Voyagers in Space

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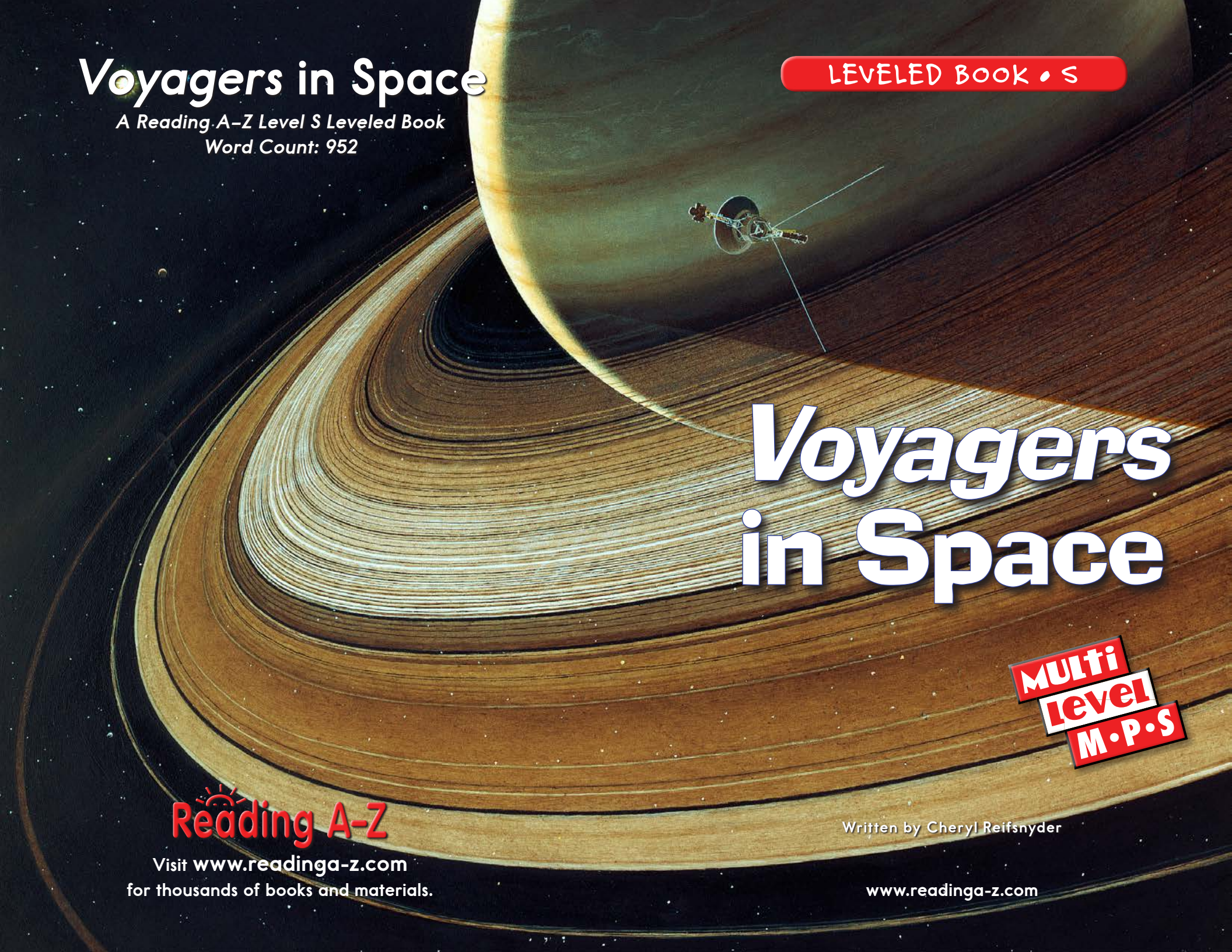

Voyagers in Space

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Written by Cheryl Reifsnyder

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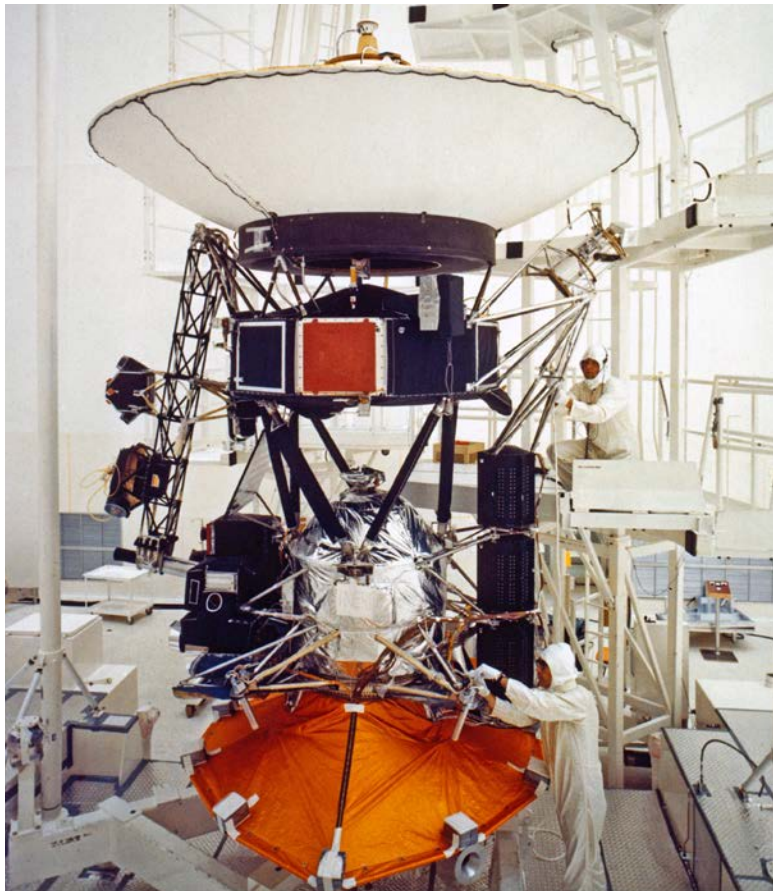

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Front and back covers: Illustration of *Voyager 2* passing close by Saturn's rings in August of 1981.

Title page: A NASA technician checks a test model of a *Voyager* spacecraft in 1977 at the Kennedy Space Center in Cape Canaveral, Florida.

Page 3: Saturn and one of its moons as photographed by *Voyager 1* on November 3, 1980. The shadow of the moon appears on the planet's cloud tops.

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Correlation

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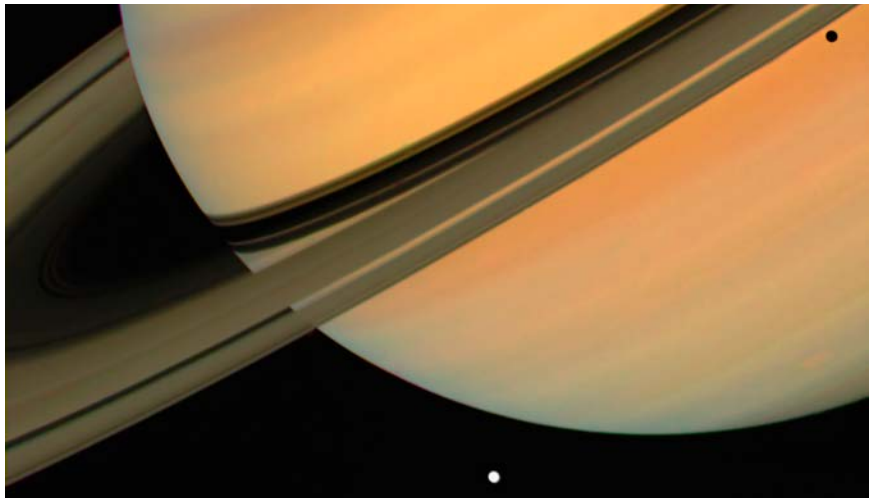

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Voyager 2 launches from Kennedy Space Center in Florida on August 20, 1977. A Titan/Centaur rocket carries it into space.

One Tough Job

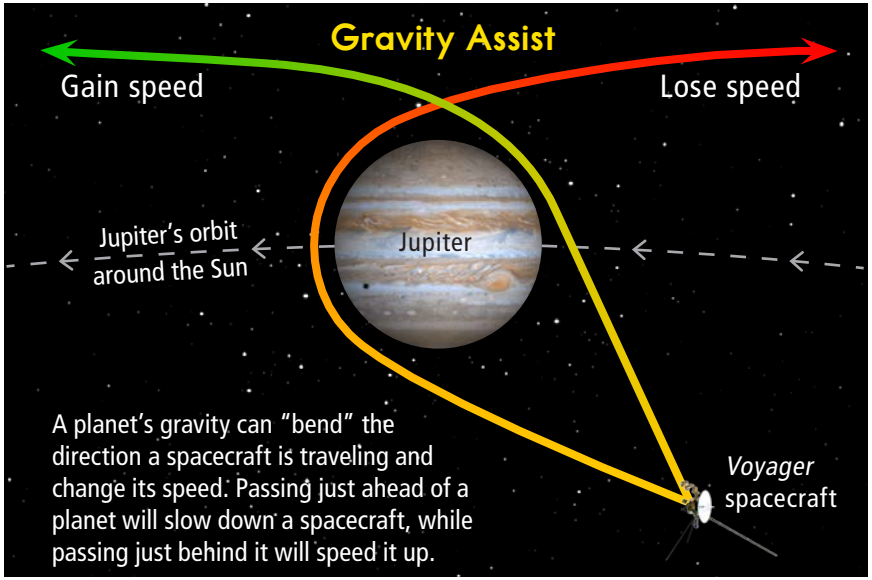
When the two *Voyager* spacecraft launched in 1977, they had a tough job ahead. Their **mission** was to **explore** Jupiter and Saturn, two of the **solar system**'s giant outer planets. During their journey, they would face freezing temperatures and powerful radiation. If something broke, the space **probes** would just have to make do with what they had.

Scientists designed the *Voyagers* to be tough. Radiation shields and computer-controlled heaters protected their **instruments**. The spacecraft also carried backups of important equipment, such as the thrusters used for steering. Their computers were programmed to deal with problems that might happen. Computers in 1977 were very different from today's machines, though. Modern smartphones have about 7,500 times more computing power and 240,000 times more memory than those operating the *Voyager* spacecraft!

Scientists guessed that the *Voyagers* would only last about five years in space. More than thirty-five years later, the twin spacecraft are still sending information back to Earth.

Can You Hear Me Now?

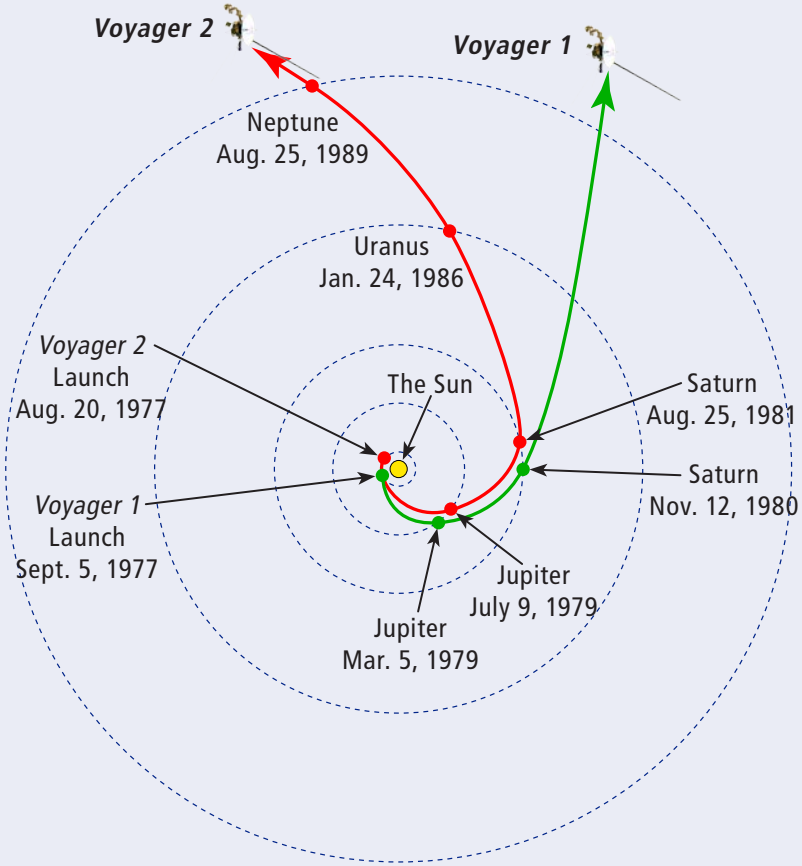
As of 2014, *Voyager 1* is about twelve billion miles away. It communicates with Earth using a 22.4-watt transmitter that's as strong as a refrigerator lightbulb. Signals take about seventeen hours to arrive. By that time, they've faded to about 0.2 billion-billionths (.000000000000000002) of a watt. NASA's Deep Space Network uses 70-meter (230 ft.) dish antennas around the globe to catch the faint signal.



Planning

The *Voyager* launches were carefully timed. In the late 1970s, the four outer planets' **orbits** placed them in nearly a straight line. With the planets so close together, it became possible to visit several of them during the same trip.

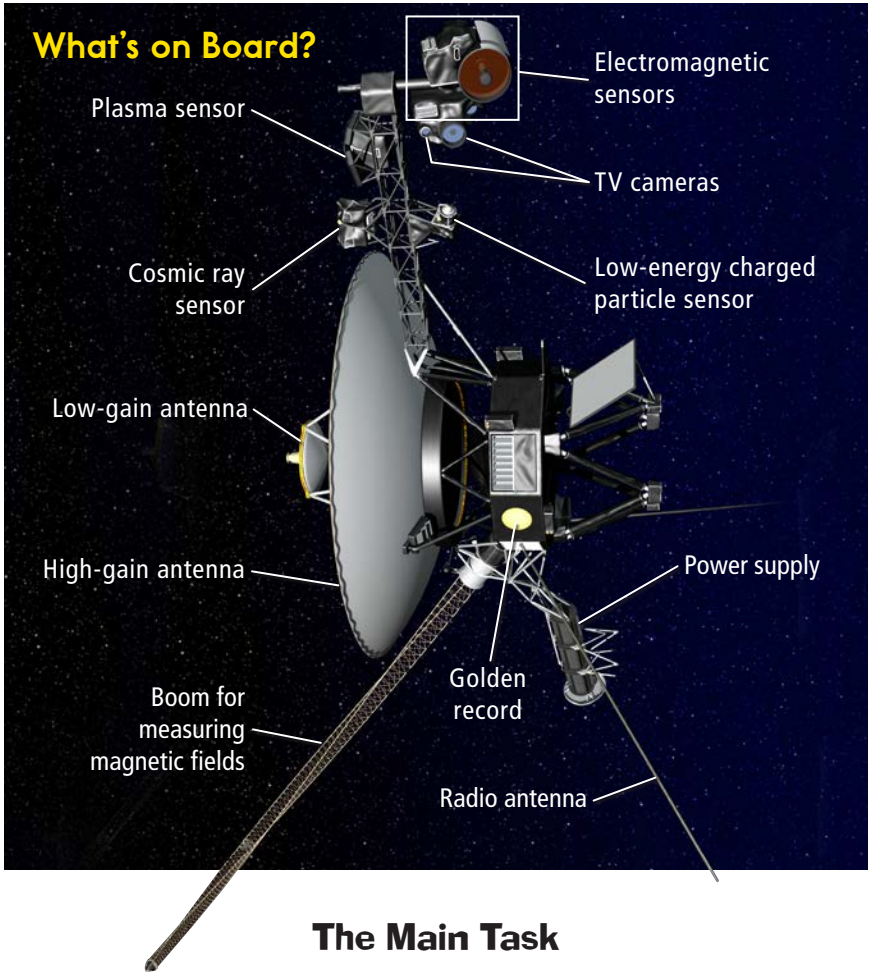
However, the spacecraft still had to travel billions of miles. Unfortunately, the rockets that launched the *Voyagers* into space could only get them to Jupiter—about halfway to Saturn. Scientists solved that problem by using Jupiter's strong **gravity** to give the spacecraft a boost as it passed by. This technique is called a *gravity assist*.



A Rare Opportunity

The arrangement of planets when the *Voyagers* launched was an extremely rare event. To understand why, imagine a clock with hands showing the hours, minutes, and seconds. Each hand circles the clock face at a different rate: once a minute, once an hour, or once every twelve hours. Any time one hand passes another, the two line up. However, all three align much less frequently.

The planets' orbits take much longer than the clock hands' revolutions, so they line up even less frequently. The four planets' arrangement during the *Voyager* missions occurs only once every 175 years!

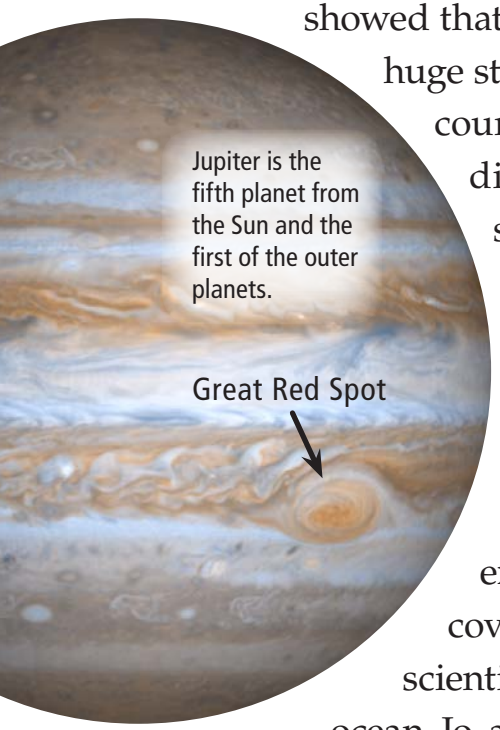


The Main Task

At first, the *Voyagers'* mission was to study Jupiter and Saturn, their larger moons, and Saturn's rings. The spacecraft carried cameras and scientific instruments, including sensors for radiation, magnetic fields, and **plasma**. Using these instruments, the *Voyagers* collected information that changed how we understand our solar system.

Jupiter

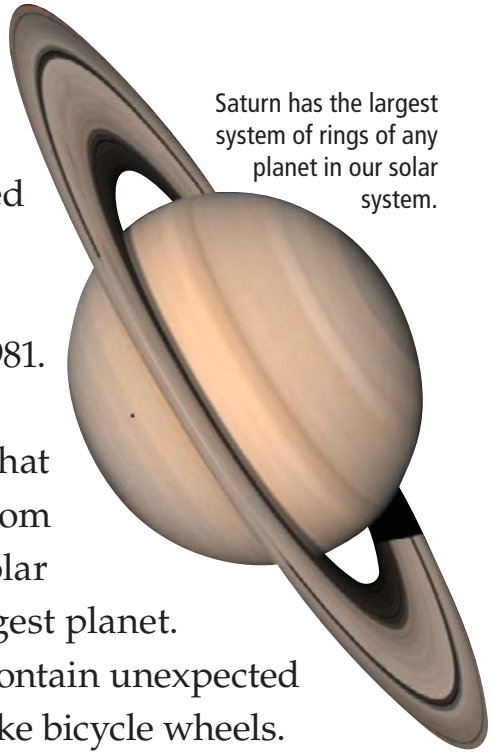
The *Voyagers'* first target was Jupiter, the solar system's largest planet. Scientists had already studied Jupiter through telescopes, but the *Voyagers* sent back new information. They showed that the Great Red Spot was a huge storm that constantly rotated counterclockwise. They discovered a faint ring surrounding Jupiter, similar to those that orbit Saturn.



Jupiter is the fifth planet from the Sun and the first of the outer planets.

They also found that Jupiter's moons are different from each other and from other planets' moons. For example, the moon Europa is covered by a sheet of ice that scientists think might hide an ocean. Io, another of Jupiter's moons, is covered with volcanoes that shoot gas and dust 306 kilometers (190 mi.) above its surface. Before the *Voyager* missions, the only known active volcanoes in our solar system were on Earth. Scientists now know that Io is ten times more volcanically active than all of Earth!

Saturn

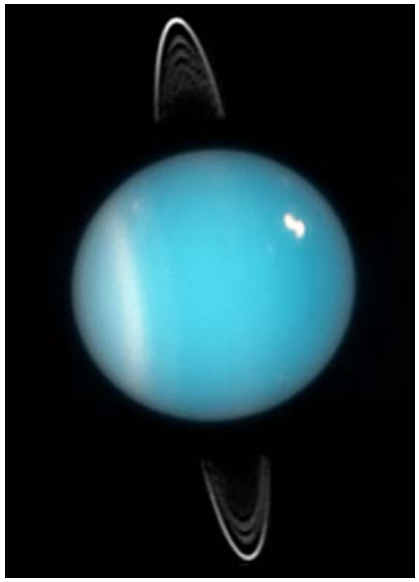

Saturn has the largest system of rings of any planet in our solar system.

The *Voyagers'* discoveries continued when they reached Saturn nine months apart, in 1980 and 1981. Close-up pictures showed new rings that could not be seen from Earth around the solar system's second-largest planet. Saturn's rings also contain unexpected kinks and spokes, like bicycle wheels. Using time-lapse photos, scientists saw spokes forming and then dissolving again.

Saturn's moons were surprising as well. Several small moons act like "shepherds" for the ice and dust orbiting Saturn, keeping them in separate rings. Saturn's largest moon, Titan, was surrounded by a thick haze—an atmosphere! This was such a shocking discovery that *Voyager 1*'s flight path was changed to give it a closer look. Could Titan support life? Some scientists think it could.

Uranus

After its Saturn flyby, *Voyager 1* headed out of the area where most planets orbit the Sun. It was flying toward **interstellar** space, the area beyond the Sun's magnetic field. However, *Voyager 2*'s position would let it continue toward Uranus. All its instruments were still working, so NASA decided to extend the mission.



The rings around Uranus clearly show how the planet is tipped on its side.

No one knew what to expect from Uranus. This strange-looking planet is tipped on its side, possibly due to a run-in with another planet-sized object. *Voyager 2* passed the planet in January 1986. Its measurements showed that Uranus's sideways position twists its magnetic field into a corkscrew "tail" following the planet. Until then, scientists didn't even know Uranus had a magnetic field!

Methane gas in Neptune's atmosphere gives the planet its deep blue color.

Neptune

When the Uranus flyby went well, NASA sent *Voyager 2* to Neptune as well. It reached the planet in August of 1989. There, it discovered five new moons. The largest moon, Triton, had geyser-like eruptions of dust and gas.

Then, like *Voyager 1, Voyager 2* began its journey toward interstellar space.

The Golden Record

Gathering information is only part of the *Voyagers'* mission. They are also carrying information out of the solar system—a message to non-Earth life forms, or aliens.

The message is on a twelve-inch "Golden Record" on the side of each spacecraft. The record includes music, art, and spoken greetings from around the world. It also includes sounds from nature.

The outside of the record has a map showing Earth's location in the universe. Aliens could use it to find Earth, but that probably won't happen anytime soon. *Voyager 1* won't come close to another star for at least forty thousand years. Neither spacecraft will come close to another planet for millions of years.

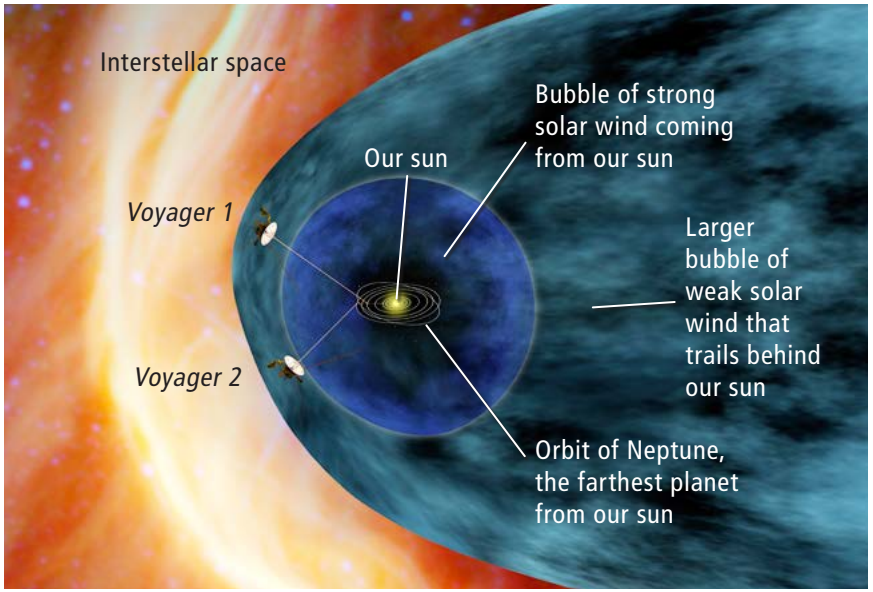
Famous American astronomer Dr. Carl Sagan led the committee that chose what to include on each Golden Record.

The First Messages to Aliens

The Golden Record isn't the first message humans have sent into space. *Pioneer 10* and *11* are the only other human-made objects currently headed out of the solar system. Each carries a metal plaque showing drawings of a man, a woman, and Earth's position in the universe.

The Final Task

Now that the *Voyagers* have finished exploring planets, they have a new job: the Interstellar Mission. They are the first probes to explore space beyond our solar system. In August 2012, *Voyager 1* left our solar system and began this new journey.



Time Line: Important Dates for the *Voyager* Missions

1977 *Voyager 1* and *Voyager 2* launch 16 days apart

1979 Jupiter flybys, with discovery of volcanoes and ice on Jupiter's moons

1980 Saturn flybys, with discovery of atmosphere on Titan; *Voyager 1* begins trip out of solar system

1986 *Voyager 2* reaches Uranus

1989 *Voyager 2* reaches Neptune and begins trip out of solar system

1990 *Voyager* Interstellar Mission begins

1998 *Voyager 1* passes *Pioneer 10*, becoming the most distant human-made object in space

2012 *Voyager 1* enters interstellar space

Conclusion

"The *Voyager* mission has opened up our solar system in a way not possible before the Space Age," says *Voyager* project scientist Dr. Edward Stone. The two spacecraft ended up exploring all of the solar system's giant outer planets and forty-eight of their moons. Now the *Voyagers* are giving us a glimpse of interstellar space. Like two small bottles in the universe's immense ocean, they carry a message from Earth to whatever lies beyond.

Glossary

explore *(v.)* to observe and learn about an area by traveling over or through it (p. 4)

gravity *(n.)* the natural force that tends to pull objects toward each other, such as objects being pulled toward the center of Earth (p. 6)

instruments *(n.)* tools, especially those used for making or recording measurements (p. 5)

interstellar *(adj.)* of or occurring in the deep space between stars (p. 11)

mission *(n.)* a flight of a spacecraft or aircraft with the purpose of completing a special assignment (p. 4)

orbits *(n.)* the paths taken by objects in space circling around other larger objects (p. 6)

plasma *(n.)* charged particles of gas that can conduct electricity (p. 8)

probes *(n.)* devices used to send back information from places that are difficult or dangerous to reach (p. 4)

solar system *(n.)* a group of objects in space that orbit a star (p. 4)