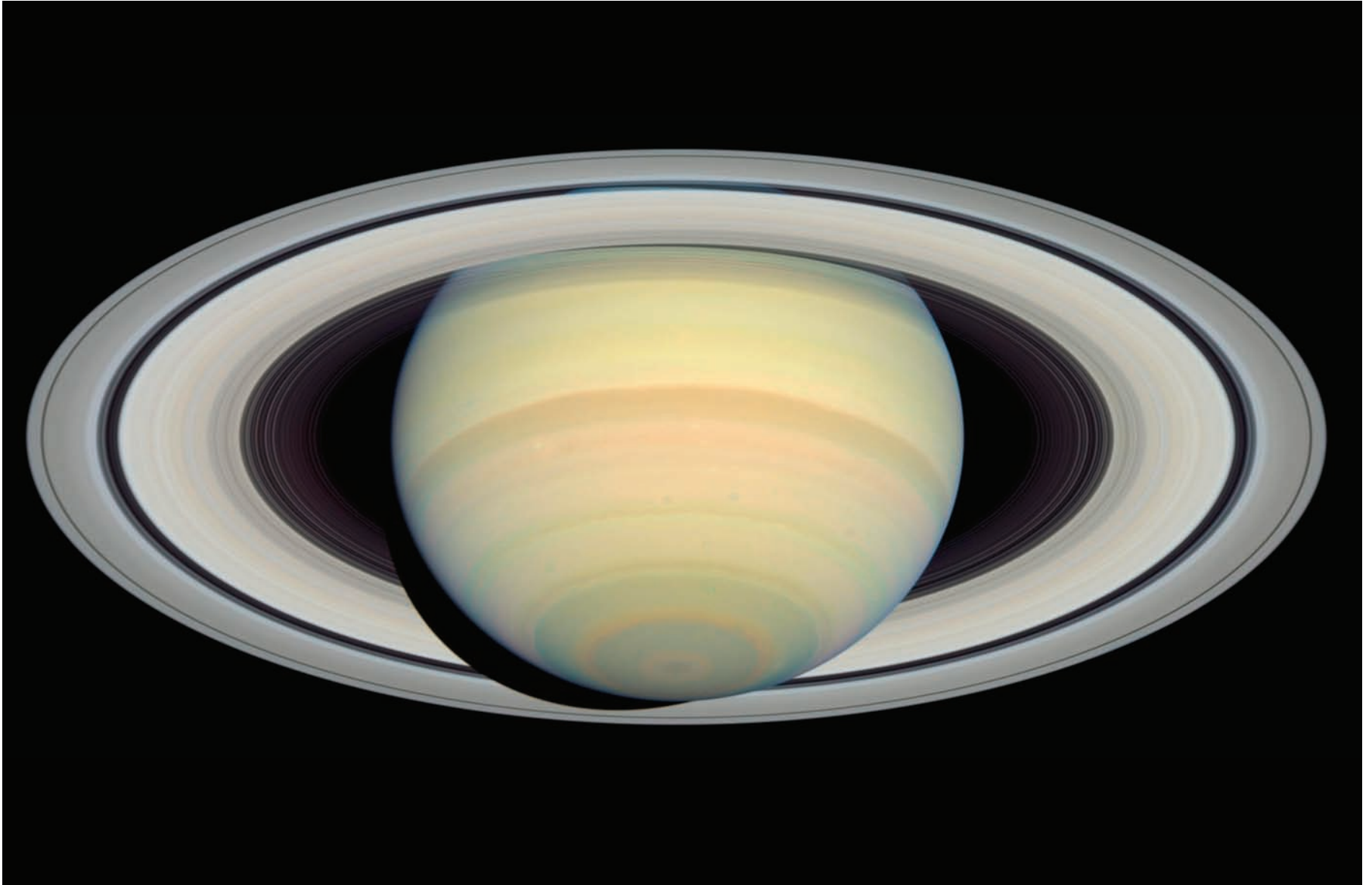




## Saturn's Rings





## Saturn's Rings

### The Mystery of the Rings

In 1610, Galileo pointed the newly invented telescope at Saturn and noticed strange shapes on both sides of the planet. Galileo thought the shapes were two moons, one on each side of the planet. The “moons” seemed to play “hide-and-seek” with him, appearing and disappearing over several years of observations.

Many other astronomers studied Saturn's strange and changing appearance for several decades without finding a good explanation. Dutch astronomer Christiaan Huygens solved the mystery in the 1650s. In his book, Huygens described Saturn as being “surrounded by a thin flat ring.” Although Huygens' explanation of Saturn's famous rings was not entirely correct, it forms the foundation for today's theories of the ring system.

After hundreds of years, astronomers are still studying Saturn, the sixth planet from the Sun, and its signature rings. Other planets have rings, but they are so faint that we cannot easily see them. Saturn's rings stand out because they are very bright and contain lots of icy material that reflects sunlight.

Saturn and its ring system have been visited over the past 30 years by several spacecraft, including Pioneer 11 and Voyagers 1 and 2. Spacecraft, however, cannot land on the ringed planet. Saturn, like Jupiter, is a gas giant and does not have a solid surface. Since its launch in 1990, the Earth-orbiting Hubble Space Telescope also has been probing the planet.

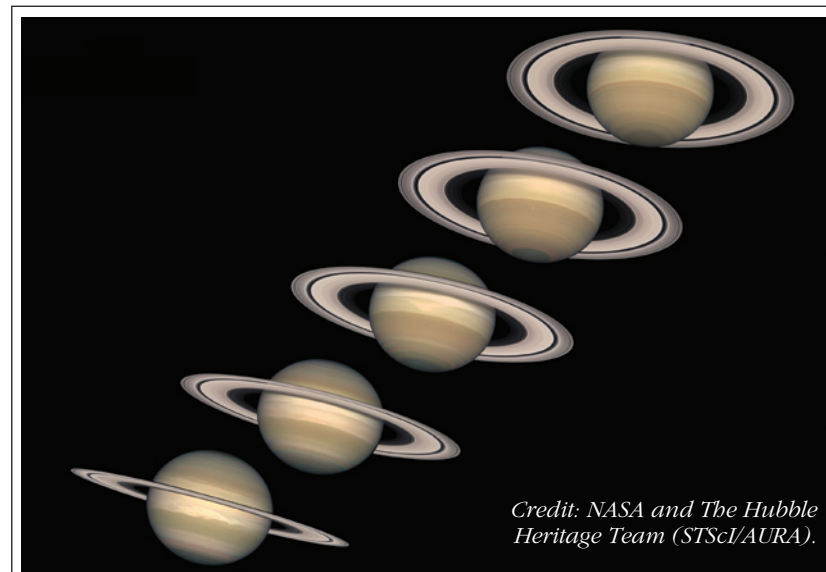
Observations by Hubble, other spacecraft, and many ground-based telescopes have yielded valuable information about Saturn and its famous rings. The planet's ring system is composed of about 10,000 rings, called ringlets. The ring system is about 175,000 miles (280,000 kilometers) across, yet only about half a mile (1 kilometer) thick. These measurements may seem large, but the rings orbit a huge planet. The rings, when compared with Saturn's size, are flatter than a piece of paper. The rings' thinness and the way they are tilted toward Earth are why Galileo saw — and even Hubble sees today — the rings disappear at times. When viewed edge-on, the rings are almost invisible.

The rings are not composed of solid sheets of material. Astronomers believe they are made of pieces of dusty water ice, which range in size from dust grains to boulders. These particles gently collide with each other as they orbit Saturn.

The greatest mysteries about Saturn's rings are how they formed, how long they will last, and why they are there at all. NASA's Cassini spacecraft, now orbiting Saturn, is providing a stunning close-up look at the planet and its rings, complementing Hubble's far view. The mysteries that began with Galileo will continue for future generations of astronomers.

### VOCABULARY

**Gas giant:** A large planet that has no solid surface because it is composed almost entirely of hydrogen and helium.



*Credit: NASA and The Hubble Heritage Team (STScI/AURA).*

**A Change of Seasons on Saturn.** The Hubble Space Telescope captured these images of Saturn over a four-year period. The images show the planet's rings at different angles, from edge-on to nearly face-on. Saturn is tilted, so our view of the rings changes as the planet travels around the Sun. Earth is similarly tilted. These slight tilts produce seasons on both planets.

### FAST FACTS

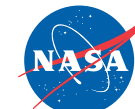
**Location:** Saturn is the sixth planet from the Sun and the second largest.

**Diameter:** 74,900 miles (120,000 kilometers).

*Credits: NASA and The Hubble Heritage Team (AURA/ STScI).*

You can get images and other information about the Hubble Space Telescope on the World Wide Web. Visit <http://www.stsci.edu/outreach> and follow the links.

The corresponding classroom activity for this lithograph can be found at: <http://amazing-space.stsci.edu/> or may be obtained by contacting the Office of Public Outreach at the Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218.





# In Search of ... Saturn's Rings

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## Description

Using the “Saturn’s Rings” lithograph, engage your students in a Level One Inquiry activity to investigate how advancements in technology have led to a greater understanding of the nature of Saturn and its ring system. A Level One Inquiry activity can help prepare students to be independent thinkers. Students conduct research to answer their questions about Saturn’s rings.

## Grade Level

Middle school, grades 6–8

## Prerequisites

Students should be aware that Saturn, a gas giant planet, is known for its extensive ring system. Knowledge of Saturn’s location with respect to Earth and the other planets may be helpful.

## Misconceptions

Teachers should be aware of the following common misconceptions and determine whether their students harbor any of them. Students may think that Saturn’s ring system is composed of one solid ring rather than individual particles that make up many rings. They may also think that Saturn is the only gas giant planet with a ring system when, in fact, all four of the gas giants have rings. Students may not realize that the great distance between Earth and Saturn makes it difficult to view Saturn and its ring system. How much of Saturn’s rings we see depends on how they are oriented with respect to Earth.

In addition, students may have misconceptions about the makeup of the solar system. Students should realize that the solar system consists of one star, the Sun, nine planets and their moons, millions of rocky asteroids, and billions of icy comets. The four largest planets, Jupiter, Saturn, Uranus, and Neptune, are composed of gas and do not have solid surfaces. Students may not realize that spacecraft cannot land on these gas giant planets to study them.

## Purpose

The purpose of this activity is to apply a Level One Inquiry technique, using images and text, to investigate Saturn’s rings and the influences of new technologies on scientific understanding. In this activity, the components of inquiry learning that students can practice are: asking questions, planning and conducting investigations, using critical-thinking skills, and communicating results. Students will make observations, formulate questions, and read for a purpose.

## Materials

- “Saturn’s Rings” lithograph.
- Computer with Internet connection for researching answers.

## Instructions for the Teacher

### Preparation:

- Obtain a lithograph for each student. Lithographs are available as PDF files at <http://amazing-space.stsci.edu/eds/tools/type/pictures.php>.
- Bookmark or identify as favorites the following suggested Web sites, and/or prepare a list of Web sites that students can access to obtain additional information about Saturn’s rings.
- Space Telescope Science Institute (STScI) AstroFiles: “Some Background on Saturn and Brief History of Telescopic Observations” and “Spacecraft Visits to Saturn” (scroll down page to locate these subheadings): <http://hubblesite.org/newscenter/newsdesk/archive/releases/1995/25/astrofile/>.
- STScI — “The Slant on Saturn’s Rings”: <http://hubblesite.org/newscenter/newsdesk/archive/releases/2003/23/image/a>.
- STScI — “A Change of Seasons on Saturn”: <http://hubblesite.org/newscenter/newsdesk/archive/releases/2001/15/image/>.

## Procedure

Evaluate your students' misconceptions about Saturn by having them write down anything they know and understand about the planet. Have students volunteer their ideas about Saturn. From those ideas, identify their misconceptions and discuss them with the class. Or, collect the papers containing their ideas about Saturn. From those ideas, compile a list of their misconceptions and discuss them with the class.

Ask students to look at the images of Saturn's rings on the front and back of the lithograph and write three questions about the features visible in the images. Compile a list of questions, and group students by common theme. Ask students to read the information on the back of the lithograph and check if any of their questions have been answered. Allow students to refine their questions by discussing them with their group. Have students use the Internet to research their questions. The Internet sites listed previously can provide a starting point for their research. Instruct students on how to access other Web sites that may be appropriate.

Ask students to prepare a report in which they explain the answers to their questions, describing how advancements in technology have led to a greater understanding of the nature of Saturn and its ring system. This report could be in the form of a slide show, a skit, a story, a graphic organizer, a Power Point presentation, or a written report — anything that conveys their understanding of the topic to another student, a group of students, or the entire class. Ask students to review their original questions to see if they were answered. Then ask them if they have any additional questions.

## Instructions for the Student

Your teacher will ask you to write down things you know and understand about the planet Saturn. You may be asked to share this information with the rest of the class. Study the images of Saturn's rings, and write down three questions about what you see in the images. Then read the back of the lithograph, and check if any of your questions were answered.

Your teacher will assign you to a group to research the answers to your questions. You can research your answers by using the Internet sites provided by your teacher. Your teacher then will ask you to present a report that demonstrates your understanding of the material you researched. This

report could be a slide show, a skit, a story, a graphic organizer, a Power Point presentation, or whatever presentation you think will communicate the information you learned about Saturn. You may be allowed to work individually or in small groups. You can make your presentations to another classmate, another group of students, or the entire class.

At the conclusion of this activity, you will be asked to review your original list of questions and reflect on whether, through your research, they were answered fully, partially, or not at all. Your teacher also may ask if you thought of any other questions while you were researching the answers to your original questions.

## Education Standards

### Benchmarks for Science Literacy

#### American Association for the Advancement of Science:

<http://www.project2061.org/tools/benchol/bolframe.htm>

#### 4. The Physical Setting

##### A. The Universe

By the end of the 8th grade, students should know that:

- Nine planets of very different size, composition, and surface features move around the Sun in nearly circular orbits. **Some planets have a great variety of moons and even flat rings of rock and ice particles orbiting around them.** Some of these planets and moons show evidence of geologic activity. The Earth is orbited by one moon, many artificial satellites, and debris.

## National Science Education Standards

<http://books.nap.edu/html/nses/>

### Content Standard E: Science and Technology

As a result of activities in grades 5–8, all students should develop an understanding about science and technology:

- Science and technology are reciprocal. Science helps drive technology, as it addresses questions that demand more sophisticated instruments and provides principles for better instrumentation and technique. Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size, and speed. Technology also provides tools for investigations, inquiry, and analysis.