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It's Saturn time!

by Jane Houston Jones

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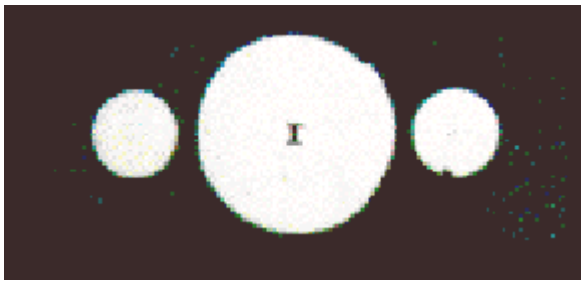
I'll never forget my first view of Saturn. It was a crisp clear winter night many years ago, and I had just completed making my first reflector telescope. I couldn't wait to look through it. I aimed my telescope at the bright golden object in the sky. After a few swing-bys, I finally found it. I gasped with wonder at the far away world I was gazing at. Now, every time I show Saturn to people, I relive that first exciting moment.

The view of Saturn this winter is about as good as it ever gets. The earth and sun passed through the ring plane in 1995 and 1996 providing a nearly edge-on viewing geometry. Since then the ring tilt increased year by year to a maximum possible tilt of 27 percent in early 2003. This winter, the ring tilt compares favorably to last year, at 26 percent. You can see and learn about the ring tilt in the multi-year Hubble Telescope image of Saturn.

The Cassini spacecraft speeds toward Saturn at 21,500 kilometers (13,000 miles) per hour and will reach Saturn just as the ringed planet disappears from our nighttime view in June. Don't worry, though. Saturn will be back in view after it emerges from behind the sun later in the year. That means you'll be able to view Saturn with the unaided eye or with telescopes when the Huygens probe descends into the atmosphere of Titan. For more information visit the Cassini-Huygens Mission to Saturn and Titan, website.

Historical observations

Saturn was the outermost of the known planets until the discovery of Uranus in 1781. Galileo first turned his telescope on Saturn on July 25, 1610 and it looked like three separate objects. His telescope was powerful enough to show the rings but made them appear as lobes on either side of the planet. Galileo was puzzled when the lobes vanished a few years later.



Galileo's first sketch of Saturn. When Galileo first turned his telescope on Saturn in 1610, he was struck by the odd appearance of the planet. His telescope was extremely crude by today's standards - magnifying just 20 times and having fairly crude optics. Galileo thought he was seeing a three-lobed planet. "I have observed the highest planet to be tripled-bodied. This is to say that to my very great amazement Saturn was seen to me to be not a single star, but three together, which almost touch each other," he wrote. Galileo's first known sketch of the planet Saturn corresponds perfectly to this description.

For a modern day comparison, look at this image taken by an amateur astronomer using a small telescope not much bigger than Galileo's telescope.

Image taken by amateur astronomer David Rosenthal using a 90mm telescope.

Observing Saturn today

On Dec. 31, 2003, Saturn reached opposition. An object is at opposition when the sun is on one side of the Earth and the object is on the opposite side. The result is that the object is fully illuminated by the Sun and appears disk-like. We see a great example of an opposition every month. The full moon is on one side of the Earth and the sun is on the opposite.

Geometry of opposition. The size of earth's orbit is exaggerated for clarity. Saturn is 9 1/2 times farther from the sun than Earth. Image courtesy of Celestron Telescopes.

When and where can I view Saturn?

The best current views of Saturn are from late December 2003 through the end of March 2004. Saturn won't disappear from our view until late June, but will be lower in the sky, and you'll be viewing through more layers of the earth's atmosphere. Saturn will look more like a fuzzy oval when it is lower on the horizon. Saturn appears near the feet of Gemini, one constellation northeast of the familiar constellation Orion. To find

Orion and Gemini, you can use the ASP Mercury magazine star chart. This handy link will let you create a special star chart showing Saturn tailored to your own location.

What will Saturn look like? It depends. You may be able to see the planet and rings clearly, depending on a lot of variables from optics to eyepieces to sky conditions. If you are observing Saturn at low power through a small 60mm - 100mm aperture telescope it will look like a golden oval. Some telescopes will show the rings distinctly and some won't. Larger telescopes will reveal gold and brown cloud bands on the planet and even the Cassini division, the large gap between the rings of Saturn. You should be able to see the moon Titan, and perhaps several of the other moons. Most importantly, view Saturn when it is highest in the sky so there is less atmosphere between your view and your target. February and March will be the best months for awesome views.

In June Saturn, along with its planetary companions Mars, Venus and Mercury, will be too low in the western sunset sky for viewing. Here is a listing of optimum times to observe Saturn this winter and spring.

Here are some excellent dates to consider for a school star party. Contact your local astronomy club, or any number of excellent outreach organizations for assistance in organizing your event.

February 15 - Saturn best viewed between sunset to 1:00 a.m. February 28th is the first quarter moon night. Jupiter joins the other planets by 8:30 p.m. Saturn is near the moon on the nights of February 2-3 and February 29-March 1.

March 15th - Saturn best between sunset to 11:00 p.m. For about 2 weeks commencing March 22, all five naked eye planets are visible in the evening sky. Mercury begins its best evening apparition of the year at month-end setting 1 1/2 hour after the sun. Venus stands 25 degrees high in the west and sets near 10:00 p.m. Mars is 40 degrees high in the western sky and sets in the west-northwest at midnight. Jupiter is at opposition March 4, and transits more than 50 degrees high before midnight. Saturn is stationary on March 7 and returns to direct (eastward) motion. It stands 65 degrees high in the south-southwest at the end of the evening twilight and sets at 2:30 a.m.

April brings daylight savings time to most states, and a later sunset. Saturn is high in the west at sunset and doesn't set until midnight. On Sunday April 25th, Saturn will be 5 degrees from the crescent moon in the early evening.

On May 10, a nearly straight-line just over 15 degrees long from upper left to lower right connects Saturn, Mars and Venus. On May 24th Mars is in conjunction with Saturn, passing just 1 degree from it, from most locations.

By month end, Saturn is visible only during evening twilight low in the west-northwest. It is lost in the glare of the setting sun in June, returning to the pre-dawn sky by month-end August. In December 2004, Saturn will be rising soon after the end of evening twilight.

Activities

Observing Saturn in the sky.

Make a Saturn model.

Paper plate Saturn.

Universe in the Classroom on Saturn #40 1997.

Activity: A Grapefruit Saturn.

Outreach

Saturn Observation Campaign

Night Sky Network

Solar System Ambassadors

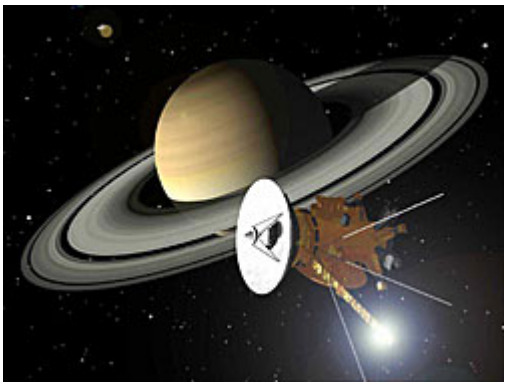
Northern California

Southern California

Science@Saturn: Cassini-Huygens Mission to Saturn and Titan

Blastoff to Saturn

Only three spacecraft have ever visited Saturn. Pioneer 11 flew by at a distance of 22,000 kilometers (13,000 miles) in 1979. Voyager 1 flew 124,000 kilometers (77,000 miles) above Saturn's cloudtops in 1980, showing us a close look at Saturn's large moon Titan and sending back stunning images of Saturn and its rings. Voyager 2 flew by Saturn at a distance of about 100,000 kilometers (62,000 miles) in 1981. In the early moonlit morning of October 15, 1997, Cassini launched from Cape Canaveral in Florida, to join these three trailblazing spacecraft on its voyage to Saturn.



The above image is an artists' rendition of the Cassini spacecraft approaching the planet Saturn and its magnificent rings. The glint of light behind the magnetometer boom at the bottom of the spacecraft represents the reflection of the sun. Since Saturn is 930 million miles away from the sun, and consequently, about 746 million miles away from Earth, from this perspective one can get a sense in the image just how far the Cassini spacecraft has to travel to reach the mysterious ringed planet.

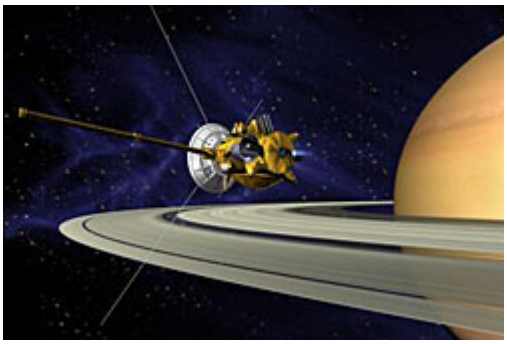
Image credit: NASA/JPL-Caltech

Cruise and tour

The Cassini-Huygens mission has two major phases: cruise and tour. Cassini has been in the cruise phase of the mission since 1997. The Cassini-Huygens mission is not unlike planning a vacation, where the cruise phase would entail referring to maps along the journey, and the tour phase would be to explore and take pictures upon arrival at the destination.

Fast forward to 2004

Cassini is now approaching the tour phase of the mission. In just a few months Cassini will fly by the moon Phoebe. Less than a month later, the Cassini spacecraft will execute the dramatic Saturn Orbit Insertion or SOI.



This is an artists concept of Cassini during the Saturn Orbit Insertion (SOI) maneuver, just after the main engine has begun firing. The spacecraft is moving out of the plane of the page and to the right (firing to reduce its spacecraft velocity with respect to Saturn) and has just crossed the ring plane. The SOI maneuver, which is approximately 90 minutes long, will allow Cassini to be captured by Saturn's gravity into a five-month orbit. Cassini's close proximity to the planet after the maneuver offers a unique opportunity to observe Saturn and its rings at extremely high resolution.

Image credit: NASA/JPL-Caltech

On to Titan

Then, just 6 months later, the Cassini orbiter will release the Huygens probe for a three-week coast toward Saturn's largest moon, Titan. After atmospheric entry and a parachute deployment, Huygens will descend into the atmosphere of Titan.

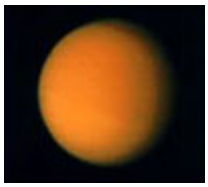
The Tour

The Cassini-Huygens mission to Saturn and Titan represents a rare opportunity to gain significant insight into major scientific questions about the creation of the solar system and primordial conditions on Earth. During the four-year Saturn Tour, Cassini will complete 74 orbits of the ringed planet, 44 close flybys of the moon Titan, and numerous flybys of Saturn's other moons Dione, Iapetus, Enceladus, Mimas, Tethys, Hyperion, Rhea, and Epimetheus.

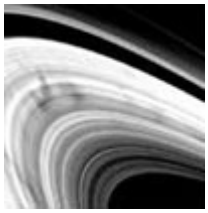
Science Objectives

Cassini's payload represents a set of interrelating instruments that will address many scientific questions about the Saturn system. Nearly 300 scientists from the United States and Europe will analyze the data. Five broad categories encompass the science of the Cassini-Huygens Mission.

Saturn Why does Saturn's atmosphere show fewer features than Jupiter? Why does Saturn have the fastest jet streams in the solar system?

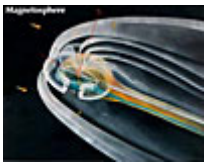


Titan What goes on beneath Titan's atmosphere? Are there continents or oceans beneath? What processes occur in such a cold environment? Will the chemistry of Titan help us understand the evolution of early life on Earth?



Rings Will the rings reveal information about how Saturn evolved? Why are there wave patterns, gaps and moonlets embedded in the rings?

Magnetosphere Sensors will study the magnetic field structure, neutral and charged



particles and the radio waves generated by interactions of the magnetosphere with the solar wind and with bodies in the Saturn system. Cassini will open an observational window into this study.

Icy satellites Does the water ice moon Enceladus have an internal heat source that erases impact craters? Why is Iapetus white as snow on one half and black as asphalt on the other?

Cassini Education programs

As Cassini nears its destination, students can learn about the fascinating planet Saturn as well. There is a wealth of educational material on the Cassini-Huygens Mission and Solar System Exploration websites from which to choose:

While scientific discovery is the impetus for the K-4 Education program, the unique focus is to use the Cassini-Huygens Mission as contextual framework to improve crucial reading and writing skills in elementary schools across the country.

Scientific engagement is the focus of the Cassini 5-8 Program, and it stresses an interdisciplinary hands-on approach to science learning at the middle grades in an effort to reach students who otherwise would not be exposed to such subject matter.

The 9-12 program will encourage guided training and image-processing software to aid in the education of analyzing real mission data.

There are many other classroom activities for educators and students of all levels. Presentations, slide sets, printed materials and references are widely available.

Below are some examples of specific Cassini-Huygens Mission educational activities that span all grade levels:

Grade level 6-12 Can photosynthesis occur at Saturn? Analogy: Titan and Saturn

Grade 3 - 12 Planetary Billiards Analogy: Cassini's tour of Saturn system using Titan for gravity assist trajectory modifications.

Grade 5 - 12 Sand or rock? Finding out from 1,000 kilometers (600 miles). Analogy: Remote sensing of thermal properties in the Saturn system.

Grade 5 - 12 Scattering: Seeing the microscopic among the giants Analogy: The rings and atmospheres of Saturn and Titan

Grades 5 - 12 Unveiling Titan's surface Analogy: Titan's surface unveiled by Cassini radar

Grade 6 - 8 Capturing a whisper from space Analogy: How a worldwide series of antennae communicate with interplanetary spacecraft such as Cassini

Grades 1 - 4 Edible Cassini Spacecraft Analogy: Cassini orbiter and Huygens probe

Make a Gingerbread Cassini. Paper models too.

Titan in a fish tank.

These activities and links are certain to whet the appetite of explorers and inquirers of all ages as we watch and learn from the mission's discoveries made at the mysterious planet Saturn and its largest moon, Titan.

About the Author

Jane Houston Jones served on the board of directors of the ASP from 2000 - 2003 and has been active in Project ASTRO in the San Francisco Bay Area for many years before joining the NASA JPL Cassini-Huygens outreach team in late 2003.