

Voyager

For kids of all ages



Satellites

BY MEMORIE YASUDA

OUR EYES IN THE SKY

What's better than a million-dollar view from the top of a skyscraper? Try a multimillion-dollar view from a satellite flying around Earth.

A satellite is an object that orbits or travels around a larger one. There are both nat-

ural and artificial satellites. The Moon is a natural satellite that orbits Earth. Artificial satellites also orbit Earth, carrying instruments for all sorts of communication, weather forecasting, scientific research, and even spying. Earth and ocean

scientists at Scripps Institution of Oceanography use satellites every day to observe our planet and conduct research.

Because satellites are so far away, they allow scientists to see huge sections of the planet. Instruments aboard satellites are

used to take many types of pictures of Earth. Pictures from satellites enable scientists to judge the health of coral reefs and forests and the size and strength of hurricanes. For example, over time old satellite images are compared with new ones to see how the planet is changing.

The path that a satellite takes determines the type of photos that can be taken. There are two basic ways that satellites orbit our planet. Geostationary satellites orbit around Earth's equator. Polar-orbiting satellites pass over the North and South Poles.

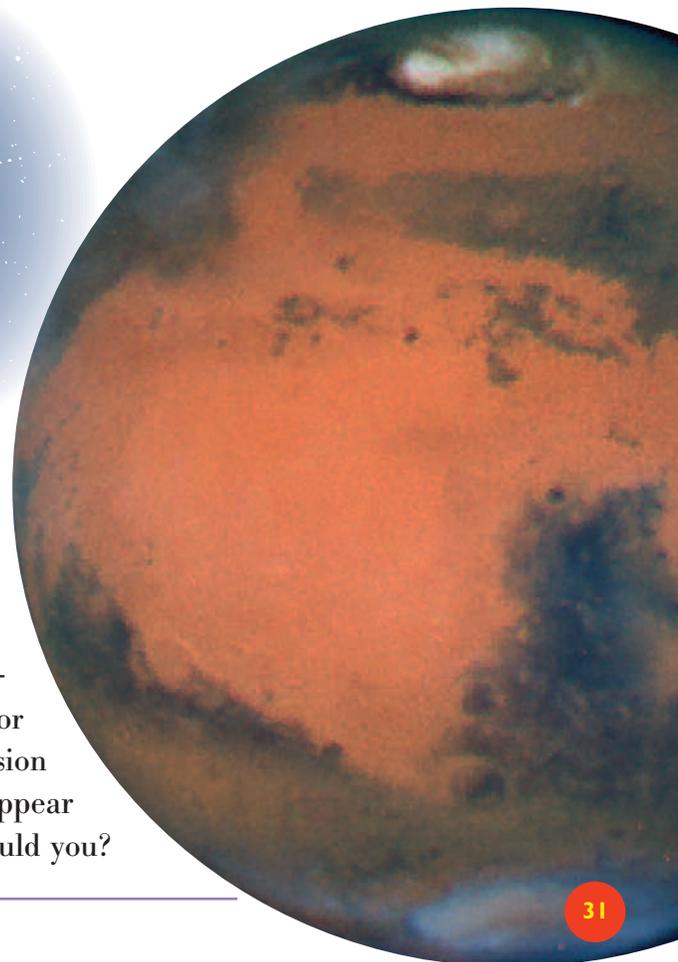
Geostationary satellites stay parked at one spot over the equator and move in the same direc-



Opposite page, A satellite image of Earth. **Top,** this page, The International Space Station flying over Florida and the Bahamas. **Middle,** The two different paths a satellite can take around Earth. **Bottom,** Mars, as seen from a satellite.



tion as Earth's rotation. They make one orbit per day as Earth rotates once on its axis. These satellites orbit at a high altitude—as much as 22,000 miles above Earth. This is more than 300 times higher than airplanes fly! Being so far from the surface of Earth allows the satellites to have a wide “footprint” or field of view. Geostationary satellites are ideal for monitoring storms over the oceans and for transmitting television signals. You wouldn't want your television signal to disappear because a satellite has orbited to the other side of Earth, would you?





An inside view of Sputnik 1, the world's first artificial satellite.
When closed, Sputnik is just a little bigger than a basketball.

Polar-orbiting satellites travel closer to Earth and cross over the North and South Poles. They travel at altitudes up to 200 miles, which is 32 times higher than airplanes can fly. Polar-orbiting satellites travel much faster than geostationary satellites. It takes about 90 minutes for them to orbit Earth, and they go around the planet about 16 times a day. These satellites collect pictures that can be patched together to show just about every square inch of Earth. Scientists use these pictures to help them investigate oceans, volcanoes, weather, and vegetation patterns.

Flying High into the Sky

Satellites can't fly into space themselves. They are carried into space by launch vehicles. Rockets are used to transport satellites from the ground, or jet airplanes can launch satellites from mid-air at high altitudes. Launches are designed to place satellites at precise locations at exact speeds in order to get them into orbit. When everything is just right, satellites neither fall to Earth nor fly off into outer space.

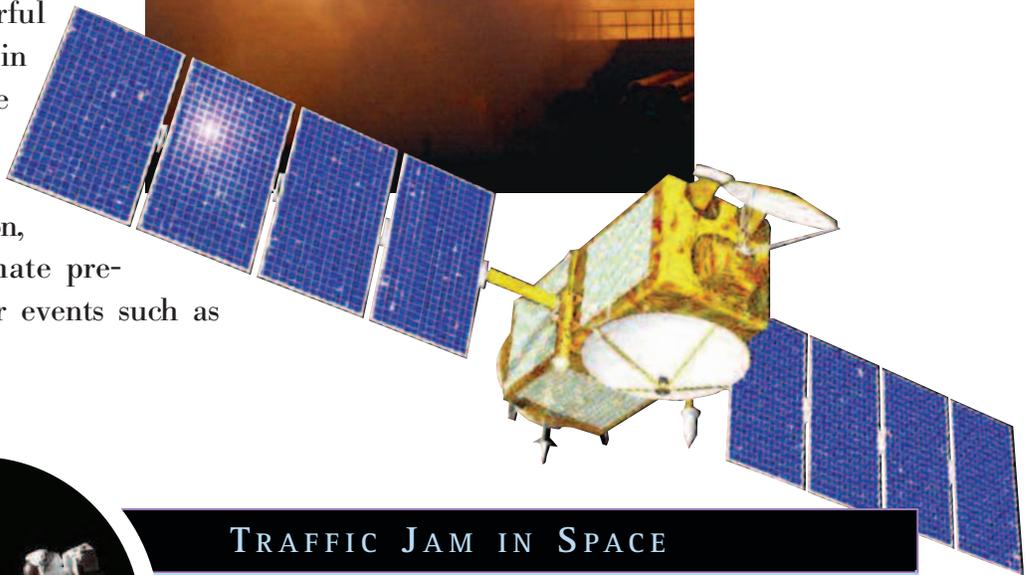
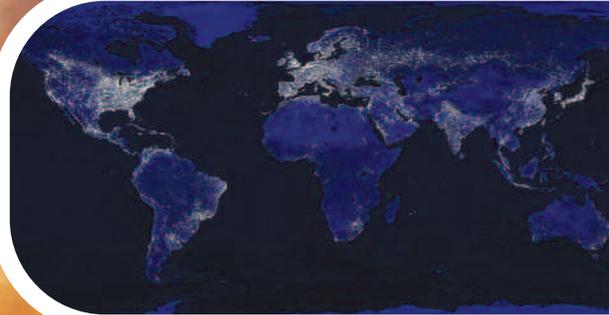
Both a jet airplane and a rocket were used to launch the SeaStar satellite, which was sent into space to observe the ocean surface. The launch vehicle,

a Pegasus rocket, and the satellite were first carried into space by a jet airplane. SeaStar and the rocket were then released at an altitude of seven miles. After the release, the rocket ignited and launched the satellite into orbit at an altitude of 200 miles. The SeaStar satellite now allows scientists to monitor life in the ocean.

The Jason-1 satellite was launched aboard a Delta II rocket from Vandenberg Air Force Base in southern California. A colorful trail could be seen in the sky after the launch. Scientists use Jason-1 to monitor global ocean circulation, improve global climate predictions, and monitor events such as El Niño predicitions.



Below left, The Jason-1 satellite monitors the world's oceans, including measurement of sea-surface height. Scripps scientist David Sandwell uses this information to make maps of the seafloor. Left, Jason-1 was launched on December 7, 2001. Below, This satellite image shows the world lit up at night.



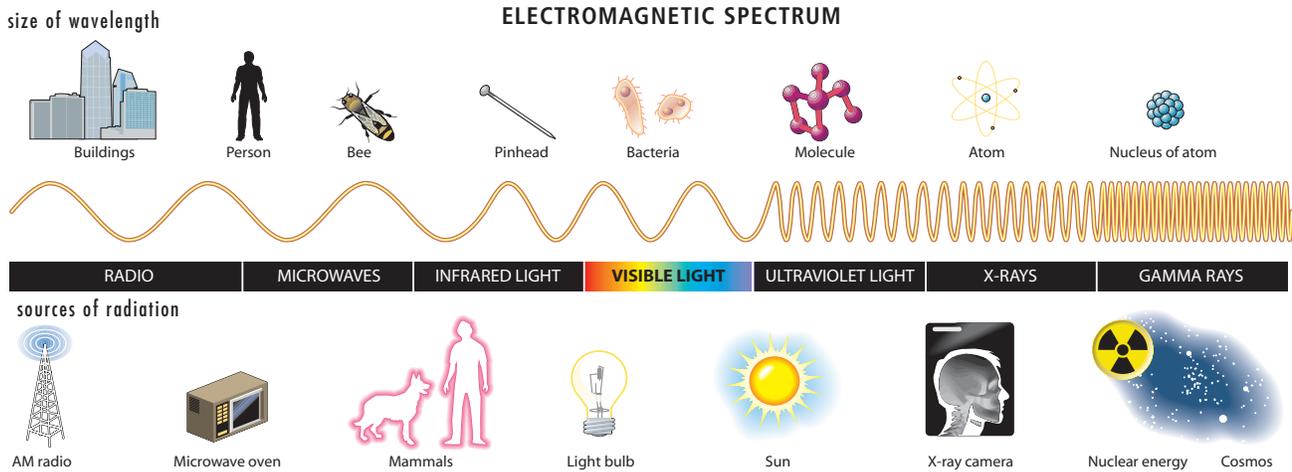
TRAFFIC JAM IN SPACE

On October 4, 1957, the former Soviet Union launched the first Earth-orbiting satellite into space. The satellite was called Sputnik 1. Its launch started the “space race” with the United States. In 1969, U.S. astronaut Neil Armstrong was the first man to walk on the Moon as a result of the challenge.

Today, businesses as well as governments own and operate satellites. About 2,400 active satellites are orbiting Earth. But not all satellites stay in space—a few thousand have fallen out of orbit and returned to Earth, either burning up during reentry, leaving nothing behind, or crashing onto land or into the ocean. There are no reports of anyone ever being hurt by such crashes.

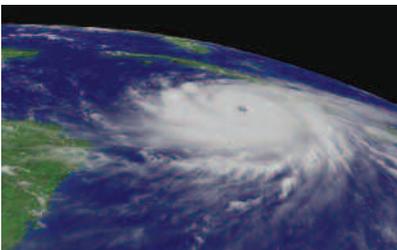
As a result of many missions into space, lots of pieces of debris or “space junk” orbit Earth. Each piece is a danger to satellites and other spacecraft. Because satellites move so quickly, as fast as 17,000 miles an hour, collisions are dangerous. A tiny speck of paint from a satellite once dug a pit in a space shuttle window nearly a quarter-inch wide. Imagine a baseball traveling at that speed instead of 90 miles per hour like a fastball. Ouch!

HOW SATELLITES “SEE”



Above, The electromagnetic spectrum spans a range of wavelengths. **Below left,** Satellite image of hurricane Ivan as it passed over Cuba in 2004. **Below right,** Sensors aboard remote-sensing satellites record the type and amount of electromagnetic radiation that is reflected from mountains, oceans, cities, lakes, farmland, and forests on Earth. Many Scripps scientists rely on data from these satellites to measure sea-surface levels, snow pack in mountains, and biological conditions of the oceans.

Satellites that take visible light measurements see things just like cameras and the human eye. The images that form in our minds take shape only



after our nerves and brain have worked together to collect and process what the eye has detected. A satellite does the same thing, except that it sends information back to Earth for storage and processing into pictures rather than doing these tasks onboard.

The instruments carried on satellites that measure electromagnetic radiation are called “radiometers.”

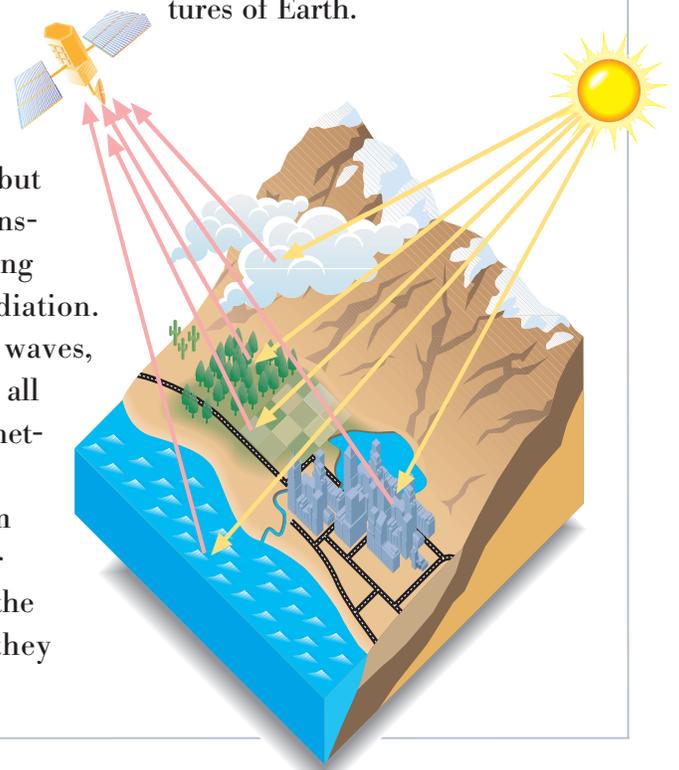
They can measure individual wavelengths or a range of wavelengths. The full range of electromagnetic wavelengths is called the “electromagnetic spectrum.” Radiometers use the full range of the electromagnetic spectrum to help us observe Earth and the many changes that occur on our planet.

Communication from satellites is almost like magic, but it’s really about transmitting and receiving electromagnetic radiation. Visible light, radio waves, and microwaves are all types of electromagnetic radiation.

They differ from each other by their wavelength and by the amount of energy they

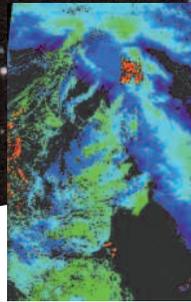
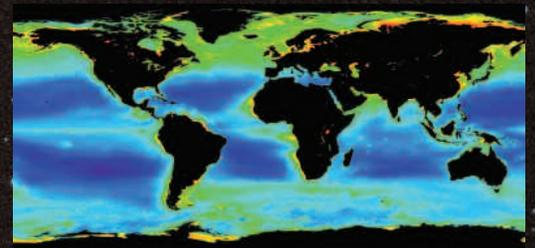
contain. The shorter the wavelength, the greater the energy.

Earth radiates energy across the electromagnetic spectrum beyond visible light. Because instruments aboard satellites can detect radiation in all parts of the spectrum, it allows us to “see” many features of Earth.



The GOES I-M satellite measures atmospheric temperature, winds, moisture, and clouds. From these measurements, scientists can make climate predictions.

Below, Satellite images show smoke from southern California fires in 2003 (left) and distribution of global marine life (right).



IT'S A BIRD, IT'S A PLANE...IT'S A SATELLITE



Can you see a satellite in the sky? Yes, you can. Under the best conditions, satellites look like faint stars moving across the night sky. They move quickly, but not as fast as a shooting star. They go from one end of the sky to another in less than 10 minutes and generally vanish in mid-flight. The Hubble Space Telescope and the International Space Station are two of the easiest satellites to spot. If you want to have some fun and you have access to a computer, check the NASA J-Pass website: science.nasa.gov/realtime/jpass. It will tell you when these satellites will be crossing the sky above your neighborhood.

Satellites are amazing devices that are an essential part of our lives. We depend on them for many things, including weather reports, telephone calls, and television transmission. As you've learned, scientists also depend on satellites to obtain images of Earth that can be used in different areas of research. Scripps scientists are thinking of new ways to observe Earth that will help their research even more.

To see the different events taking place on our planet from outer space, visit visibleearth.nasa.gov. You too can observe Earth just like a scientist. 🌐