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EDITORS' NOTE: THIS SECTION SHOULD NOT BE READ BY GROWN-UPS

# The New York Times

For Kids

## TO THE RED PLANET

A NEW ROVER SEEKS  
SIGNS OF  
LIFE ON MARS



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ILLUSTRATION BY TIM MCDONAGH

# NASA'S NEW ROVER BEGINS A MARTIAN ADVENTURE

BY NICHOLAS ST. FLEUR • ILLUSTRATION BY TLM McDONAGH

Does life exist elsewhere in the universe? Mars, our most similar planetary neighbor, may hold the key to finding out. Today it is a barren wasteland where the average temperature reaches minus 64 degrees Fahrenheit. But scientists think that billions of years ago it may have been warmer and awash with rivers and oceans. Because every organism — from microbes to mammals — needs water to survive, Mars offers us the best opportunity of any planet in our solar system for discovering signs of ancient extraterrestrial life. For decades, NASA has sent rovers on 300-million-mile journeys to the Red Planet to probe the secrets of its wetter past. Between July 20 and Aug. 11, NASA plans to launch its latest rover, Perseverance. "We know that Mars was once habitable, but we haven't yet found that ancient life," says Katie Stack Morgan, NASA's deputy project scientist for the rover. "That's what Perseverance is going to Mars to find and hopefully collect, so that future missions can bring them back." When Perseverance arrives in February 2021, after about seven months of space travel, it will drill into Jezero Crater, a 28-mile-wide impact site. Scientists think the crater was once filled with an 800-foot-deep lake. That makes it the perfect spot to search for hints of the basic building blocks of life, like hydrogen, oxygen and carbon. Unlike its predecessor Curiosity, which pulverized rocks into powder, Perseverance will collect about 50 intact rock and soil samples and store them in tubes in its belly. Someday it may give the tubes to a different robot that will send them to Earth and into the hands of NASA scientists. Perseverance will spend one Martian year, or 687 Earth days, using its high-tech instruments to find and grab promising samples. If everything goes as planned, it will have gathered the best evidence yet that ancient life once existed on Mars.

## 7 MINUTES OF TERROR

Soaring 309 million miles through space sounds tough, but the real challenge is sticking the landing. "It takes seven minutes for the rover to go from the top of the atmosphere of Mars all the way to the ground," says Swati Mohan, the guidance-navigation and control operations lead. But it takes about 11 minutes for data from Perseverance to reach Earth — so the rover has to handle its descent all on its own. NASA won't immediately know if the landing was a success or if their eight years working on the rover ended in a crash. "In mission control we end up nail-biting for those minutes," Mohan says.

## ENTRY

The spacecraft enters Mars's atmosphere at about 12,000 miles per hour. As it screeches through the sky, it can reach scorching temperatures up to 3,800 degrees. It won't melt because it is protected by a large disc called a heat shield.

## PARACHUTE

About four minutes into the descent, it deploys its parachute, which helps slow the capsule to about 100 m.p.h. It glides for about two minutes, taking photos of the ground to determine its location.

## POWERED DESCENT VEHICLE AND SKY CRANE

The craft separates from its heat shield and, once it's low enough, activates a tool that helps it avoid dangerous spots below, like cliffs and craters. In the last minute, the parachute and back of the capsule detach. This releases a rocket-powered vehicle that carries the rover. When the vehicle is about 65 feet from the surface, it activates its sky-crane tool: three 25-foot ropes that lower Perseverance to the ground, leaving the rover to begin its mission on the Martian terrain.



## A BRAINY ROVER

The Perseverance rover is like a souped-up version of the Curiosity rover, which landed on Mars in 2012. It has tougher aluminum wheels, better cameras and a smarter "brain" that makes it better at mapping out paths. It is seven feet tall, 10 feet long and nine feet wide and weighs a whopping 2,260 pounds.

## NAMING

The rover's name was suggested by Alexander Mather, a 13-year-old from Springfield, Va., who won NASA's "Name the Rover" essay contest out of 28,000 entries. "It takes a lot of Perseverance," Alexander says, "to get something from Earth to fly all the way there and do the science to further human exploration of space."

## THE INSTRUMENTS

### RIMFAX

The brick-red dirt and dust that blankets Mars's barren surface is fascinating. But scientists are also interested in what lies underground. A tool called RIMFAX will use radar that can search for ice hidden more than 30 feet deep. "That's the kind of technology that humans, if they were to go to Mars, could use to search for water," Katie Stack Morgan says.

### MOXIE

If you'd like to go to Mars one day and return home, you'll need lots of oxygen (to make rocket fuel). "On Earth, trees make it for us," says Michael Hecht, the principal investigator. "On Mars, MOXIE makes it for us." MOXIE will convert carbon dioxide in the air into oxygen. Scientists hope to one day use a more powerful version for rockets and habitats.

## SUPERCAM

Perseverance has a superpower: it can shoot lasers from its face. By firing them at rocks and soil, the rover (and the NASA scientists back on Earth) can determine the target's chemical makeup and whether or not to drill into it. The team expects SuperCam can make about three million laser shots. "We're zapping up the planet," says Roger Wiens, the instrument's principal investigator.

## LASER EYE

## MASTCAM-Z

This rover will be the first one with a camera capable of zooming in and focusing on faraway targets. Known as Mastcam-Z, this tool is mounted on the rover's "head" and will take 3-D pictures and videos, as well as spot things the size of a housefly on rocks more than a football field away.

## SHERLOC AND PIXL

The hand also carries tools designed to detect potential clues about past microbes. One is called SHERLOC, which searches for minerals and organic molecules (made with carbon). Another is PIXL, which uses an X-ray beam to identify elements in rocks. "Those two instruments prepare us better than any other rover before to actually search for signs of life," Stack Morgan says.

## ROBOTIC ARM

### ARM

This 7-foot robotic arm has an elbow, shoulder and wrist, which allow it to move like yours. It holds drills and sensors and will drill and collect rock samples that it can store in tubes located in the rover's belly. Eventually those tubes may be given to a different robot and sent back to Earth so that NASA can study direct Martian samples for the first time.

## HELICOPTER SIDEKICK

Perseverance won't explore the Red Planet alone. Tucked beneath its belly is its sidekick, a mini-helicopter called Ingenuity. When released, it will make short flights through the thin Martian atmosphere over the course of 30 days. "Nobody's ever flown a craft outside of our planet that can take off and land again," says Timothy Canham, the project's operations lead. "The Ingenuity helicopter is a trailblazer."

## ANTENNAE

Ingenuity (named by Vaneza Rupani, a 17-year-old from Northport, Ala.) gets its commands to take off and land from Perseverance. The robots can communicate over a distance of about 1.2 miles.

## SOLAR PANEL

To power its flights, Ingenuity absorbs energy from the sun. After zipping around for a minute and a half — which is as long as its batteries will allow — it needs two to three days to recharge.

## AVIONICS AND BODY

The helicopter weighs only four pounds and stands about one and a half feet tall. It has two blades that spin in opposite directions to keep it stable. It can fly nearly 325 feet and hover about 16 feet off the ground.

## SENSORS AND CAMERAS

It has two cameras that help it see. One looks forward, and the other points down and snaps photos of the ground 30 times a second. Its sensors help direct it and tell it how fast it's going.

## MISSION!

Perseverance has four main goals.

1. To find signs that indicate that ancient microbes may have once existed on Mars.
2. To learn about the ancient environment and help determine how Mars's climate could have supported life.
3. To collect and document rock and soil samples for potential return to Earth.
4. To examine current environmental conditions, so NASA knows how to keep future astronauts safe on the planet, and to test experimental tech humans might one day use there.



## HUMANS ON MARS

"We're going to Mars someday, and NASA would like it to be soon," Michael Hecht says. "Probably 2040s is reasonable." When humans do eventually arrive, they'll find that some things have already been set up: Future Mars missions will colonize the planet by constructing a research base and then habitats and power stations. Instruments aboard Perseverance, like MOXIE, will help pave the way.

Right now MOXIE can only make 10 grams of oxygen per hour, about enough to keep a small dog alive. But it's possible that one day a much more powerful version of it could supply a base with breathable air. A team of four humans sitting in a room would need about 100 grams of oxygen an hour. "That's why we're doing this now," he says, "to prepare for maybe 20 years from now." ♦