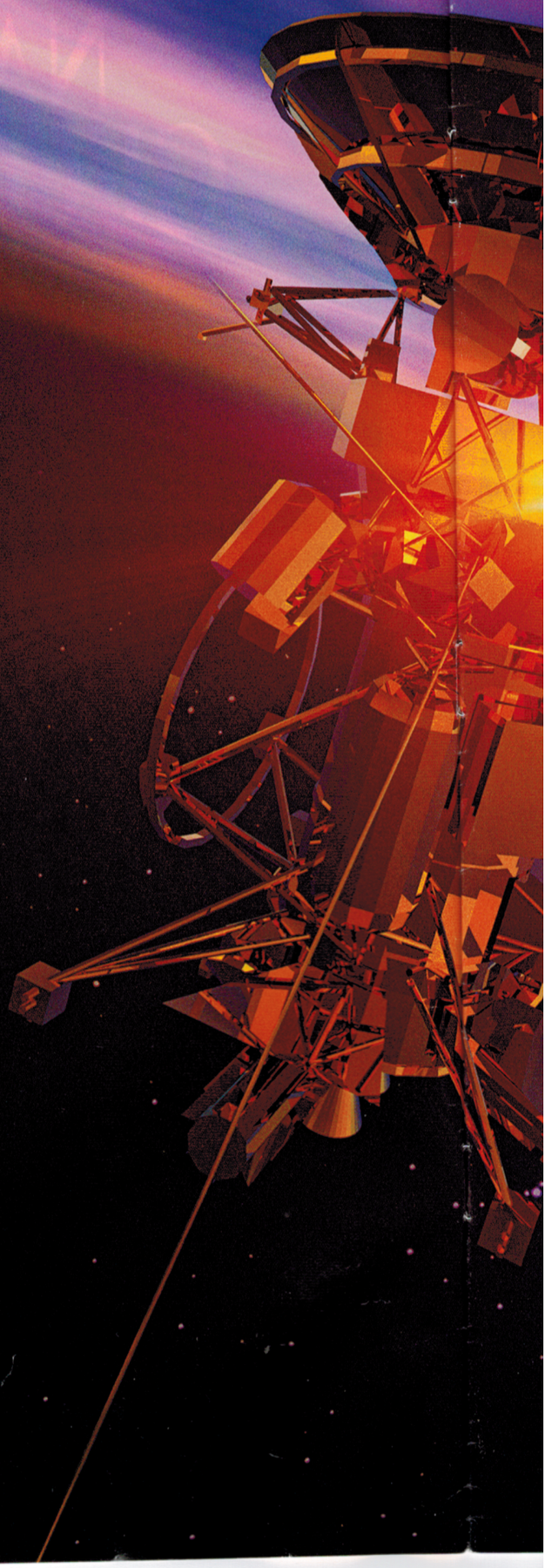
PATHFINDER EDITION NGPATHFINDER.ORG OCTOBER 2009

NATIONAL GEOGRAPHIC Explorer!

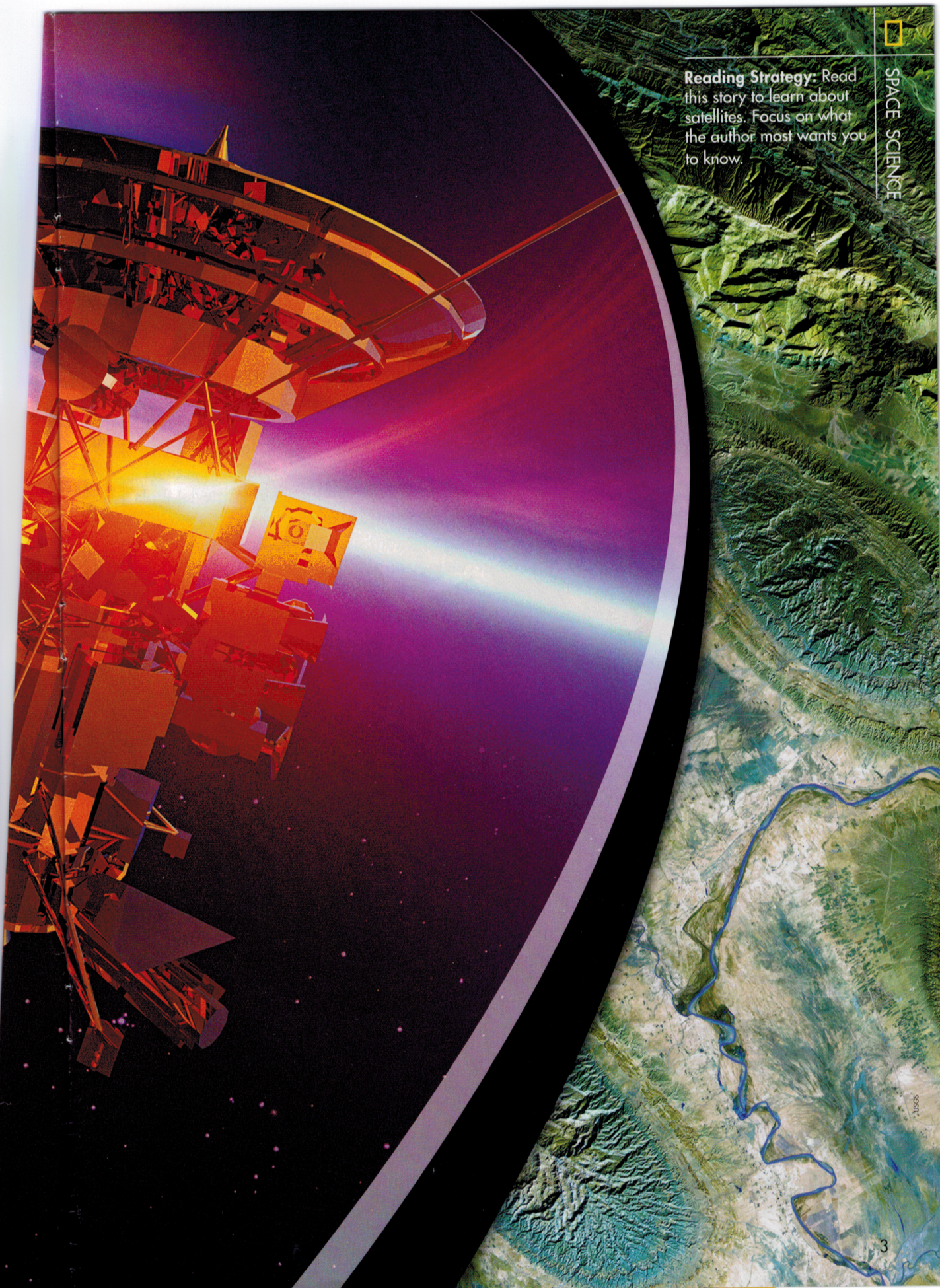
Frightful Animals 10

EYE IN THE SKY



How do objects hundreds or thousands of miles above Earth affect you down here? From TV programs to cell phones and weather forecasts, satellites play a big part in your life.

By Jonathan McDowell
Astrophysicist, Harvard-Smithsonian Center for Astrophysics



Reading Strategy: Read this story to learn about satellites. Focus on what the author most wants you to know.

SPACE SCIENCE

Thwap! A tranquilizer dart pierces the elephant's thick hide. The giant creature trumpets loudly before falling to her knees. Carefully, National Geographic explorer Michael Fay and his team put a collar on the elephant. They name her Annie.

Fay is in Zakouma National Park in the African nation of Chad. In the past few years, poachers have wiped out many of the park's elephants. Poachers kill the elephants for their valuable ivory tusks. The rainy season is an especially dangerous time for the elephants. That's when they usually leave the park's protected borders, in search of food and water.

When Annie wakes up, the collar will radio her location to a satellite. The satellite will then send the information to Fay's laptop. This will allow him to know where Annie goes. By tracking elephants like Annie, Fay can monitor where and when the herd leaves the park. The new information will help protect the elephants. Park guards will know exactly where to patrol against poachers.

Satellites are helping Michael Fay track elephants, but you don't have to be an explorer to make use of satellites. Every time you listen to a weather forecast or watch your favorite television program, you depend on satellites high above Earth.

MICHAEL NICHOLS

Satellite Basics

A satellite is any object that orbits, or circles, another object in space. The moon is a natural satellite. It orbits Earth once every month. Artificial satellites are a human invention. They help people study the world, send information, and more. An artificial satellite may orbit Earth, another planet, or even an asteroid.

To reach its orbit, a satellite is strapped to a rocket and launched into space. The satellite then separates from the rocket. It continues on its own to carry out a special job, or mission.

A satellite has everything it needs for its journey. Solar panels collect the sun's energy for power. A battery stores the energy for when sunlight cannot reach the satellite. From Earth, people use radio signals to send instructions to the computers on the satellite. Special tools carry out the satellite's mission. For example, a communications satellite has large antennae for receiving and sending signals.

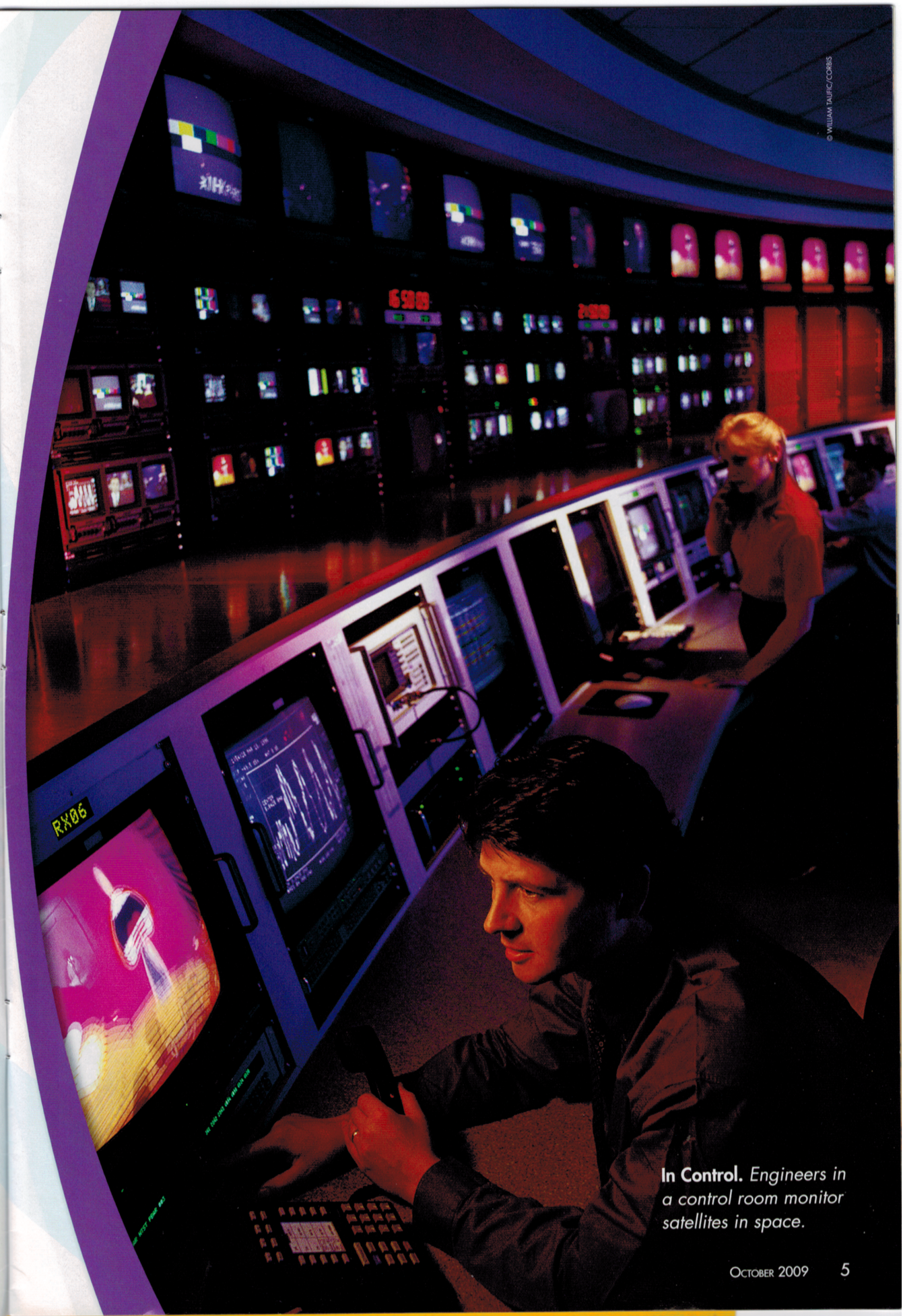
Space Issues

Even with all this equipment, some satellites still fail. Sometimes their computers don't work or their batteries run out. Occasionally, the sun burps out a huge wave of energy. That can fry a satellite's equipment!

Some satellites face a different problem. They have low orbits, just above Earth's **atmosphere.** As a satellite orbits, air may slow it down. That makes the satellite drop closer to Earth. Eventually, the satellite can fall so low that it reenters the atmosphere. It burns up from the heat made by air rubbing against the satellite.

Today, we depend on satellites for many things. But satellite technology has not always been around. The first artificial satellite was called Sputnik 1. The Soviet Union launched it into space on October 4, 1957. Overnight, a new era of space exploration started. Today, there are over 1,000 working satellites in space.

Jumbo Job. *Satellites will track where this elephant travels and send the information to scientists on the ground.*



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In Control. *Engineers in a control room monitor satellites in space.*

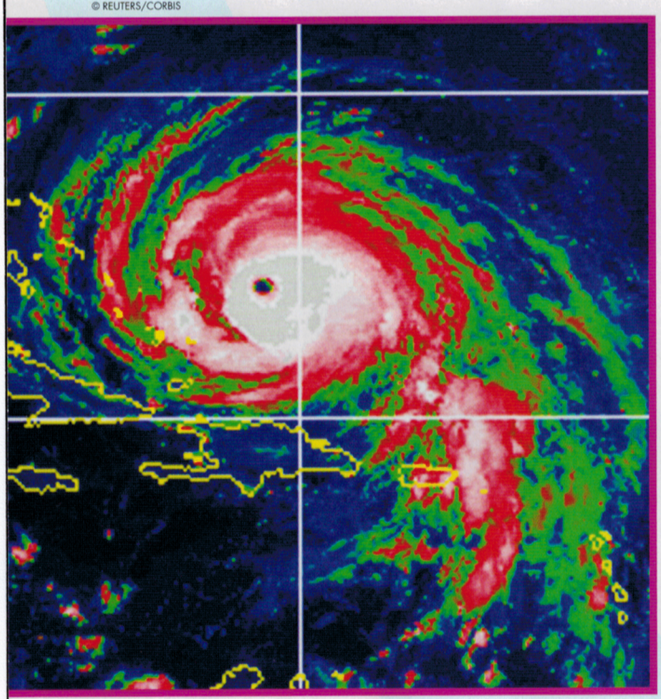
Sky Talk

Of the 1,000 or so working satellites, about 600 help people communicate. They serve as **relay stations** for cell phones and television. Here's how it works. Say you are calling a friend in Puerto Rico. How does your voice travel there? First, radio waves travel from your cell phone to a cell tower near you. The tower then sends the waves to a satellite. The satellite sends the signal back down to a cell tower in Puerto Rico.

Television works in the same way. The satellite relays television programs from a central broadcast station to a local television station. The local station feeds the programs through a cable or by airwaves to your home. If you have satellite television, the satellite sends the programs directly into your home.

Communications satellites need to be in just the right place to get and send signals. Yet they're always moving. The secret lies in the way they orbit Earth.

The satellites travel around the Equator at the same rate as the planet spins on its axis. So the satellite is always above the same point on Earth! It's as though a communications satellite were sitting on top of an invisible radio tower 35,786 kilometers (22,236 miles) high!



Earth Observers

Satellites don't just connect people around the world. Some take pictures of the world, too. Have you ever wondered how forecasters can predict the weather? They use satellites. For example, **satellite images** show where clouds are forming. So weather satellites can help people predict major storms like hurricanes. That can be a matter of life and death.

Most weather satellites travel in polar orbits. Polar orbits follow lines of **longitude** between the North and South Poles. As the satellite loops around Earth, the planet is constantly spinning on its own axis below. This allows the satellite to "see" almost the entire Earth.

Satellites also help scientists monitor changes in Earth's environment and climate. Deforestation is a major problem affecting the health of our planet. That's when people cut down large areas of trees. Satellite pictures help scientists see where forests are being lost.

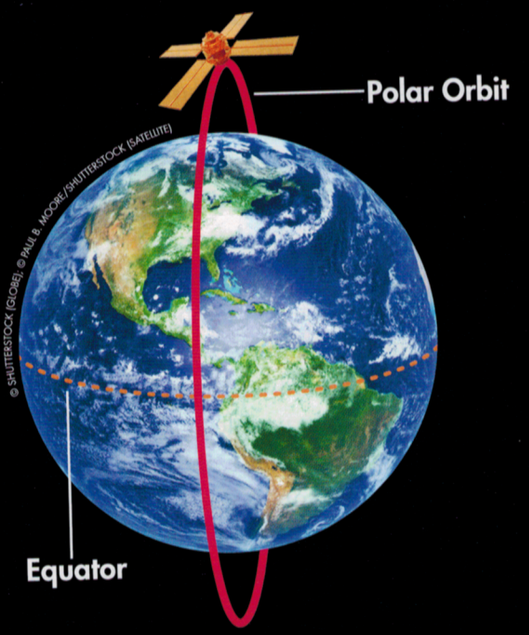
Other satellites help scientists study global warming. That is a worldwide rise in Earth's temperature. As the planet heats up, ice sheets at the Poles are melting. So are glaciers. Satellites measure how much ice has melted over time. That helps scientists understand how bad the problem is.

Movers and Shakers

Scientists are even trying to use satellites to predict earthquakes. When pieces of Earth's surface move, they make radio waves. The radio waves travel into space. If satellites could pick up the waves soon enough, we might be able to tell when and where an earthquake will happen. Think how many lives could be saved that way!

Eyes in the sky are watching more than nature in action. In movies, the life of a spy is action-packed and full of adventure. But in real life, many spies are just quietly orbiting satellites. They tell us about the movement of other countries' weapons. They even monitor radio waves from foreign armies!

Strong Storm. *A satellite took this image of Hurricane Floyd in 1999. The storm's winds reached 250 kilometers (155 miles) an hour.*



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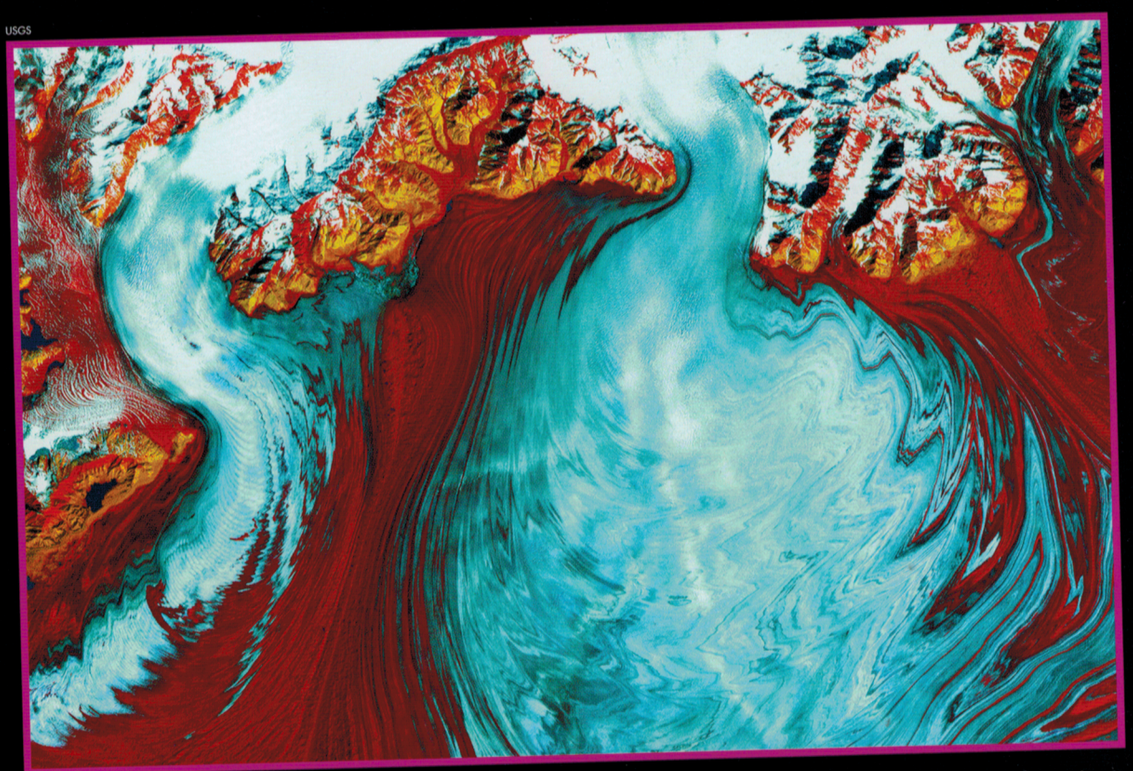
Live Lava. *This image of an active volcano was taken from high above Earth. Scientists used it to track changes in the craters and the path of mudflows.*

USGS



River of Ice. *This is what the largest glacier in Alaska looked like in 2000. By comparing it to images from 1980, scientists discovered that it had lost 20 meters (60 feet) of thickness.*

Space Patrol

While some satellites help us learn about our planet, others look outward toward space. They help us study places that are hard to reach. To visit Neptune, for instance, an astronaut would have to blast through space for about ten years. That's how long it takes to reach the edge of our solar system!

Thanks to satellites, people can explore even farther than Neptune. You may have heard of the Hubble Space Telescope. It is one of the most famous satellites ever launched. This telescope has been orbiting Earth since 1990.

Hubble and other space telescopes have helped scientists better understand the universe, including its age (13.7 billion years!) and what it is made of. As you can see below, Hubble also has given us spectacular images of outer space.

Getting Around

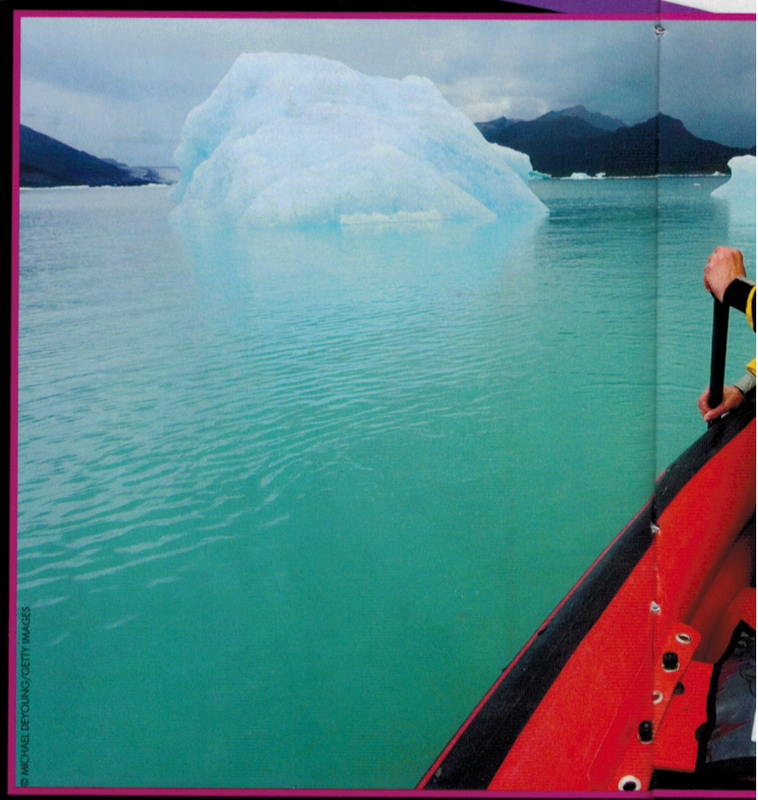
Back here on Earth, more and more people are using satellites to find their way around. You may have ridden in a car with a machine that tells the driver where to go. The machine relies on a group of about 20 satellites. They are called the Global Positioning System, or GPS.

GPS satellites send radio signals with their **latitude** and height above Earth. A GPS device in a car or person's hand receives the signals. It uses them to determine how far and fast you've gone. The device then uses that information to figure out where it—and you—are.

Satellites help people at sea as well. When a ship gets into trouble, the crew sets off an emergency beacon. It sends a signal to a satellite. The satellite then sends the beacon's location to a rescue team. Since 1982, satellites have helped save about 24,000 people.

NASA/ESA/HOWARD BOND, STSCI

Space Scenes. *Hubble took this picture of a group of stars quadrillions of miles from Earth!*



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Directional Device. *This woman uses GPS to explore Glacier Bay National Park in Alaska.*

From Today to Tomorrow

From dramatic rescues at sea to daily life on the road, satellites play an important role. They help Mike Fay protect elephants. They let scientists study our planet. They help you talk to friends in faraway places and watch television.

Who knows? Things that seem unthinkable today might just be possible tomorrow, thanks to satellites!

Wordwise

atmosphere: gasses surrounding a planet

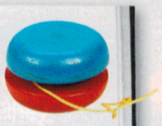
latitude: distance north or south of the Equator

longitude: distance east or west of Greenwich, England

relay station: machine that sends a signal from one place to another

satellite image: picture taken by a satellite

High-Tech Hobby

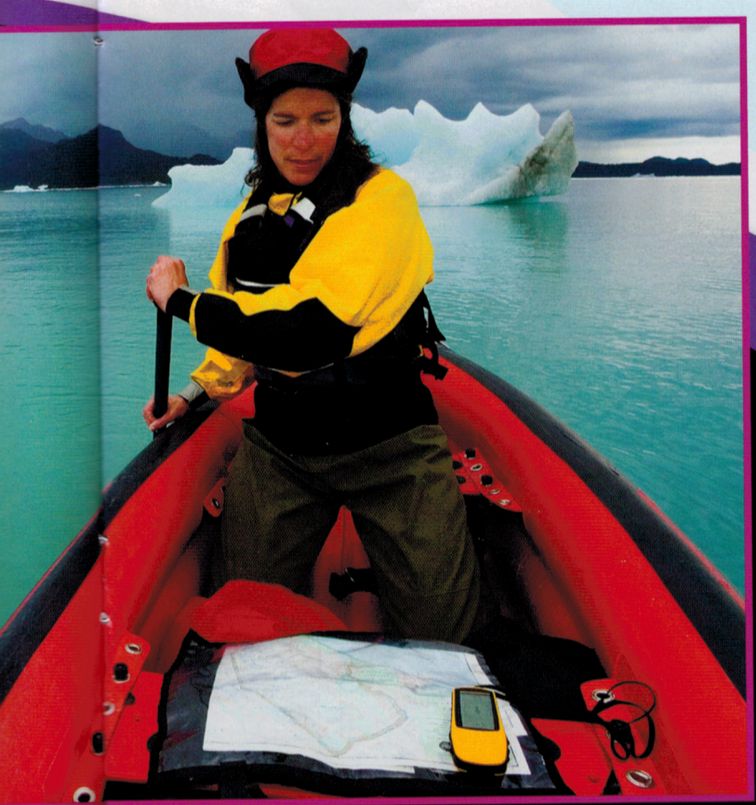


Geocaching is a modern treasure hunt that uses satellite technology. It begins when someone hides a cache, or group of objects. These may include small toys or souvenirs.

He or she then goes to a special website and posts the cache's coordinates. Those are numbers that tell you exactly where something is on Earth. They are based on latitude and longitude.

To find the treasure, you use a handheld GPS device. You enter the coordinates. Then the device gives you directions. To find the cache, you might have to climb rocks or hike through forests.

Once you find it, you record your name in a logbook to prove you found the cache. Geocaching shows that satellite technology isn't just useful. It can be a lot of fun, too.



Risky Rescue. *Rescue teams use satellites when they train to find people at sea.*