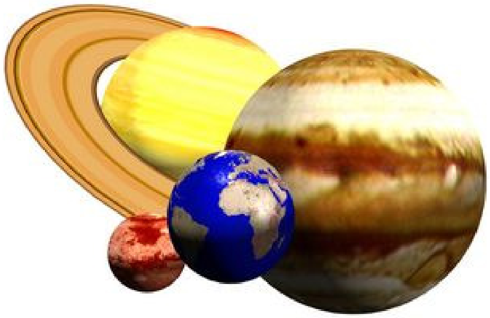


A Traveler's Guide through the Solar System
Jupiter & Saturn
Curriculum Guide grades 3-6

Objectives:

Language Arts
- Organize and apply factual information using a Venn diagram.
- Write a poem to describe Saturn.

Science
- Describe the physical properties of Jupiter and Saturn
- To investigate how digital messages are created, sent, and received.
- To construct a scale model of the complex ring system of Saturn.

Mathematics
- Understand measurable attributes of objects and the units, systems and processes of measurements.

Vocabulary:

Astronomer – A scientist who studies planets, moons, stars, and other objects in outer space.

Belt – the westward moving dark clouds circling Jupiter in a band

Band – a dark cloud that circles Saturn parallel to its equator

Interplanetary – between planets

Mass – The amount of matter contained in an object

Orbit – The path a planet takes to travel around the Sun, or a moon to travel around a planet

Gravity – the force of attraction that exists between one heavenly body and another; the more massive an object, the greater its gravity

Ringlets – The name given to the thousands of individual rings circling Saturn.

Orbital Speed - the speed of an object in orbit around another object.

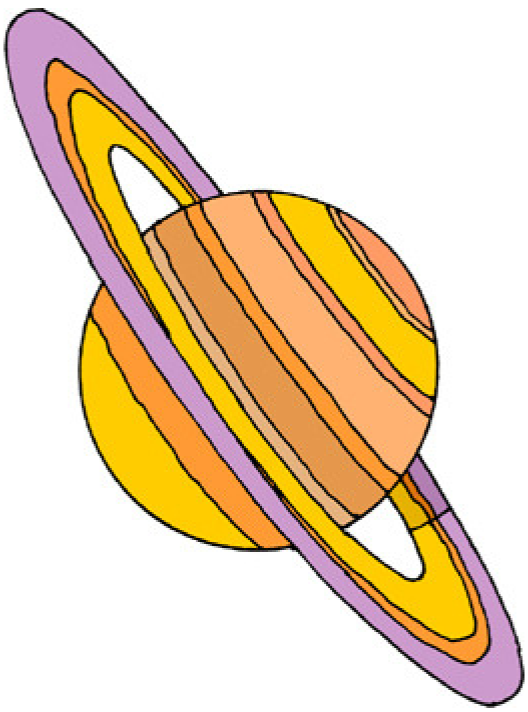
Surface Gravity – a measure of the acceleration of gravity at the surface. For Earth, acceleration of gravity is about 9.8 meters/sec^2

Activity 1

Before participating in Jupiter and Saturn, engage students in the following activity: Using the KWL Chart, (included below) have the students complete the sections "What I Know" and "What I want to Know" about Jupiter and Saturn.

Activity 2

Students will complete the KWL Chart section "What I learned" after Jupiter and Saturn.



KWL Chart

What I know about Jupiter & Saturn	What I want to know about Jupiter & Saturn	What I learned about Jupiter & Saturn

<u>Activity 3 –</u> A Picture is Worth a Thousand Words

Background:

An image is a picture created by a camera on photographic film (called a photograph) or by a remote sensing detector, and displayed on a screen or on paper. A camera takes light energy and records it chemically on film. The film is then processed, and the image transferred to paper where we can look at it. This is called a photographic image. Most films have chemicals that are sensitive to visible light energy. This means it will record the same images a human eye can see. Camera film can also be chemically sensitive to the "invisible" infrared energy, recording on the film images that the human eye cannot see.

Scientists have created very complex detectors that can sense many different wavelengths in the electromagnetic spectrum. These sensitive instruments record the reflected energy as numbers or digits. Digital images are recorded and transferred as pixels. The more pixels that are used, the better or clearer the image. This is often referred to as resolution. This digital information is often recorded on magnetic tape, like in a tape recorder or videocassette, or radioed back to Earth. Computers then put these numbers together and make pictures.

In an analog television, each line is a continuous signal that is shot onto the screen by an electron gun. When an electron hits the phosphorus that coats the screen, it will emit light. The gun shoots electron through three sets—red, green, and blue. There are magnets on each side of the tube, which move the electrons across the screen. There are also magnets on the top and bottom of the screen, which can move the electrons up or down rows.

High-Definition Television (HDTV) is more lines of resolution both horizontally and vertically plus digital audio. The basic concept behind high-definition television is actually not to increase the definition per unit area, but rather to increase the percentage of the visual field contained by the image. It takes more lines of resolution to achieve this wider field of vision, and this wider field of vision engages the viewer significantly more than does the old standard.

Portable ultrasound machines that can send images to doctors also use a similar concept. These machines have been tested on the International Space Station. While in space, the images from the ultrasound were transmitted to doctors on the ground. This will be useful on long-distance missions when astronauts are more likely to develop illnesses that need medical attention.

In this lesson, students will learn how digital images can be transmitted from place to place.

Materials:

- Graph paper
- Color markers or pencils
- Student Sheets

Guidelines:

1. This activity requires students to work with a partner. Place students into pair prior to starting the activity.
2. Using the background information, discuss how digital images are recorded and transferred as pixels.
3. Hand out the Student Sheets, and go over the directions.
4. Allow time for the students to complete the Student Sheets

Discussion/Wrap Up:

- Have students share their "sender" and "receiver" images with the class and compare them. Discuss answers from Student Sheets.
- Ask students what benefits sending images in this way could offer for the future.

Extension:

- Have students create colored drawings, and repeat the activity. Remind students that they would have to assign every color used with a number code.
- Display color-coded messages.
- Have students make a picture and then write the code out on paper. This code could then be shared with the class, and students could use it to make images.

A Picture is Worth a Thousand Words - Student Sheet

Procedure:

1. Choose one student to be the "sender." The other will be the "receiver."
2. The "sender" and the "receiver" should each take a sheet of graph paper and draw a square, 20 boxes by 20 boxes.
3. The "sender" should fill in boxes in the square to create a simple picture. The "sender" should not allow the "receiver" to see the picture.
4. The sender needs to "read" the picture to the receiver, using the digital code below.

   If a square is blank, the sender says, "Zero"; if the square is filled in, the sender says, "One."

5. The sender, using the code, starts with the top row and reads from the left to the right.
6. The receiver, upon hearing the code, transfers the information to his or her square on the graph paper.
7. At the end of the first row, the sender says, "End row1." Repeat this at the end of each row.
8. At the end of the last row, look at the picture on the receiver's paper. Check the results to see how accurate the transfer was.
9. Switch roles and repeat steps 1 – 8.

Answer the following questions:

What was the most difficult part of the activity to do?

Can you think of a better way to transmit and receive information?

Describe how a digital image is formed based on your experiment.

Can you figure out how the information is coded electronically?

Activity 4 – Saturn's Got Rings!
Pre-lesson Instructions:

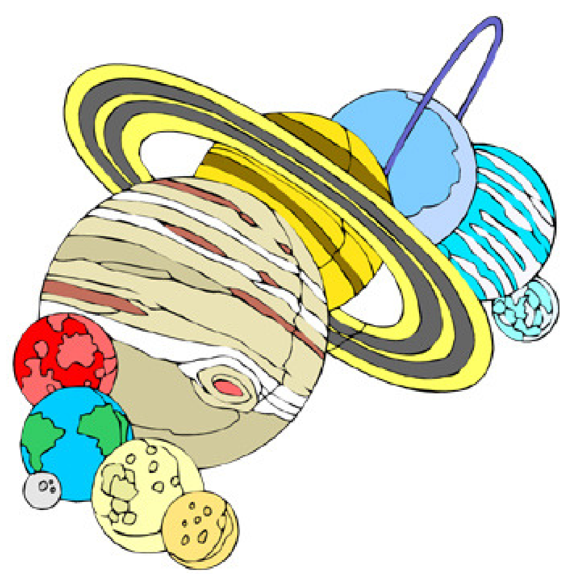
- Duplicate the Student Sheets (one per student). Due to the availability of materials, this activity can be done in groups of two.
- Provide each student with a ruler, mathematical compass, card stock or poster board, scissors, and colored pencils or markers.
- This activity can be done in two dimensions (attached to a piece of paper with glue or tape), or in three dimensions, using string to suspend it from the ceiling.

Background Information:

We have a lot to learn before we fully understand planetary rings. Saturn's rings are the brightest and, therefore, more famous than Jupiter's and Uranus's rings. The total number of rings is seven, and each one was given a letter between A and G for its name. They were labeled in the order at which they were discovered. Three of the rings (A, B, and C) are visible from Earth with a telescope.

Saturn's rings were first discovered by Galileo in the 1600s, although at the time he didn't know what they were. In 1655, the astronomer Christian Huygens predicted that Galileo had seen rings. Later on, more powerful telescopes proved Huygens right. In 1675, a scientist named Cassini found what appeared to be a gap between the A and B rings. This gap was later called the Cassini division. In the 1800s a third, faint ring was found and named C. It wasn't until 1979 that we found the E, F, and G rings, when the Pioneer 11 and Voyager spacecrafts flew by Saturn. They also found a smaller gap between the A and F rings, called the Encke division.

These rings still remain somewhat of a mystery to scientists. We now know that Saturn's gravity keeps the small particles that make up the rings in place. It also prevents the chunks of ice and rock from combining to form moons. Depending on the planet's gravitational force, anything too close to the planet cannot combine to create larger objects. That is why the rock particles are mostly a few centimeters in size. However, most of Saturn's moons are far enough away to stay together. Saturn has a radius of 60,268 kilometers, with the rings extending as far out as 480,000 kilometers



Guidelines:

1. Distribute the Student Sheets.
2. Have students determine the scale they would like to use for their models.
3. Instruct students to use the data and construct the rings of Saturn. Due to size constraints, they do not have to make the E ring to the proper width.
4. Have students answer the questions at the end.

Materials:

- Student Sheets
- Calculator
- Scissors
- Mathematical compass
- Rulers and/or protractors
- Color markers or pencils
- Card stock or poster board
- Tape or glue (optional)
- String (optional)

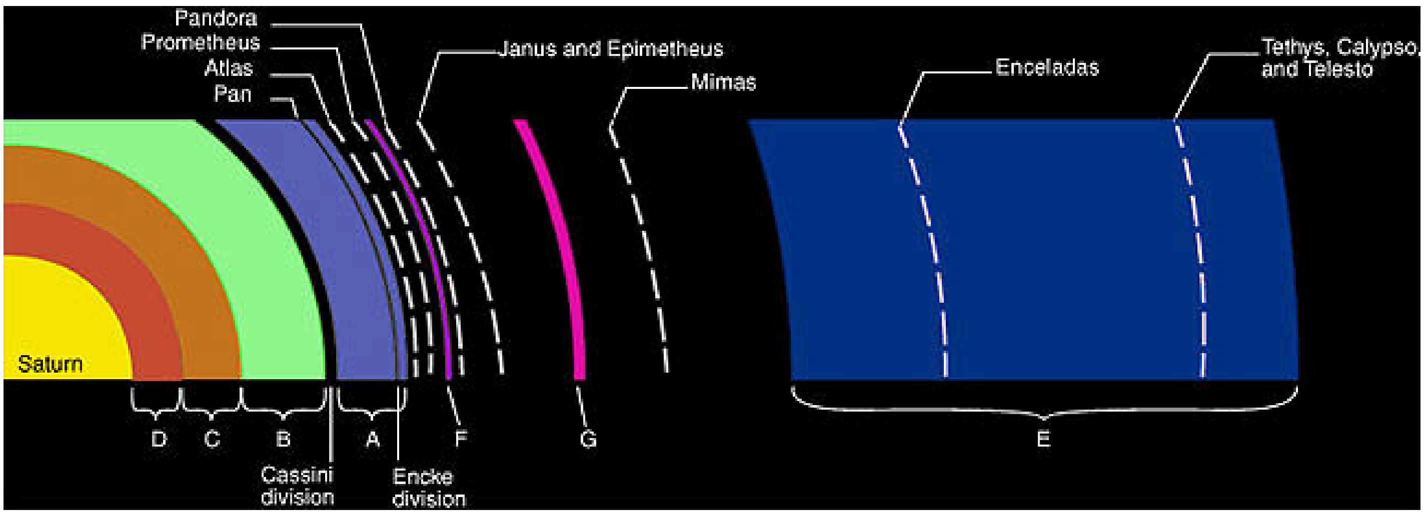
Discussion/Wrap-up:

- Discuss some of the things that Cassini can do in orbiting Saturn, that we have been unable to do before by just observing from a distance.
- Ask the students, "How would life on Earth be different if it had a set of rings similar to Saturn? For example, would space travel have happened sooner or later than history showed?"
- Possible answers to the questions:
    a. *Student answers will vary. Current theories speculate they are former satellites that were crushed, materials leftover from when Saturn formed, or leftovers from a comet collision.*
    b. *Student answers will vary and will probably depend on how they answered question a.*
    c. *The rings were labeled based on when they were discovered. That is why you can only see rings A, B, and C from Earth.*
    d. *No, there are 11 inside the rings. Use the picture in the Background Information to help with labeling.*
    e. *Some possible answers: large mass (need a large gravitational field to hold the small objects in), far away from the Sun (the Sun would probably disrupt any rings too close to it), and made mostly of gas (providing the right amount of orbital fluctuation and planetary density). There could be many more. Accept any that make sense and are well-supported.*

Saturn’s Got Rings! – Student Sheet

Background Information

We have a lot to learn before we fully understand planetary rings. Saturn's rings are the brightest and, therefore, more famous than Jupiter's and Uranus' rings. The total number of rings is seven, and each one was given a letter between A and G for its name. They were labeled in the order at which they were discovered. Three of the rings (A, B and C) are visible from Earth with a telescope



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Two of Saturn's moons, Prometheus and Pandora, are called shepherd satellites. They are both tiny moons located on either side of the F ring. They work against each other, pushing the particles inside the F ring towards the middle of the ring. The result is a small, compact F ring.

Materials:

- Scissors
- Calculator
- Mathematical compass
- Rulers and/or protractors
- Colored pencils or markers
- Card stock or poster board

Procedure:

1. The following chart lists the rings of Saturn and their sizes. This also includes some of the divisions between the rings. The distance from Saturn is measured from the center of the planet to the edge of the ring or division in km. The width is the distance from the starting edge to the finishing edge of the ring.

Ring or Division	Distance from Saturn (km)	Width (km)
D Ring	67,000-74,500	
C Ring	74,500 – 92,000	
B Ring	92,000 – 117,500	
Cassini Division	117,500 – 122,200	
A Ring	122,200 – 136, 800	
Encke Division	133,570	325
F Ring	140,210	35
G Ring	165,800 – 173,800	
E Ring	180,000 – 480,000	

2. Calculate the other widths in the chart using the information given.

3. To make a scale drawing of the rings of Saturn, decide what size a kilometer will be on your paper. Record your scale here: _____ km = __________.

4. Using the mathematical compass and ruler, draw out the rings of Saturn to scale. It may help to draw a scale model of Saturn first. Due to size constraints, you may not want to cut the E ring to proper width.

5. Per your teacher's instructions, combine the rings to form a two- or three-dimensional model.

6. Use the colored pencils or markers to distinguish between the rings.

7. Answer the following questions:

   Where do you think the rings of Saturn came from?

   Why do you think there are gaps in the rings?

   The rings in the table were listed in order of distance from Saturn. Why are the rings not alphabetical? In other words, how were the rings labeled or named?

   Are all of Saturn's satellites outside the rings? If not, label the ones that are within the rings of Saturn.

   Based on the planets that have rings (Jupiter, Saturn, Uranus, and Neptune), list three criteria that makes a planet a good candidate for rings. Explain your answers.

Activity 5 – Awesome Saturn: Poems

Pre-lesson Instructions:
Prepare chart paper for creating word lists or word banks. Make a copy or transparency of Poem Examples.

Background Information:
The images sent from Earth from the Cassini-Huygens spacecraft are magnificent. The scientific value of the images is obvious, but their ability to inspire cannot be overlooked. With this in mind, this lesson encourages young students to give a voice to the awe that Saturn can inspire. Students can use a variety of poetic forms in this lesson, among them: acrostic poems, place poems, list poems, and "I used to think…" poems. With each form, students express their own understanding of Saturn.

Materials:
- Copies of "Saturn Poem" worksheets for each students

Procedure:
1. Begin this lesson by reading one of the recommended books to your students. You can focus your reading on specific sections of the text.
2. When you have completed the reading, elicit from students some of the facts they have learned about Saturn.
3. Review Saturn images with your students.
4. After reviewing the images, brainstorm with your students to come up with nouns and descriptive words for Saturn, its moons, space, and other topics associated with Saturn.
5. Try to generate 15 to 20 words for each topic. List your words under each topic heading to help students organize their writing. The lists can be placed on the board or on word walls. See Poem Examples and Word Banks sheets to help guide the discussion.
6. Have the students choose the type of poem they would like to write. Encourage the students to use the word bank developed during the brainstorming session.

Poem Examples

Acrostic Poem – a short verse that is constructed so that the first letter of each line forms a specific word. You begin with the word and add the verse.

S pinning
A mazing
T itan
U nbeliveable
R ings
N arrow

Place Poem – describes the essence or feel of a particular place. The first line contains the name of the place, followed by three lines of descriptive words. The second line contains two words, the third three, the forth two. The last line contains the name of the place again.

Saturn!
Ringed, Icy
Cold, spinning, orbiting,
Tan, dim.
Saturn!

Chant Poem – a poem without a fixed form. However, one or more of its lines are repeated over and over. It is fun to recite as a group.

Saturn is cold!
Saturn is cold!
Far from the Sun,
Saturn is cold!

List Poem – itemizes an event, place, or thing.

When Cassini gets to Saturn it will find rings.
When Cassini gets to Saturn it will find moons.
When Cassini gets to Saturn it will find ice.
When Cassini gets to Saturn it will find helium.
When Cassini gets to Saturn it will find hydrogen.
When Cassini gets to Saturn we will celebrate!

Thing Poem – created by describing a place or thing in as many ways as you can. This would be a great whole-class poem.

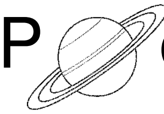
It is round.
It has rings.
It has moons.
It is made of gases.
It is cold.
It is Saturn!

"I used to think….but now I know Poem – created by recalling what you used to think and compare it with what you currently think. This poem form is an effective way to capture changes in student thinking that have taken place over the course of this unit.

I used to think Saturn was small but now I know it is huge.
I used to think Saturn was close to Earth but now I know it is very far.
I used to think Saturn was standing still but now I know it is orbiting.
I used to think Saturn was hot but now I know it is cold.
I used to wonder about Saturn but now I want to learn even more!

Word Bank

Solar System	Saturn	Moons	Titan	Rings	Cassini
Sun	rings	craters	thick atmosphere	icy	spacecraft
Mercury	ringed	spherical	clouds	Cassini Division	journey
Venus	6th planet	round	orange	A-rings	7 years
Earth	2nd largest	orbiting	big	B-rings	division
Mars	icy rings	paths	smog	equator	Huygens
Jupiter	gas giant	icy	orbiting	ringlets	antenna
Saturn	cold	rock	cold	moons	instruments
Uranus	no life	irregular	probe	shepherding	mission
Neptune	rotates	bumpy	parachute	particles	launched
Pluto	clouds	diameter		crashing	probe
Orbit	cold gases	collided		thin	scientists
Planets	wind storms	impact		huge	astronomer
Rotation	core	smooth		wide	
Revolution	inner layer	surface		gaps	
Moons	outer layer	grooves		orbiting	
Asteroids	surface	reflect			
Comets	orbits	frozen water			
Milky Way	gravity	canyons			
	Moons	cold			
	Atmosphere	frost			
		Shepherding			
		Co-orbital			
		Terrain			
		Big			
		Small			

Saturn Pem

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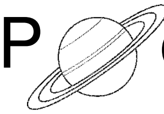
Saturn Pem

Saturn

__________ __________

__________ __________ __________

__________ __________

Saturn!

Critical Thinking Skills:

What information did you learn about Jupiter and Saturn that surprised you the most? Explain why.

Websites:
http://photojournal.jpl.nasa.gov/index.html
http://seds.lpl.arizona.edu/nineplanets/nineplanets/overview.html
http://www.nasaexplores.com
http://saturn.jpl.nada.gov/multimedia/images/index.cfm
http://www.kidsastronomy.com
http://saturn.jpl.nasa.gov/kids/activities.cfm
http://solarsystem.nasa.gov/index.cfm

National Mathematics Standards:

Number and Operations – Understand numbers, ways of representing number, relationships among numbers, and number systems; proportion, estimation

Problem solving – representation of a real world situation with models

Algebra – Use mathematical models to represent and understand quantitative relationships.

Measurement – Use visualization, spatial reasoning, and geometric modeling to solve problems.

Communication

Using math in another subject and critical thinking using mathematics

National Science Standards:

Science as Inquiry – abilities necessary to do scientific inquiry; Understandings about scientific inquiry

Physical Science – Properties of objects and materials

Earth and Space Science – objects in the sky

Science and Technology – Understandings about science and technology; Abilities to distinguish between natural and objects made by humans.

History and Nature of Science – Science as a human endeavor

Nature of Science – Science process skills

NCST Standards for the English Language Arts

Students adjust their use of spoken, written, and visual language to communicate effectively with a variety of audiences and for different purposes.

Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.

Student apply knowledge of language structure, language conventions, and genre to create, critique, and discuss print and non-print texts.

Students participate as knowledgeable, reflective, creative, and critical members of a variety of literacy communities.

Students use spoken, written, and visual language to accomplish their own purposes.