DETROIT THE NEW Science CENTER

DASSAULT SYSTEMES

PLANETARIUM

Solar System Adventures

Teacher's Resource Kit

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Solar System Adventure
Teacher's Resource Kit

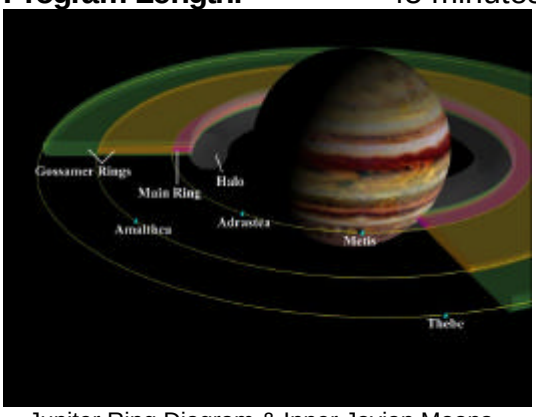
Thank you for scheduling a field trip to the New Detroit Science Center and its newest facility, the Dassault Systèmes Planetarium. The Planetarium is a 50-foot wide tilted theater with 116 seats, room for 6 wheelchairs, and assisted listening devices for the hearing-impaired. Using advanced projection equipment, the Planetarium can create virtually any environment. You can be seated in the interior of a spacecraft, witness the birth of a star, stargaze at the night sky over Southeastern Michigan, or travel faster than light through the Milky Way galaxy.

About the Show

Solar System Adventure will take you on a virtual voyage through our local neighborhood – The Solar System. The presentation starts with a guided tour of the current night skies over Southeastern Michigan, featuring what planets are visible from your backyard throughout the night We will visit the nine planets, explore their moons, probe asteroids and comets, while we investigate how earthlings discovered the nature of these celestial objects. This show is a great introduction to your studies of the Solar System or a way to test your students' knowledge after completing their studies!

This show is appropriate for

Grade Level(s): 3 - 12
Program Length: 45 minutes



Jupiter Ring Diagram & Inner Jovian Moons

Michigan Content Standards and Benchmarks

More information can be found at the Michigan Department of Education website at:
http://cdp.mde.state.mi.us/MCF/ContentStandards/default.html

*The Detroit Science Center and the Dassault Systèmes Planetarium are dedicated to assisting all educators in building and utilizing curricula based on the above-mention standards and benchmarks. Each of our shows for school groups keeps you and your students needs in mind. For **Solar System Adventure**, the Standards & Benchmarks addressed include:*

Elementary School

Cells III.4-1, 2
Matter & Energy IV. 2-1; 3-2, 4-5
Solar System, Galaxy and Universe V. 2-1, 3-1, 4-1,2

Middle School

Matter & Energy IV. 2-5, 3-2
Solar System, Galaxy & Universe V. 2-1, 4-1,2

High School

Cells III.4-2
Matter & Energy IV. 1-5, 3-2
Solar System, Galaxy & Universe V. 4-2,3,4,6

We welcome any suggestions, comments, or tips on these activities and resources, so we can improve these resources for you and your students in the Southeastern Michigan community! Thanks again for choosing the New Detroit Science Center and the Dassault Systèmes Planetarium! Contact us @

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Program Objectives:

Upon completion of this program, students will be able to:

1) Identify the different types of objects in the solar system: including planets, moons, asteroids, interplanetary dust, and comets;

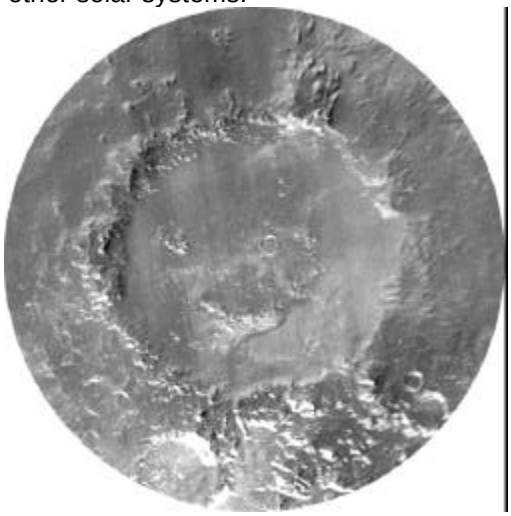
2) Explain the differences between planets, moons, asteroids, and comets;

3) Identify the planets in order from the innermost to the outermost, and identify which planets are currently visible in the evening sky with the naked eye;

4) Understand how the use of robotic missions has increased our knowledge of the Solar System;

5) Understand the spatial relationships between objects in our solar system and other objects in the Universe, and

6) Understand the limits of our knowledge of our and other solar systems.



Mars Happy Face Crater–Courtesy NASA/JPL Jet Propulsion Laboratory–Mars Global Surveyor

Pre-visit Activities

Solar System Adventure - Focus on Astronomy Questions

Questions for you and your students to ponder before your visit…

Q: What can I see in the Sky?

A: In the daytime, you can see the Sun, the Moon (sometimes), clouds, and rainbows. On a clear night away from city lights you can see stars, the Milky Way, the Moon (sometimes), planets, meteors (often called shooting stars), and comets.

Q: Why does the Moon change shape and appear sometimes during the day or sometimes at night?

A: From any location on the Earth, the Moon appears to be a circular disk, which at any specific time, is lighted to some degree by direct sunlight. However, the Moon orbits the Earth, so we get to see more or less of the side that is lit by the Sun during this 29 and one half-day cycle. Although this cycle is a continuous process, there are eight distinct, traditionally recognized stages, called phases. The phases designate both the degree to which the Moon is illuminated and the geometric appearance of the illuminated part. These phases of the Moon, in the sequence of their occurrence are: a) new moon (not visible); b) waxing crescent; c) 1st quarter moon; d) waxing gibbous); e) Full Moon; f) waning gibbous; g) 3rd quarter; and h) crescent gibbous. The cycle starts over with the next new moon.

Q. What are the planets?

A. Once thought to be gods, the planets (from the Ancient Greek word for wanderer) are worlds made of either solid matter (terrestrial or Earth-like) or Gas Giants (consisting of hydrogen, helium and other gases) Terrestrial planets include Mercury, Venus, Earth and Mars; while the gas giants include Jupiter, Saturn, Uranus and Neptune. Pluto, the most distance planets, is still unexplored and unknown.

Q. How do you tell planets from stars?

A. You can tell a planet from a star by watching the object and its location among the stars every clear night. Stars will remain in a relatively fixed place, rising in the east and setting in the west, while a planet will move among the stationary stars over the passing of days and weeks. The further the planet is from the Sun, the slower it will move in the sky.

Q. How many of the planets can we see in the sky without the use of a telescope or binoculars?

A. Five planets are located close enough or are large enough to be observed by the naked eye on the Earth. These include: Mercury, Venus, Mars, Jupiter and Saturn. Whether any of these five planets can be seen in the evening sky is dependant upon the location of the earth, sun, and these five planets. If the planet is too close to the Sun, from the perspective of Earth, then an earthly observer cannot see it. Planets such as Mercury and Venus, being close to the Sun, vary in their location in the sky quickly, sometime seen in the sky before sunrise, and changing position to be seen shortly after sunset. Planets such as Jupiter and Saturn move slowly through our sky, due to their great distance from the Sun.

Q. Is the Earth the only planet with a moon?

A. Earth is not the only planet with a moon, although it was the first to be observed by humans. No other moons were found until 1610, when Galileo Galilei used the newly invented telescope to look at celestial bodies. His telescope revealed the craters and mountains on the Moon, the four largest moons orbiting Jupiter, and the phases of Venus. These observations shattered the belief that Earth was the center of the universe, and paved the way for the Sun to take its place as the center of the Solar System.

Q. What are shooting stars, and where do they originate or come from?

A. Meteoroids are the smallest particles orbiting the sun, and most are no larger than grains of sand. These objects originated from comets orbiting the Sun. Comets are large balls made of frozen gasses and water, rock particles, and dust. As some comets fall in towards the Sun, the heat of the Sun melts the comet, and the dust and gasses form a gas and a dust tail that can grow millions of miles long. The dust and rock particles are left behind in a cloud, and become meteoroids.

Meteoroids cannot be observed moving through space because of their small size. Over the years numerous man-made satellites recovered by manned spacecraft have shown pits in their metal skins, which were caused by the impact of meteoroids. Meteoroids become visible to observers on Earth when they enter Earth's atmosphere. Then they are referred to as meteors. They become visible as a result of friction caused by the air slamming against the surface of the meteor while it falls at 60,000 miles per hour! The friction typically causes meteors to glow blue or white, although other colors have been reported. Most meteors completely burn up in the atmosphere at altitudes of between 60 and 80 miles. They are rarely seen for periods longer than a few seconds. Occasionally, a large meteor will not burn up completely as it moves through Earth's atmosphere. If it has a mass of more that 2.2 pounds = 1 kilograms, it might survive the trip and fall to Earth's surface. These are known as meteorites.

Q. What is in the Solar System?

A. The Solar System refers to our system of one star (The Sun), nine planets, over 90 moons, over 10,000 asteroids, millions of comets, and uncounted bits of dust and rock (meteoroids).

Q. What is the Sun, and how does it make the light and heat we see and feel on Earth?

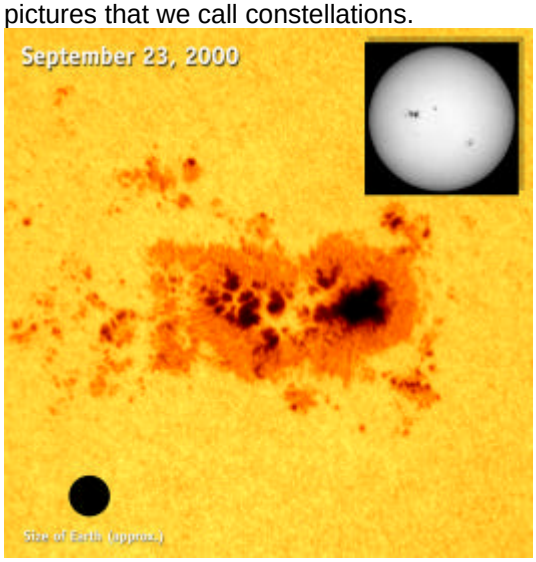
A. The Sun is a small yellow dwarf star, made out of very hot gasses. The Sun is much brighter that the nighttime stars only because of its relative closeness to Earth. The Sun is an average 93 million miles from us, while the next nearest star is 25.2 million million miles away. Look at a flashlight next to your face with the same flashlight down the hall at school. The closer the light is, the brighter it appears to be. Like other stars that we can see in the night sky, the Sun has mostly hydrogen and helium, although astronomers have detected most of the naturally occurring elements including gold, iron, and oxygen. At the center of the Sun, called the core, hydrogen is heated to 15 million degrees and placed under extreme pressure. This combination of pressure and heat forces hydrogen atoms together to create helium, along with a tremendous amount of energy. The Sun's output includes X-Ray, ultra-violet, visible, infrared, and radio light. These light waves reach Earth in 8 minutes and 20 seconds.

Q. What are the dark spots on the Sun?

A. First seen by the Chinese over 5,000 years ago, these are called sunspots. Not many people took notice of them unless they became so large as to be seen by the naked eye. Regular observation of these storms in the photosphere did not start in Europe until the invention of the telescope and the re-discovery of sunspots by Galileo in 1610. Soon astronomers found that sunspots come and go in an 11-year cycle, which marks increased activity by our star. Although they are small compared to the Sun, look at the picture below. Each sunspot is much larger than our Earth.

Q. What is outside the Solar System?

A. The Solar System is part of a collection of stars that are in an arm of a galaxy that we call the Milky Way. The stars that we can see all belong to our arm, and our ancestors organized the stars into pictures that we call constellations.



Large Sunspot Group – 09/23/2000

Post Visit Activities

The Official Toilet Paper Solar System Scale Model!

Materials required: Index cards, markers, and rolls of toilet paper

First be sure that your students understand the concept of scale models. Ask the class Why it is necessary to put things on a scale when discussing distance and size in the study of astronomy.

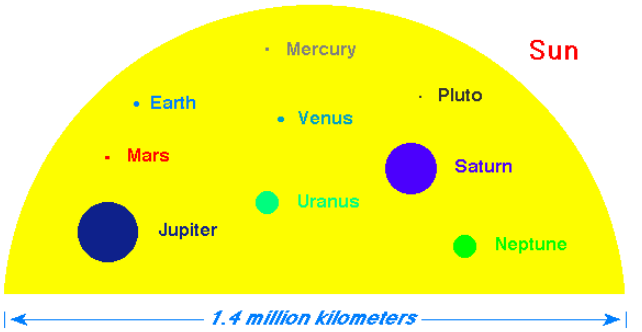
In this model, toilet paper represents an imaginary celestial yardstick, with each square of toilet paper representing 1 million (1,000,000) Miles.

The table on this page gives the average distances of each of the planets from the Sun. We are using an average because each planet's orbit or path around the Sun is not a perfect circle, but an ellipse.

Please note that the number of squares listed by each planet is their individual distances from the Sun, and not the distance from the preceding planet! Also, the table also lists the approximate size of each planet, to scale with the distances of each planet from the Sun.

Write the names each of the planets and the Sun on an index card, and place small cut-out circles on each card to present the size of each planet. Select a student to represent each planet and the Sun, and give them the appropriate index card. They will stand at the correct distance from the Sun, and represent the location of their planet.

Due to the size of this scale model, your school may not be large enough to do the entire model, so you may want to wait for a bright sunny day to do this activity outside. You may elect to have each toilet paper square represent 10 million miles, but the scaled down size of each planet would be reduced ten times as well, and make it very hard for you and your students to see!



Object	Distance from Sun	Distance Needed	Planet Diameter thick as
Sun			staple hole
Mercury	36 sheet	3.6m	Staple hole
Venus	67	6.7m	Paper clip thickness
Earth	93	9.3m	Paper clip thickness
Mars	135	13.5m	.5 paper clip thickness
Jupiter	483	48.3m	>Pencil
Saturn	886	88.5m	Pencil
Uranus	1783	178.3m	Lace hole
Neptune	2793	279.3m	Lace Hole
Pluto	3675	367.5m	Small staple

Astronomy & Space Exploration Web Sites

http://www.boonhill.net - Master Web Site for Michigan Astronomical Societies, including the Warren Astronomical Society and the Ford Amateur Astronomy Club

http://www.nasa.gov - ***NASA HQ's*** Web Site. A great place to start your research!

http://www.jpl.nasa.gov/forum/indexpg.html @ NASA's Jet Propulsion Laboratory (JPL) supplies a master list of web sites for astronomy and space exploration!

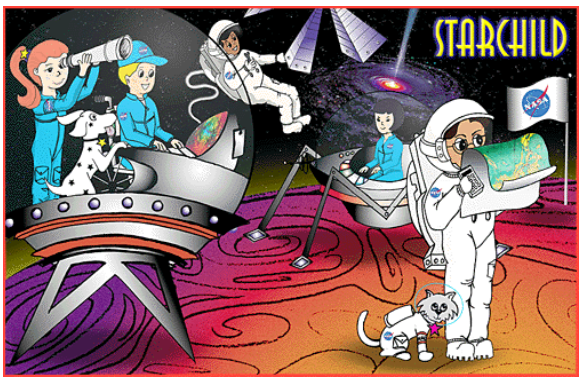
http://www.stsci.edu - ***Hubble Space Telescope*** (HST) HQ. Movies & pictures!

http://amazing-space.stsci.edu/ **-** ***Amazing Space*** a site with lots of Web-based activities designed for classroom use and for the general public.

http://origins.stsci.edu **-** ***The Origins Program*** studies events starting at the birth of the universe in the Big Bang, the forming of galaxies, stars, & planets, & the start of life on Earth and possibly elsewhere.

http://www.stsci.edu/exined - Welcome to ***Education, Please*** stop and take a look at our latest electronic offerings of Macintosh, Windows, and DOS software available for downloading!

http://photojournal.jpl.nasa.gov @ NASA's Jet Propulsion Laboratory (JPL) - ***The Planetary Photojournal*** will provide you with easy access to the images from various Solar System exploration programs.



http://imagine.gsfc.nasa.gov/docs/homepage.html ***Go Imagine the Universe*** is a learning center for **high school students** 14 years and up.

http://starchild.gsfc.nasa.gov/docs/StarChild/StarChild.html ***Starchild*** is a learning center for **Elementary or Middle school** astronomers.

http://www.skypub.com - Home site for ***Sky and Telescope magazine***, started in 1936. S&T is the oldest and longest running astronomy magazine in the US

http://www.astronomy.com - ***Astronomy magazine***, started in 1973, and is published by Kalmbach Publishing.

http://www.jpl.nasa.gov/cassini/Kids/ ***Cassini for Kids*** , a site just for kids where they can explore the beautiful ringed planet Saturn and learn about the spacecraft currently on their way there!

http://www.jpl.nasa.gov/galileo/education.html ***Galileo K-12 Educator's Resources*** The materials gathered in these pages are aimed at K-12 teachers and students for NASA's The Galileo mission to study Jupiter and its moons.

http://www.estec.esa.nl/outreach @ ***European Space Agency***. The main education and outreach web site for ESA missions and activities.

http://www.astronomy.com/Content/static/parentsteachers/default.asp - ***Astronomy Maga***zine's web site for Parents and Teachers

Planet	Year of 1st Moon Discovery	Latest Number of Moons and names of 1st found moons
Mercury	No Moons	
Venus	No Moons	
Earth	Prehistory	1 (Luna or Moon)
Mars	1877 (A. Hall – USA)	2 (Phobos and Deimos)
Jupiter	1610 (Galileo – Italy)	61 (Io, Europa, Ganymede, Callisto-Galilean moons)
Saturn	1655 (C.Huygens-Nederlands)	31 (Titan)
Uranus	1787 (W Herschel-Great Britain)	25 (Titania & Oberon)
Neptune	1846 (W. Lassel-Great Britain)	11 (Triton, Nereid)
Pluto	1978 (J. Christy-USA)	1 (Charon)