers kept rolling forward, trying out new ideas. The high-wheeler was one. It was the first metal bike. High-wheelers had huge front wheels—about 1.5 meters (5 feet) tall—but tiny back wheels. The rider balanced high off the ground and steered very carefully.

These wobbly bikes did have one advantage. The wheels had **spokes**. Spokes absorbed the shock from bumps and bounces on a rough road. These features made for a smoother but risky ride that inspired a new phrase. When the huge front wheel hit a rock or a hole, unlucky riders "took a header." The wheel stopped short, but the riders kept going—until they hit the ground headfirst!

Safe Arrival

To keep riders in their seats, bike makers kept tinkering. They switched the front and back wheels to make high-wheelers safer. The smaller wheel was now in front, and the larger wheel was in the back. This made the bicycle safer and less likely to tip forward.

As people learned new ways to work with metal, bike design improved. Designers added chains and **gears**. Previously, metal wasn't light enough for things like bike parts. Gears let riders change speed more easily, and use less pedaling energy.

Bike makers also replaced wooden tires with rubber tires. They made the tires the same size, too. The high-wheeler became a thing of the past. The new bikes gave a smooth, safe ride with fewer crash landings. It was the birth of the modern bicycle.

Making Progress

In the 1890s, pedal pushing caught on and became a favorite pastime. Bicycling was an activity everyone could enjoy. It didn't cost much. It gave people an easy form of transportation. Bike riding's popularity sparked changes in other areas of life.

Fashion designers made clothes more comfortable for women, so they could pedal along with ease. Workers paved over cobblestone roads, so bicyclists could travel more smoothly. Bikes also inspired some important inventions.

The Wright brothers used bike parts to design their first flying machine. Henry Ford used bike parts to make his first car. These two inventions would soon change the world.



© HERZ/HUTTON ARCHIVE/GETTY IMAGES

Pedal Pushing. A hobbyhorse (above left) had no pedals. Riders moved by pushing their feet along the ground. Boneshakers (above right) were the first bikes to have pedals.



© HUTTON/DEUTSCH COLLECTION/CORBIS

Bikes and Balance. When riding a high-wheeler bike, the rider perched on a seat about 1.5 meters (5 feet) above the ground.