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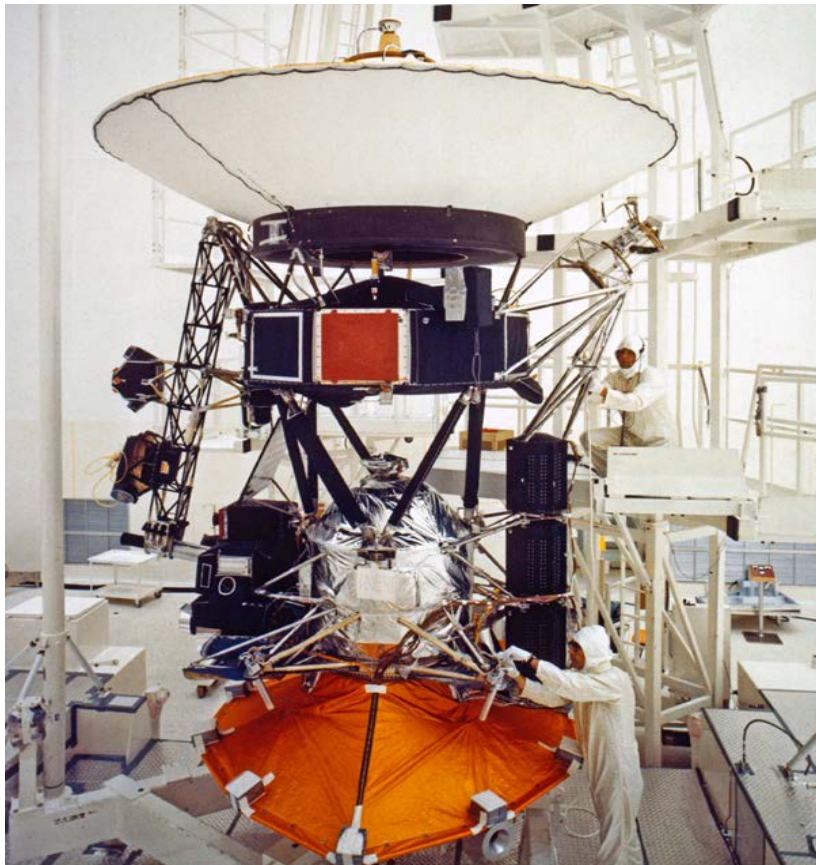
Voyagers in Space

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Written by Cheryl Reifsnyder

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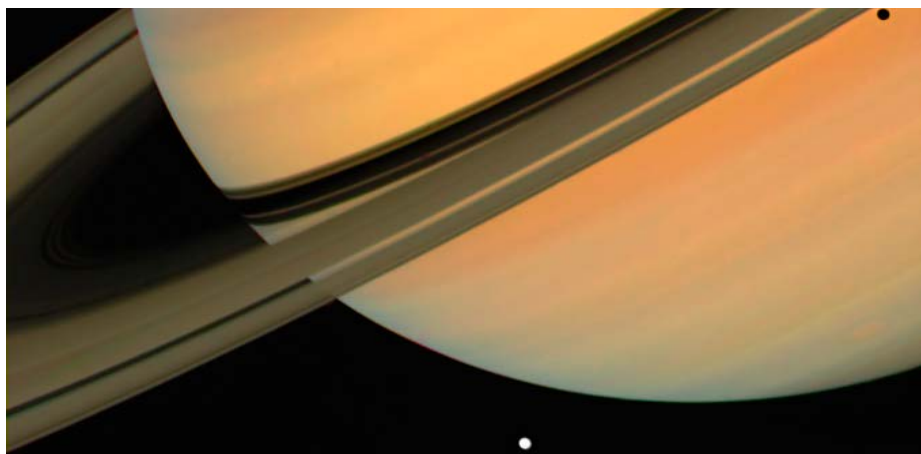


Table of Contents

One Tough Job	4
Planning	6
The Main Task	8
Jupiter	9
Saturn	10
Uranus	11
Neptune	12
The Golden Record	13
The Final Task	14
Conclusion	15
Glossary	16



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

One Tough Job

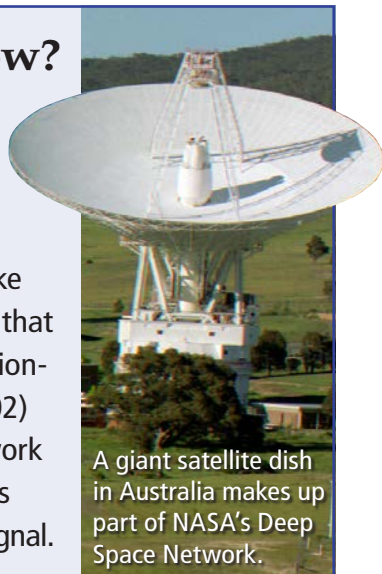
When the two *Voyager* spacecraft launched in 1977, they had a tough job ahead. Their **mission** was to **explore** Jupiter and Saturn, two giant planets in the outer **solar system**. Their journey would be long and difficult. If something broke, the space **probes** would just have to make do with what they had.

Scientists built the *Voyagers* to be tough. Their computers were set up to deal with problems that might happen. Those computers would be toys by today's standards, though. They are thousands of times less powerful than a modern cell phone!

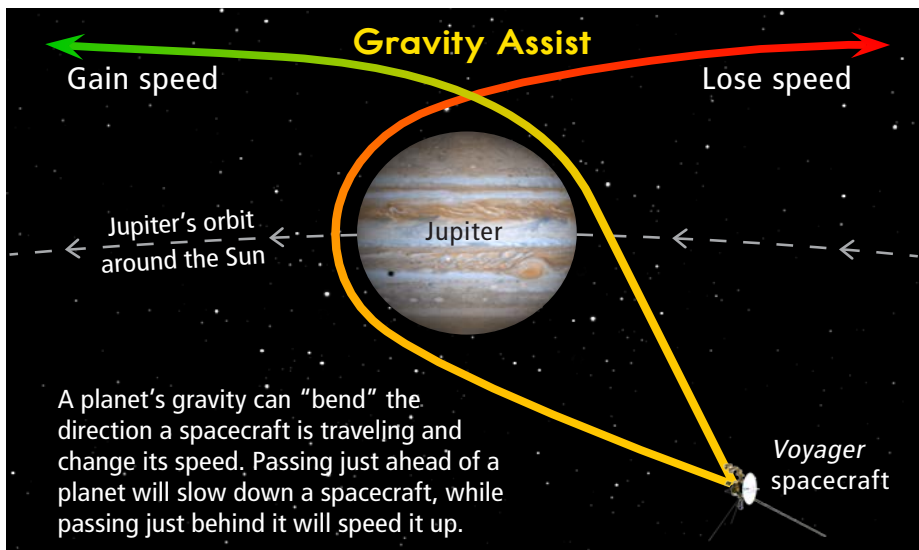
Scientists guessed that the *Voyagers* would only last about five years. More than thirty-five years later, the twin spacecraft are still sending information back to Earth.

Can You Hear Me Now?

As of 2014, *Voyager 1* is about twelve billion miles away. It uses a 22.4-watt transmitter that's as strong as a refrigerator lightbulb to communicate with Earth. Signals take about seventeen hours to arrive. By that time, they've faded to about 0.2 billion-billionths (.0000000000000000002) of a watt. NASA's Deep Space Network uses 70-meter (230 ft.) dish antennas around the globe to catch the faint signal.



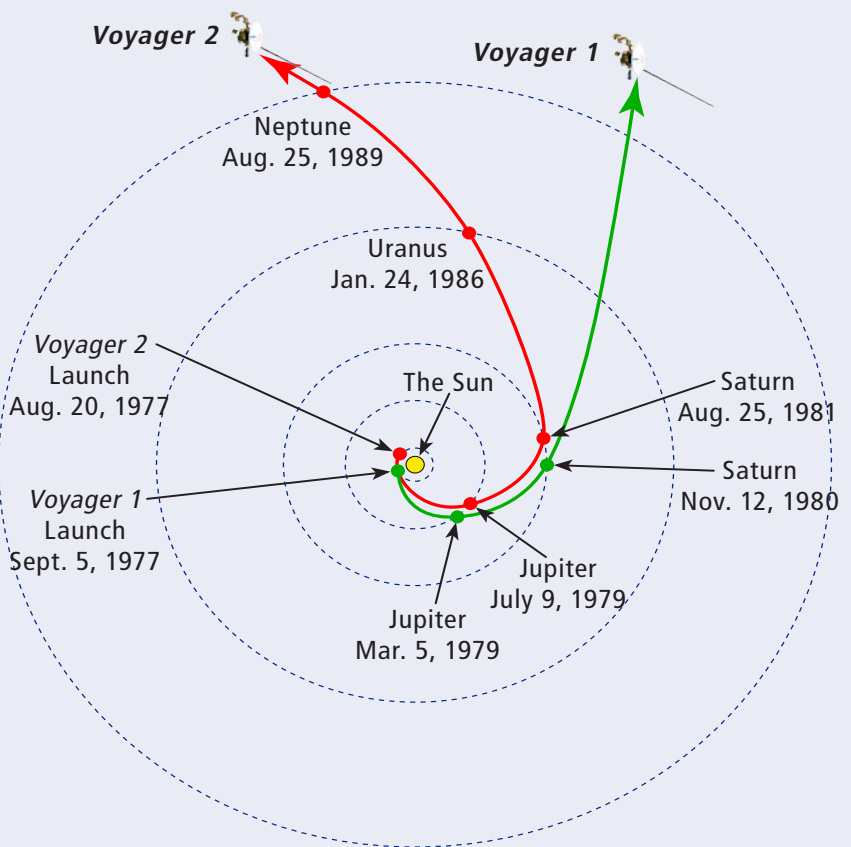
A giant satellite dish in Australia makes up part of NASA's Deep Space Network.



Planning

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

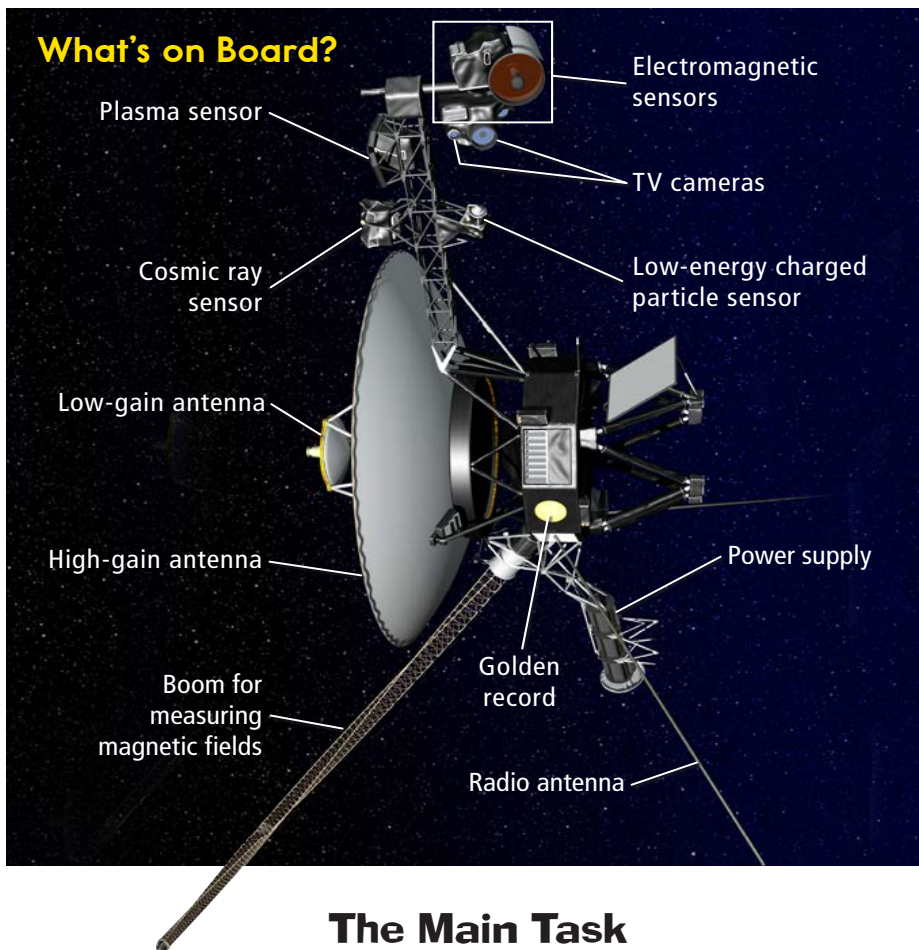
Unfortunately, the rockets that launched the *Voyagers* into space could only get them to Jupiter—about halfway to Saturn. Scientists solved that problem by using Jupiter's strong **gravity** to give the spacecraft a boost as it passed by.



A Rare Opportunity

The arrangement of planets when the *Voyagers* launched was a very 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 often.

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

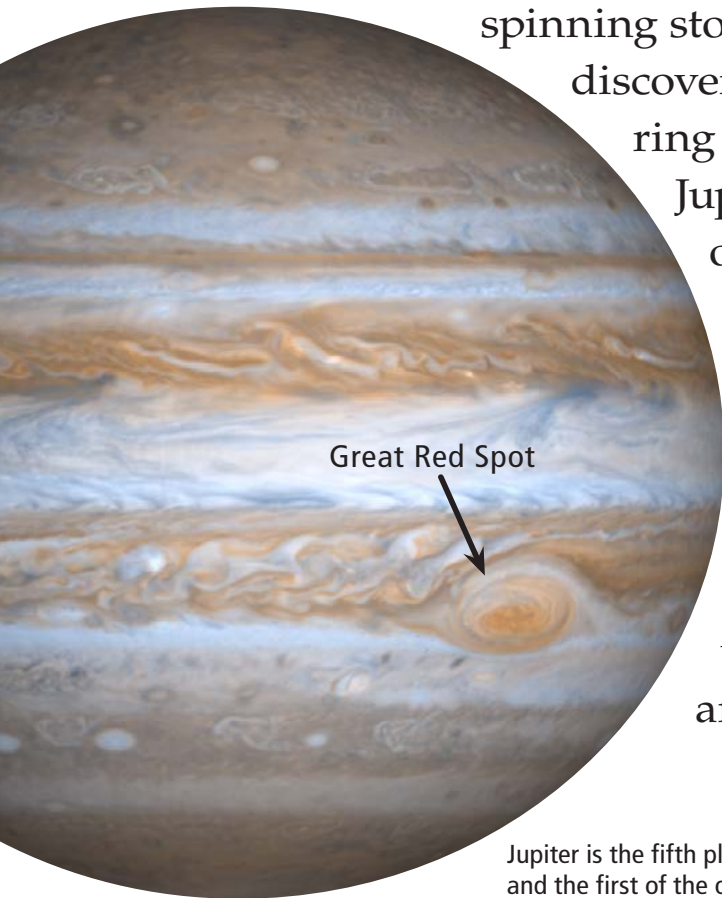


At first, the *Voyagers'* mission was to study Jupiter and Saturn, their larger moons, and Saturn's rings. The spacecraft carried cameras and scientific **instruments**. Using these instruments, the *Voyagers* collected information that changed how we understand our solar system.

Jupiter

The *Voyagers*' first target was Jupiter, the solar system's largest planet. Humans had already studied Jupiter through telescopes, but the *Voyagers* sent back new information. They showed that the Great Red Spot was a huge, constantly spinning storm. They

discovered a faint ring surrounding Jupiter, like the ones around Saturn. They also found ice sheets on one of Jupiter's moons and volcanoes on another.



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

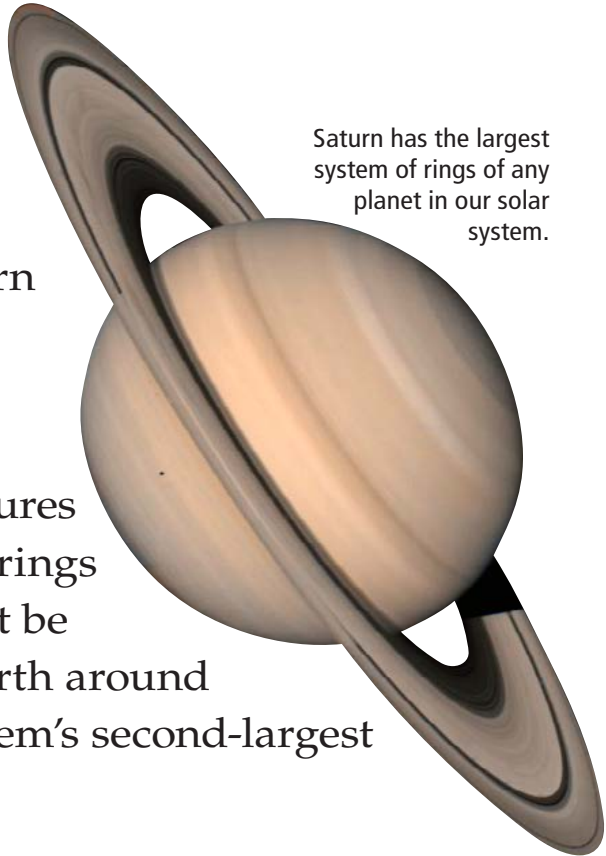
Saturn

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 moons were surprising as well. Several small moons act like "shepherds" for the ice and dust around Saturn, keeping them in separate rings. The *Voyagers* also made the shocking discovery that Saturn's largest moon, Titan, had an **atmosphere**.

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

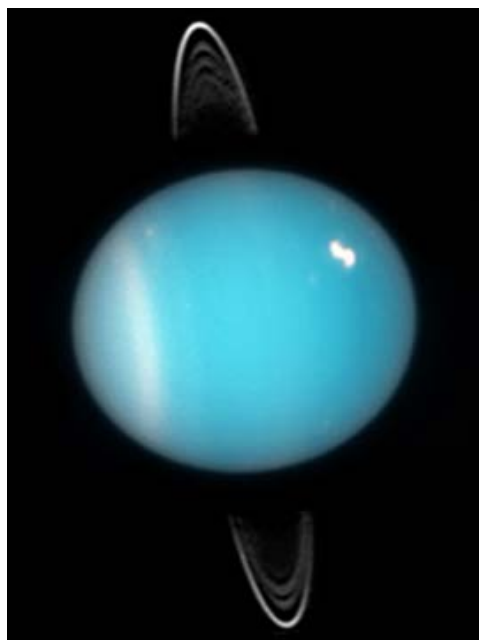


Uranus

After its Saturn flyby *Voyager 1* headed toward deep space. However, *Voyager 2* continued toward Uranus. All its instruments were still working, so NASA decided to keep going.

No one knew what to expect from Uranus. This strange-looking planet is tipped on its side. *Voyager 2* passed the planet in January 1986. It discovered 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!



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



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.

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

The Golden Record

Gathering information is only part of the *Voyagers'* mission. They are also carrying information *out* of the solar system. It's 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!



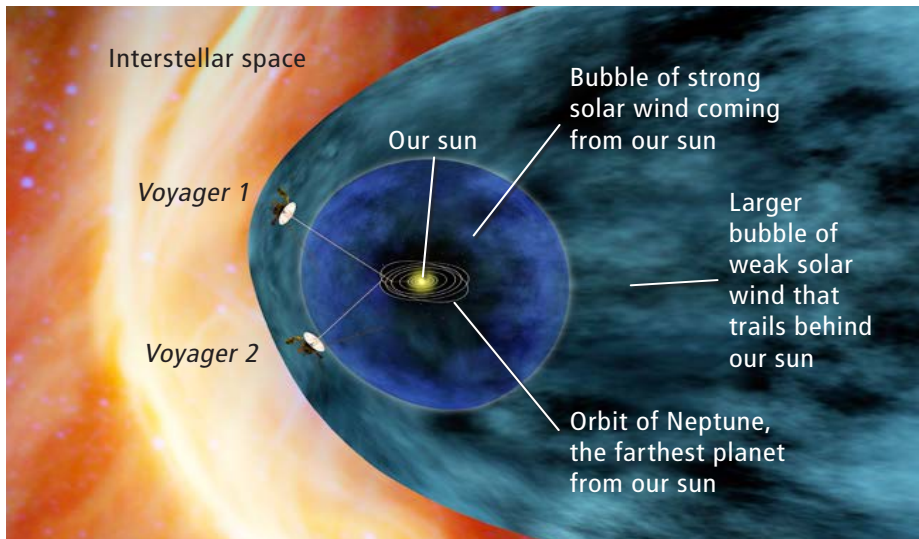
Famous American astronomer Dr. Carl Sagan led the committee that chose what to include on each Golden Record.

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. They are the first probes to explore space beyond our solar system. In August 2012, *Voyager* 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,” says 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 first look at deep space. Like two small bottles in the universe’s huge ocean, they carry a message from Earth to whatever lies beyond.

Glossary

atmosphere (<i>n.</i>)	a layer of gases surrounding a planet, star, or moon (p. 10)
explore (<i>v.</i>)	to observe and learn about an area by traveling over or through it (p. 4)
gravity (<i>n.</i>)	the natural force that tends to pull objects toward each other, such as objects being pulled toward the center of Earth (p. 6)
instruments (<i>n.</i>)	tools, especially those used for making or recording measurements (p. 8)
magnetic field (<i>n.</i>)	an area around a magnet or a moving electric charge where there is a magnetic force (p. 11)
mission (<i>n.</i>)	a flight of a spacecraft or aircraft with the purpose of completing a special assignment (p. 4)
orbits (<i>n.</i>)	the paths taken by objects in space circling around other larger objects (p. 6)
probes (<i>n.</i>)	devices used to send back information from places that are difficult or dangerous to reach (p. 4)
solar system (<i>n.</i>)	a group of objects in space that orbit a star (p. 4)

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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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