



Q U A N T U M
QUEST
A CASSINI SPACE ODYSSEY
3D



Solar Safari Activity Guide

Join the Quest!

See the Solar System
like you've never seen it before.



Download this Planetary Activity Guide at:
www.QQtheMovie.com/#/education/planetary-guide

Guide Produced and Presented by The Planetary Society and Jupiter 9 Productions



Quantum Quest, Science and Space Education

A message from Film Maker/ Scientist

Dr. Harry Kloor, Ph.D. Physics, Ph.D. Chemistry



Quantum Quest: A Cassini Space Odyssey is designed as a means to advance science literacy through a large format film, its

website www.qqthemovie.com, and ancillary material like this booklet. Each booklet contains pre and post theater materials that can be used by kids, teachers, and parents to enhance their film learning experience. Educators may freely use the characters for non-profit purposes.

With an all star cast, and Hollywood approach to storytelling, Quantum Quest seeks to appeal to everyone, from the science enthusiast to the novice who is fearful or uninterested in science or space exploration. On its surface, Quantum Quest is a sci-fi action film set in a scientifically accurate rendering of our solar system in 3-D stereoscopic. Visually, the film blends computer animation with the fantastic images captured during recent NASA and NASA/ESA space explorations, including the international Cassini Huygens mission. The audience is taken on a simulated solar safari, exploring the inner planets between the Sun and Saturn, and touring the Saturn system's, rings and moons. The film concludes with a Grand Canyon-like flight over the surface of Titan, using image and radar data from Huygens and Cassini space craft.

Science is imparted in the film through its characters (particles and concepts) and the actions they take to save the Cassini-Huygens space craft. Since the inception of the project, the film has been closely

reviewed at every stage by JPL for scientific accuracy. In addition, Dr. Peter Diamandis, the founder of X Prize, and other scientists, have closely reviewed the film to ensure science concepts and all depictions of the Space Discoveries and actions of the Cassini-Huygens space craft are scientifically accurate.

The story of Quantum Quest takes place in a fantastic atomic world, where the forces of Knowledge and Good are represented by positive matter and light who work for THE CORE (William Shatner), and the forces of Evil and Ignorance represented by anti-matter and concepts who work for THE VOID (Mark Hamill). The hero of our story is a photon, named DAVE, played by Chris Pine. Dave is forced from his home in the Sun and must save the Cassini Huygen's space craft from FEAR (Samuel L. Jackson), GENERAL IGNORANCE (Jason Alexander), and MAJOR MORON (Jason Alexander). Dave is assisted on his journey by solar surfing protons lead by JAMMER (Hayden Christensen), a solar neutrino RAYNA (Amanda Peet), Gal 2000 (Sandra Oh), Razor (Doug Jones), Admiral Halifax (James Earl Jones), and a photon who is searching for a free quark which he can't ever seem to find by the name of MILTON (Robert Picardo).

We are honored to have Neil Armstrong, the first man to walk on the moon, voice the character of Jack Doohan. This is Neil's first and only involvement in a film. We are also thankful to Abigail and Spencer Beslin who voiced the two kids who are in the scene with Neil.

For more information visit www.QQtheMovie.com

This Quantum Quest Guide to the Solar System is appropriate for grades 4-12 and grade levels are suggested for each activity. It is most useful when accompanying the film, but is a valuable resource on its own. Teachers are strongly encouraged to adapt the activities included in this guide to meet the specific needs of the grades they teach and their students. All activities developed are consistent with the National Standards for Science and Math but are not referenced specifically due to space constraints and differences in standard use throughout the nation.

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"I'm honored to be an ambassador of Quantum Quest because it is synergistic with my educational goals and commitments. This movie represents a new way of reaching out to children to get them excited and interested in math, science and space which is vital for our future. It is not only an entertaining and educational movie but has a educational outreach element through the web and other materials that keep the life and the value of the movie ongoing indefinitely."

Anousheh Ansari

First Private Female Space Explorer & Co-Founder/Chairman Prodea Systems
www.AnoushehAnsari.com

"Quantum Quest combines entertainment, education, and an all-star cast in a unique, exciting way. Journey through the solar system with David, as he saves Cassini and discovers himself, encountering quantum effects, photon physics, and a tour of Titan based on actual NASA radar mapping that will knock your socks off!"

Dan Barry

Astronaut (STS – 72, 96, 105), Contestant "Survivor: Panama", Scientist

"Quantum Quest is a stroke of Brilliance. Dr. Kloor brings together science fact, entertainment, and a galactic cast in a beautiful 3D action adventure story that will entertain and education from age 6 to 96. NASA should be congratulated for supporting Harry Kloor as he turned otherwise boring science data into an enthralling story and breathtaking images that bring NASA's space missions to life. This movie turns NASA's Cassini Huygens Mission from "nominal" to "phenomenal"."

Peter H. Diamandis, MD

Chairman & CEO, Co-Founder X PRIZE Foundation, Co-Founder International Space University, Zero-G Corp, and Space Adventures

"Quantum Quest is an important part of our science/educational outreach program for the Cassini-Huygens mission. Millions of students will benefit from this animation and it's ancillary educational materials..."

Charles Kohlhase

NASA Distinguished Service Medal Winner & JPL Public Engagement Coordinator for Quantum Quest: A Cassini Space Odyssey, The Cassini Project



Solar Safari Activity Guide

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Quantum Quest Guide to the Solar System

QUANTUM QUEST

A CASSINI SPACE ODYSSEY

3D

Meet The Players



DAVE

"I'm DAVE, a photon, a simple particle of light. I love to play Novaball in Sun City at the core of the

Sun with my best friend Rayna, who is a neutrino — the best looking neutrino you've ever seen. Follow me on my solid light hologram surfboard through the solar system and see your spectacular solar neighborhood as you've never seen it before."



"Dave" is voiced by one of Hollywood's hottest actors, CHRIS PINE, who most recently starred as a young Captain James T. Kirk in the

blockbuster *Star Trek*.



ADMIRAL FEAR

"I am FEAR itself, and I serve my master "The Void" in his mission to obliterate all knowledge.

When you are afraid to learn something, I become more powerful. I hate education and learning because it weakens me. Don't let teachers pass their knowledge virus on to you. Be fearful of new things, and you will help me to annihilate your world."



"Admiral Fear" is voiced by SAMUEL L. JACKSON, one of the world's highest grossing actors, who has appeared in over 70 movies including

three of the six *Star Wars* films.



JACK DOOHAN

"Hi, I'm JACK DOOHAN, the world's greatest meteorite hunter. I have found meteorites in Antarctica that come

from the Moon, in the Amazon that come from asteroids, and in New Mexico that come from comets. In space, meteorites are called meteoroids and they're as stunning as they are dangerous."



On June 20, 1969, Apollo 11 mission commander NEIL ARMSTRONG ("Jack Doohan") became the first man to walk on the Moon. A former

test pilot, university professor and United States Naval aviator, *Quantum Quest* is Mr. Armstrong's first film project.



THE CORE

"Greetings earthlings. I am THE CORE, the embodiment of all stars. Without me, earth would be a

cold, lifeless place. I urge you to join me and my children - photons, protons and neutrinos - to fight The Void, destroyer of all life, for the future of our planet."



"The Core" is voiced by WILLIAM SHATNER, universally known as *Star Trek's* Captain James T. Kirk. Mr. Shatner starred for five seasons in

ABC's critically acclaimed *Boston Legal* as Denny Crane, a role which earned him two Emmy awards and a Golden Globe.



JAMMER

"Surfing the solar winds is not only fun, but for solar protons surfing is literally how we accelerate away

from the Sun. I should know, I'm JAMMER, a solar proton and nothing is as wickedly cool as taking a solar safari."



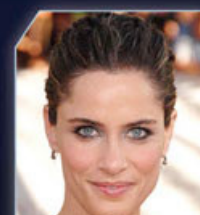
HAYDEN CHRISTENSEN, the voice of "Jammer," starred as Anakin Skywalker in the prequels *Star Wars: Episode II - Attack*

of the Clones and *Star Wars: Episode II - Revenge of the Sith*.

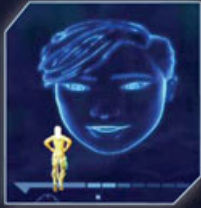


RAYNA

"I'm RAYNA, a Neutrino Ranger. I serve The Core in his fight to stop The Void. The Void wants to destroy the entire Universe."



"Rayna" is voiced by AMANDA PEET. She is well known for her work in comedy/drama films and TV series. Her blockbuster films include *The Whole Nine Yards*, *Something's Gotta Give*, *Identity*, *The X-Files Movie* and 2012.



GAL 2000

"I am Cassini's brain, its central computer. Cassini-Huygens is a real space joint NASA/ESA/ASI

mission to explore the Saturn system. The spacecraft was launched in 1997."



"Gal 2000" is voiced by SANDRA OH. Sandra is best known for her role in *Grey's Anatomy*. She is also in, *Blindness*,

For Your Consideration, *The Night Listener*, and our favorite, *Sideways*.



RAZOR

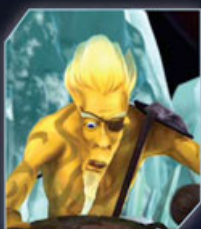
"Like my bro Jammer, I surf the solar winds. When I was young I used to play Novaball and I was awesome!

My girlfriend, Shalla-Bal draws the most epic stylish lines in the magnetic solar winds that roll through your solar system."



"Razor" is voiced by DOUG JONES. Doug has played numerous cool characters and creatures. He was the Silver Surfer in *Fantastic Four: Rise*

of the Silver Surfer, *Fauno* and *Pale Man* in *Pan's Labyrinth*.



MILTON

"I'm a free quark miner, and while most earth scientists think finding a free quark is a near impossibility, I believe I will find

one. Quarks and leptons are the most fundamental particles in the Universe. Margaret is my trusted companion."



"Milton" is voiced by ROBERT PICARDO. Robert was the DOCTOR in *Star Trek: Voyager*. He has joined the cast of *Stargate Atlantis*. Watch Robert

in the film *Sensored*.



THE VOID

"I am that which existed before the Universe was created. I am nothingness, emptiness. Help me erase the Universe."



"The Void" is voiced by MARK HAMILL. Mark was Luke Skywalker and the voice of Joker in the *Batman* series.



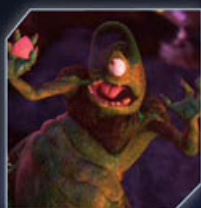
GENERAL IGNORANCE

"Ignorance is bliss! My good friend Major Moron and I have only a quarter of a brain—

if we had more perhaps we wouldn't be so stupid. Being stupid can have its advantages.



"General Ignorance" is voiced by TOM KENNY. Perhaps best known for his work as *Sponge Bob*, Tom has voiced a billion voices! Okay, not a billion but it seems like it. You can hear him in *Transformers* the animated series.



MAJOR MORON

"The keys to being a 'Major Moron' like me are simple. First, make sure you have

as little brains as possible. Next, don't pay attention at school and don't use any of the educational materials on the Quantum Quest site."



"Major Moron" is voiced by JASON ALEXANDER. Jason is best known for playing George in *Seinfeld*, and has appeared in numerous movies and

TV series. Jason is a very experienced voice actor and brilliant comedian.



GENERAL HALIFAX

"I'm Admiral Halifax, I represent a deuteron, which is the nucleus of heavy hydrogen.

I lead The Core's eternal war against the forces of The Void."



"Admiral Halifax" is voiced by JAMES EARL JONES. James began his magnificent acting career in Shakespeare's *Othello*, and, most

famously, in *The Great White Hope*. He is perhaps best known as the voice of Darth Vader in *Star Wars*.



ANTHONY

"I am a championship video game player, and when I grow up I am going to develop video games. So,

I try to learn as much as possible about science and math, because this will help me create great games."



"Anthony" is voiced by SPENCER BRESLIN. Spencer burst into the acting scene with his wonderful performance in *The Kid* with Bruce Willis.



JEANA

"Science is cool. I love playing video games, baseball, and riding my bike, and, science lets me understand all

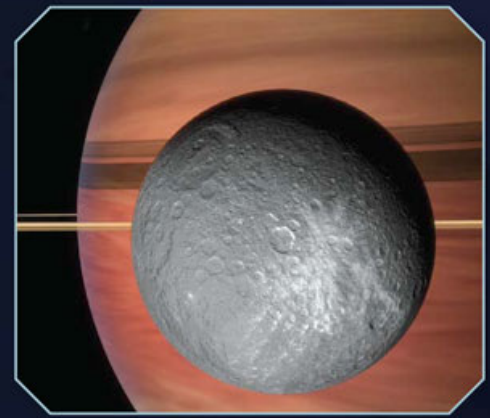
of these things. When I grow up I want to be the first professional baseball playing astronaut."



"Jeana" is voiced by ABIGAIL BRESLIN. Abigail was the lead in *Definitely, Maybe*; *Nim's Island* and *Kit Kittredge: An American Girl*.

introduction

Quantum Quest is an animated science fiction adventure film that captures scientifically accurate renderings of our solar system. Initiated at JPL/NASA, Quantum Quest blends computer animation with astounding real images and radar data from a spectrum of ongoing space missions.



As our characters surf through the Solar System, the audience will see the real surface of planets and moons in 3D, beginning with a journey over the blazing surface of the Sun (via images from NASA's Solar and Heliospheric Observatory — SOHO). From the Sun the viewers are taken on a journey through the Solar System, over the spider craters of Mercury, through the dense clouds of Venus — racing through the canyons of Mars to the Moons of Saturn. The film concludes with a Real 3D tour of Titan, a moon of Saturn that has rivers, giant lakes of natural gas, and even methane rainfall!



Through DAVE and his friends, the viewers are taken on an atomic odyssey that inspires them to learn more about physics, chemistry and the universe.

The Jet Propulsion Lab (JPL), NASA's facility in Pasadena, California, has been a part of this production process and has ensured scientific accuracy of the physics concepts

and representations, the correct engineering depictions of the Cassini spacecraft and Huygens probe as well as all NASA images.

cast of characters

Quantum Quest features dynamic, wonderous characters that represent physics concepts. Our mythology centers on an epic battle of knowledge/life vs. ignorance/non-existence, the outcome of which will determine the fate of the universe.



DAVE is a photon, a being of light, who lives in Sun City — not Arizona, but at the core of the Sun. Sun City is inhabited by Photons, Neutrinos and Proton citizens, all living in tranquility and unity. Until one day DAVE is forced to leave the Sun and engage in a conflict between The CORE (knowledge) and THE VOID (absolute nonthingness). DAVE's quest is to save his people, the Cassini Spacecraft, and ultimately, the Universe from annihilation.

ADMIRAL FEAR, GENERAL IGNORANCE, MAJOR MORON and ZERO, an anti-proton warrior, all endeavor to divert DAVE from his mission. But with the help of neutrino, RAYNA, and two protons, JAMMER and RAZOR, DAVE goes on to fulfill his destiny.

storyline

Quantum Quest opens with a stunning view of the planet Saturn. Heading toward this giant world is NASA's spacecraft Cassini-Huygens. We are in the CalTech auditorium watching a video presentation through two students' points of view.

"Welcome to the atomic realm of Quantum Quest, where a war wages at the edge of Earth's solar system between the forces of the CORE and the VOID."



The CORE, a being of knowledge and light leads the citizens of Sun City against... the VOID, a being of nothingness, desirous that all knowledge and life be destroyed, who leads an army of anti-matter.

We follow the probe into space as we scan radio stations to settle on Casey Kasem's broadcast:

"In other news...
Mission Control has
just announced... in

just three short weeks the Huygens Probe will punch through the thick cloud-covered veil that surrounds Titan, Saturn's largest moon. What marvelous secrets will Huygens uncover?"

We then dive into the sun's core and move back in time one million years to Sun Coast Middle School Stadium where we hear the thunder of cheering crowds and a Novaball game in progress. Here we meet the main characters, DAVE, a photon, and RAYNA, a neutrino, who go on to help their team, the Solar Winds, win the Novaball competition.



As rewards, Admiral Halifax of the CORE offers RAYNA and DAVE high positions in Operations. RAYNA accepts and departs in Ranger status, but DAVE chickens out and remains behind. After all, he's no Milton Rah, all-time hero of the good guys.

Meanwhile, inside the Kuiper Belt, just beyond Pluto, the Rangers battle a force of anti-proton ships. The Proton fleet suffers heavy losses and aboard Admiral Halifax's ship the mood is grim. RAYNA is tasked with getting a message out for help. She rockets into a field of asteroids, barely escaping

with her life. In the camp of the VOID and the dark forces, we meet kooky characters such as MAJOR MORON and GENERAL IGNORANCE, who lend a bit of levity to this grave situation. The army of the VOID consists of GELLMAN ghosts, the essence of non-existence. Their plan is to kill the Rangers and destroy the Cassini Spacecraft.



Back at the stadium, RAYNA reunites with DAVE. GELL-MAN ghosts follow her in and DAVE is forced to take a stand. RAYNA begs him to find the Cassini Commander and give him a message that is hidden in a gem. She shoves the gem into his chest and he takes off to seek his destiny.

In DAVE's quest for the Cassini Commander he befriends a group of Surfer Protons who help him search for the spacecraft. On their journey, they battle the GELL-MAN ghosts on a perilous surfer ride through the Solar System. They zoom by Mercury's spider crater and pass by the thick clouds of Venus. They scoot over Mars' moon Phobos and toward the red planet. There they fly through the giant canyon, Valles Marineris.

At the same time DAVE is nearing Saturn's system, ADMIRAL FEAR, leader of the VOID is making plans to destroy Cassini. Cassini represents knowledge and all knowledge must be destroyed.



As DAVE descends onto Saturn's moon, Enceladus, with its field of icy monoliths, he spies another photon like himself, but much older. It is Milton Rah, great military commander of all time, leading a double-ass Tarmouth named Margaret. Rah is now a burnt-out photon, mining the moon's surface. When Rah sees the "gem" DAVE is carrying, he taps it and out comes a message: Cassini is in imminent danger.



In a struggle to save the spacecraft, DAVE must call on his reserves and unleash the hero that has been hidden within. He locates Cassini and

enters the craft. There a voice welcomes him — the voice of GAL 2000, the brain of Cassini. GAL is excited about downloading data to Earth from the Huygens probe on the moon Titan.



In a final confrontation with FEAR, DAVE, with the help of Milton Rah, defeats the dark VOID and saves Cassini-Huygens. DAVE returns home a hero in RAYNA's eyes... and in his own.



From Casey Kasem: "I've just been informed Huygens is punching through the bottom cloud layer of Titan. An image is forming on my screen. Oh my... it's... it's amazing!"



Q U A N T U M
QUEST
A CASSINI SPACE ODYSSEY
3D

Solar Safari Introduction



Welcome!

I am the Core, the embodiment of all stars. Without stars, the universe would be a cold, lifeless place. My children, all citizens of the Sun, are photons, protons, electrons, and neutrinos. They bring warmth and illumination to Earth.

Your Sun, named Sol, is one of my favorite middle-sized stars. Sol has a family of 8 planets and several other celestial relatives I think you should meet.

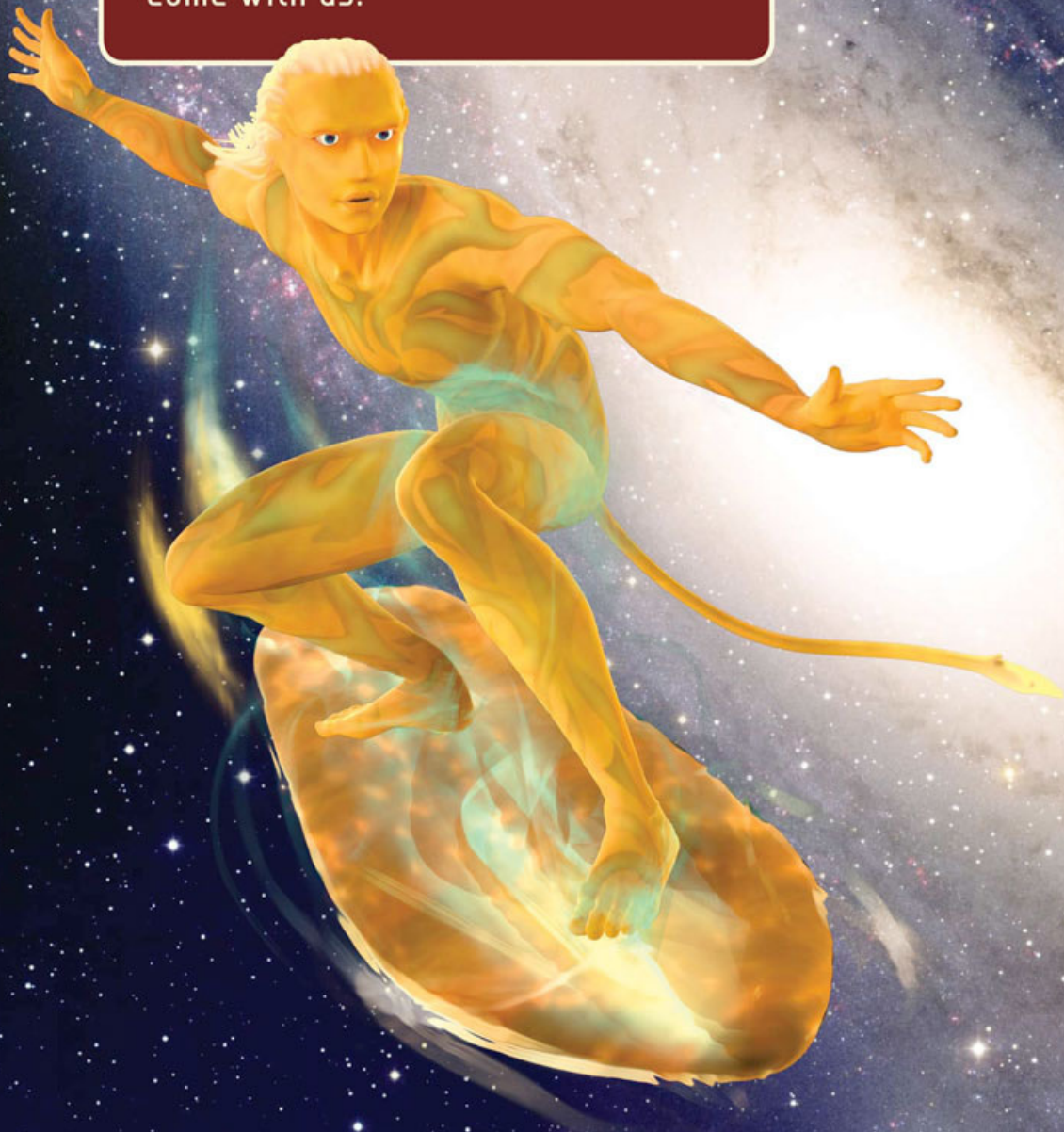
Expand your horizons! Increase your knowledge! Join the Citizens of the Sun on an interplanetary expedition of your very own solar system.



THE
PLANETARY
SOCIETY

Solar System Formation

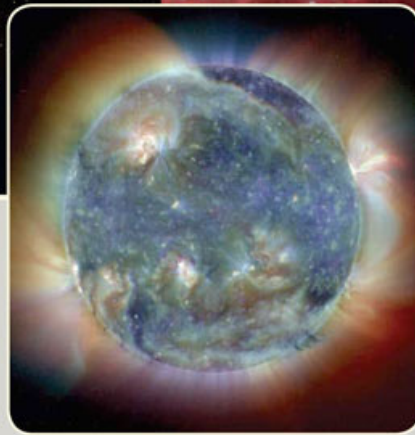
Hi, My name is Dave. I'm a photon; a simple particle of light. My friends and I had a blast surfing through your solar system in the movie Quantum Quest. We're on our way back to explore it right now — come with us!





Andromeda, the Galaxy Next Door

At approximately 2.5 million light-years away, the Andromeda Galaxy, or M31, is our Milky Way's largest galactic neighbor. The wisps of blue making up the galaxy's spiral arms are neighborhoods that harbor hot, young, massive stars. Meanwhile, the central orange-white ball reveals a congregation of cooler, old stars that formed long ago.



First Stop: Planetary Formation

Now, since Earthlings weren't around before the Solar System formed, there is no eyewitness account or scientific proof that documents exactly how it happened. An accepted theory, called the Theory of Planet Formation, says that 4.6 billion years ago the Sun and its solar family was born from a molecular cloud of interstellar gas and dust like this one [pictured below].



The thickest part of the molecular cloud became the core, and as the core sucked in more and more matter, it grew thicker and thicker. Then the new core, known as the proto-Sun, collapsed into itself and grew

hotter and hotter, and nuclear reactions began deep in its core. It started to shine as "Sol," your magnificent Sun.

Next, the leftovers from the cloud pulled together into a disk that was called the solar nebula. It was freezing cold at its edges and boiling hot near the proto-Sun, and particles within the nebula started to collide and clump together. Before long, small bodies started forming out of those particles, which attracted even more particles, growing larger and larger. The bodies that were closest to the proto-Sun got too hot to hold water or ice, so they evolved into the small rocky planets that you call Mercury, Venus, Earth, and Mars. Farther from the Sun's heat, where the temperatures were much, much colder, Jupiter, Saturn, Uranus, and Neptune formed. These colder bodies are called the gas giants because of their gigantic size and because

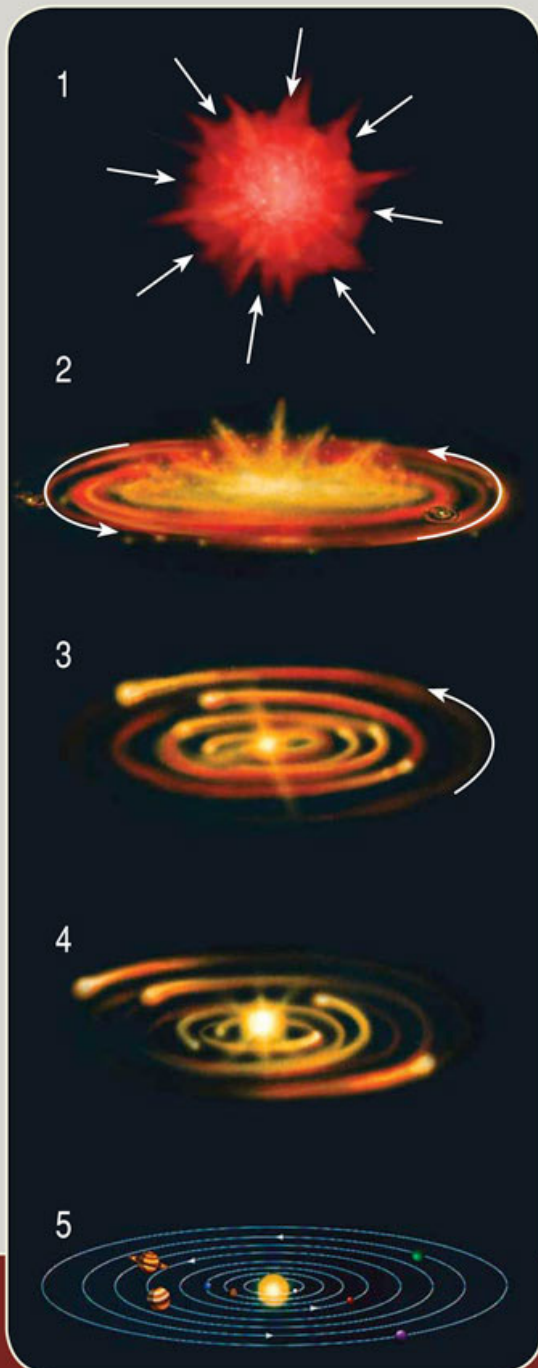
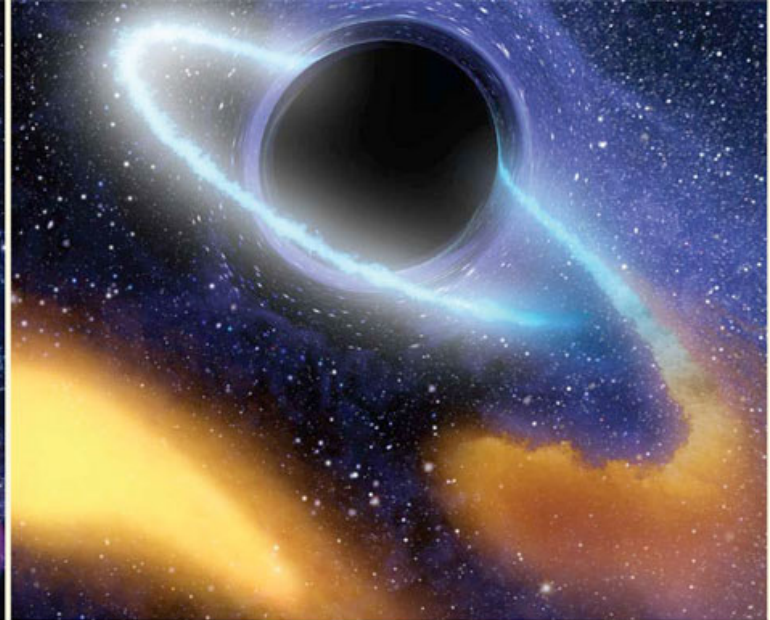
they were mostly made of gasses like hydrogen and helium.

Rocky and metallic fragments called asteroids that never formed into planets wound up between Mars and Jupiter, in the Asteroid Belt.

Extremely far out, in a part of your Solar System called the Kuiper belt (illustrated below) where the Sun's heat barely reaches, icy bodies resembling dirty snowballs took shape.



Most of them were small and cold and packed with frozen water and rocky elements. A few collided and formed plutoid/dwarf planets like Pluto, and still others turned into comets.



We continue to learn more about the formation of planetary systems.

We recently discovered debris belts surrounding nearby stars and the discovery of more than 350 extrasolar planets so far! Teams of scientists are coming up with new theories of planetary formation as they discover even more planets around other stars. They're doing this with the Kepler Mission and also with the Hubble Space Telescope, the Very Large Telescope, the Spitzer Space Telescope, the James Clerk Maxwell Telescope, the Very Large Baseline Array, and—starting in 2014—the James Webb Space Telescope. You can learn about many of these missions and their discoveries in the "Explore More" section [on the next page].

PLANETARY SOCIETY HOT SPOT

See the growing number of exoplanets with The Planetary Society's Catalog of Exoplanets!

Visit: www.planetary.org/exoplanets/



Stars have life spans just like humans do.

At 5 billion years old, your star Sol is middle aged, so he'll be turning hydrogen into helium in his core for at least 5 billion years more!

Extrasolar Planets

www.planetary.org/explore/topics/extrasolar/
Learn about planets outside our solar system.

The Circumstellar Disk Learning Site

www.disksite.com
Learn about outer space stellar debris.
[Click on the "Image Gallery" on top]

Very Large Telescope

www.eso.org/public/astronomy/teles-instr/paranal.html
Learn about the primary space telescope for the Europe. Click on the "Multimedia" link on the left for images & videos.

The James Webb Space Telescope

[planned launch 2014]
www.jwst.nasa.gov/
Learn about the next major NASA telescopic adventure, scheduled to launch in 2014. Be sure to click on the link on the left "For Public".

Kepler Mission: A Search for Habitable Planets

www.kepler.nasa.gov/
Learn how NASA is searching for planets outside our solar system. Click on some of the link on the right to see some of the images recently taken on this new mission.

Very Large Baseline Array

www.vla.nrao.edu/
Learn about radio astronomy. Click on the link on the right "Read about the fundamentals of Radio Astronomy".

Hubble Space Telescope

www.hubblesite.org/
Learn about many of the new discoveries that the Hubble Space Telescope has made. Click on the "Gallery" link for pictures.

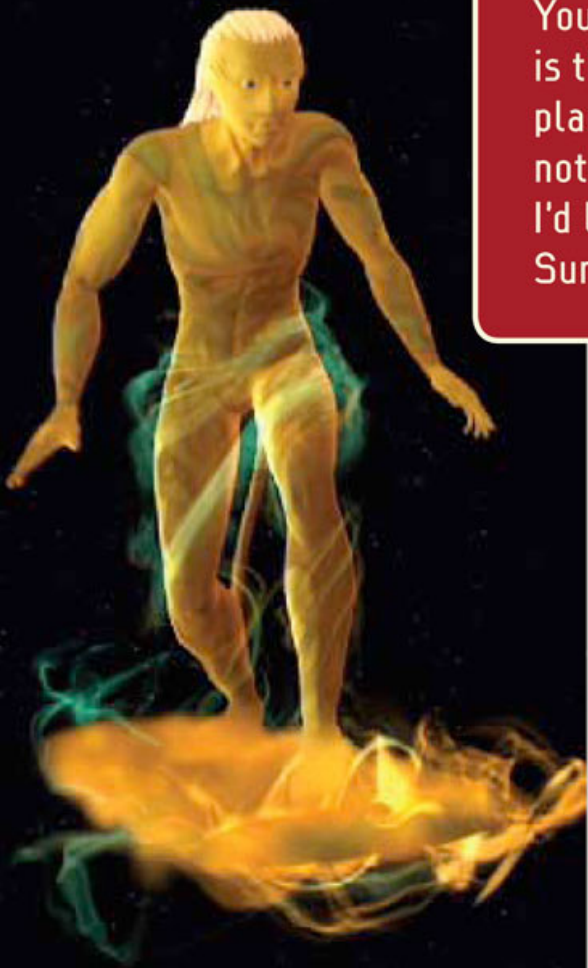
Spitzer Space Telescope

www.spitzer.caltech.edu/
Learn about another NASA Space Telescope. Click on one of the continually updated links to see what this telescope has recently seen.



SUN

You Earthlings love the Sun because it is the primary source of energy for your planet. Without it, life as you know it could not exist! However, if I were an Earthling, I'd be very careful...because at times, the Sun can cause BIG trouble!



For Example...

Every 11 years or so, sunspots, which look like freckles on the surface of the Sun, start to appear in greater numbers. This is the sunspot cycle. Menacing electromagnetic storms usually follow. They're extremely powerful and can knock the Earth's high-tech civilization right on its butt by disrupting satellites, power grids, radio communications, and the global positioning systems.



Solar Missions

Solar and Heliospheric Observatory (SOHO) (Launch: 1995)

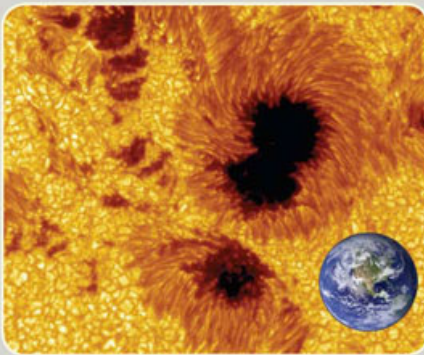
Solar Terrestrial Relations Observatory (STEREO) (Launch: 2006)

Solar Dynamics Observatory (SDO) (Launch: 2009)

Hydrogen • Helium • Other • Contains 99.86% of the mass of the whole Solar System

Bubble! Bubble! The Sun Can Mean Trouble!

The Sun is 145 million kilometers from Earth • 29 Million degrees Fahrenheit at its core

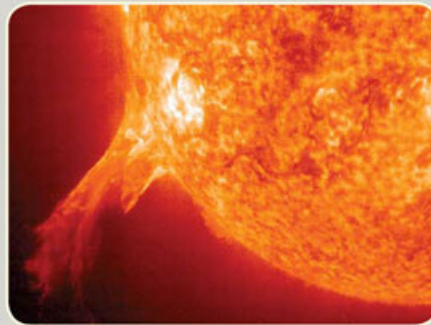


Sunspots

They look dark because they're thousands of degrees cooler than the rest of the Sun's surface, are intense concentrations of magnetic energy. They're the source of auroras, solar flares, intense ultraviolet radiation, and gigantic eruptions of charged particles called CMEs (which stands for Coronal Mass Ejections).

Heat

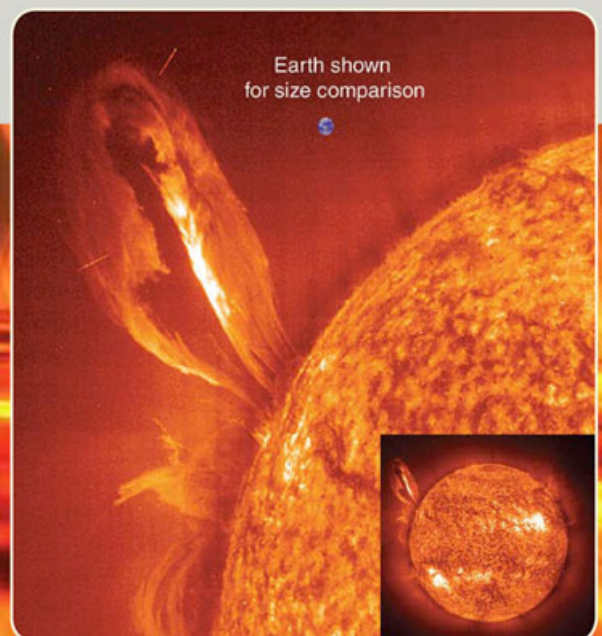
The Sun's core makes its outer layer churn like a pot of boiling water. Solar storms are born deep within this outer layer along



with tangled solar magnetic fields, which tend to snap without warning, like rubber bands that have been stretched too far. When they snap, they release enormous amounts of energy in the form of either solar flares or CMEs.

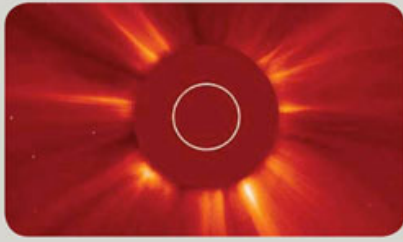
Solar Flares

Sudden explosions, equal to billions of nuclear bomb blasts that occur within the Sun's atmosphere. CMEs are solar eruptions that blast billions of tons of charged particles out into space at millions of miles per hour. Scientists are still trying to pin down the cause of solar flares and CMEs, so that solar storm predictions can be improved, and astronauts will know when to shield themselves from deadly radiation!



WARNING!

Never stare directly at the Sun!
Not even with sunglasses! You
WILL DAMAGE your eyes!



The Corona & The Solar Wind

The corona, the outermost layer of the Sun's atmosphere, is constantly leaking away into space like steam from a tea pot filled with boiling water. The constant outflow of gas is called the solar wind. It's like a conveyor belt that carries charged particles that were once part of the Sun's surface into interplanetary space. It travels about 1 million miles per hour but can gust up to 4 million miles per hour if a powerful CME is passing by.

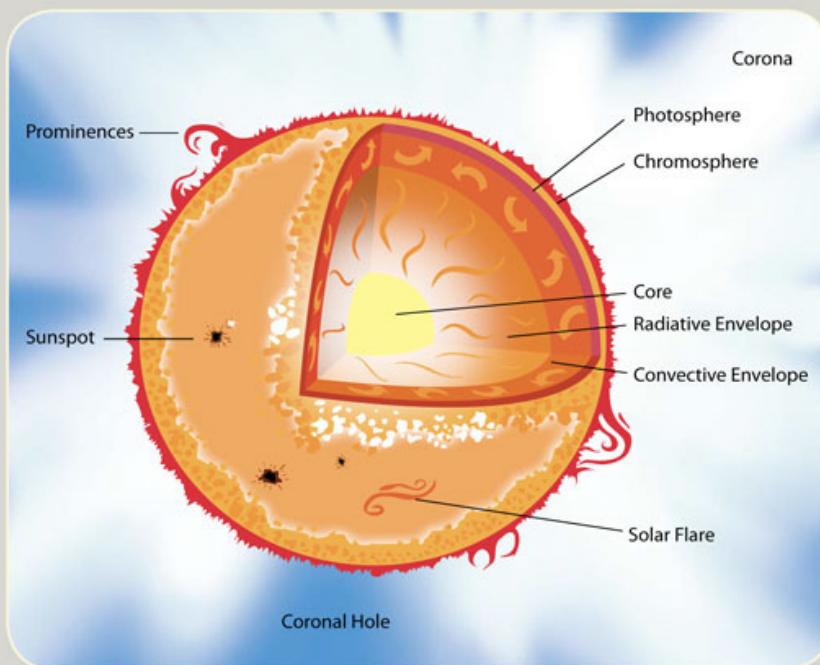
When the solar wind encounters a planet, it can have a damaging effect on a planet's atmosphere or on the planet's magnetic field (which is a shield that protects the planet's surface from the force of the solar wind). Earth, Jupiter, Saturn, Uranus, and Neptune have powerful magnetic fields to help protect them, but Venus and Mars do not, so they experience the dangerous force of the solar wind.

The Aurora Known as the Northern Lights, or the Aurora Borealis, auroras form after electrically charged particles from the Sun hit the Earth's atmosphere. They are visible evidence that the Sun and the Earth are connected by more than just sunlight. Excited

oxygen and nitrogen atoms hundreds of miles above Earth's surface create their spectacular colors. Oxygen emits a greenish-yellow or red light, and nitrogen usually gives off a light that looks blue. If the colors blend, you might even see purples, pinks and whites!



The best places to see auroras are in central Canada, Alaska, Greenland, northern Scandinavia, and northern Russia. (On rare occasions, they can also be seen as far south as Florida and Texas!)



PLANETARY SOCIETY HOT SPOT

The Planetary Society is developing a kind of spacecraft called LightSails that will be propelled by the pressure of sunlight! These spacecraft may one day be used to alert us to CMEs.

Find out more about LightSails: http://www.planetary.org/programs/projects/solar_sailing/



NASA Solar Eclipse Page

www.eclipse.gsfc.nasa.gov/solar.html

Learn about Solar Eclipses. Click on one of the many links of years to learn about and see images of various eclipses.

Solar Terrestrial Relations Observatory (STEREO)

www.stereo.gsfc.nasa.gov/

Learn all about the STEREO Mission. Click on any of the links in the "Resources" section on the left side to see some of the discoveries of this mission.

Solar and Heliospheric Observatory (SOHO)

www.sohowww.nascom.nasa.gov/

Learn all about the SOHO Mission. Click on the "Gallery" link on the top to see pictures this mission has taken.

Solar Dynamics Observatory (SDO)

www.nasa.gov/mission_pages/sdo/main/index.html

Learn all about the various missions NASA has undertaken to study the solar system. Click on the links "Current Missions" on the left for an up-to-date listing of the missions. Click on "Multimedia" on top for a collection of images and videos.



Jammer's Neat Facts

The Sun is the star at the center of the solar system. Its gravity holds the solar system together.

One million Earths could fit inside the Sun, if the Sun were hollow.

Photons take almost one million years to escape the Sun's core and reach its surface.

At five billion years old, the Sun is middle aged.

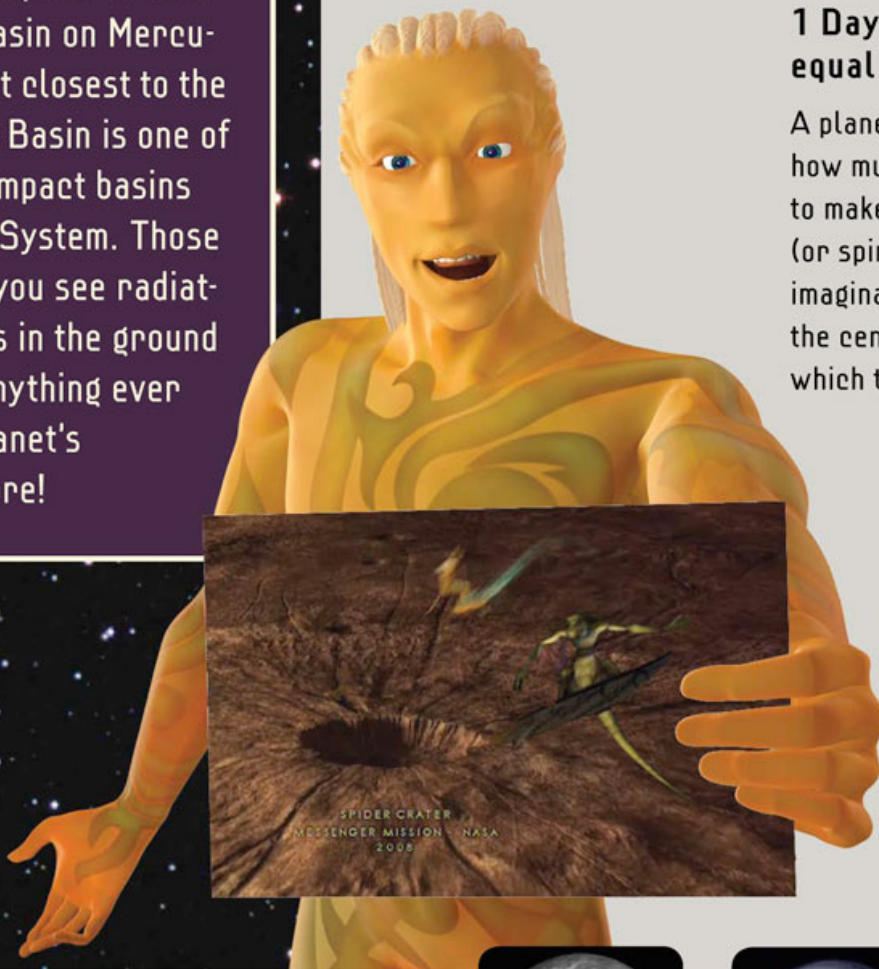
Light from the Sun takes about eight minutes to reach the Earth and about five point three hours to reach Pluto.

It's illegal to walk backwards after the sun sets in Devon, CT, USA.

MERCURY

Hey Kids...look at this!

It's a picture of Jammer from Quantum Quest, surfing over the Spider crater in Caloris Basin on Mercury, the planet closest to the Sun! Caloris Basin is one of the largest impact basins in the Solar System. Those cracks that you see radiating outwards in the ground are unlike anything ever seen on a planet's surface before!



Check it out! Here's something really interesting!

**1 Year on Mercury is
equal to 88 Earth Days**

**1 Day on Mercury is
equal to 2 Mercury Years**

A planet's day is measured by how much time it takes the planet to make one complete rotation (or spin) around on its axis: the imaginary line that runs through the center of the planet, around which the planet spins.

PLANETARY SOCIETY HOT SPOT

Compare Mercury with the other planets!

http://www.planetary.org/explore/topics/compare_the_planets/

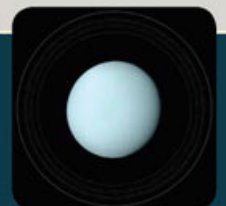


Image of three drawings of planet shaped objects showing the tilt of rotation axis: ie; 0 degrees (Mercury) 23.5 degrees (Earth) and 97.9 degrees (Uranus)

No moon or rings • Boiling days • Freezing nights

Smallest Planet...Shortest Year!

Iron and rock • Liquid iron core • Grey in color • Wrinkled ridges

A planet's year is measured by how much time it takes the planet to make one complete orbit around the Sun. So a day on Mercury is longer than a year, because it takes Mercury longer to spin once around on its axis than it does for Mercury to orbit the Sun!

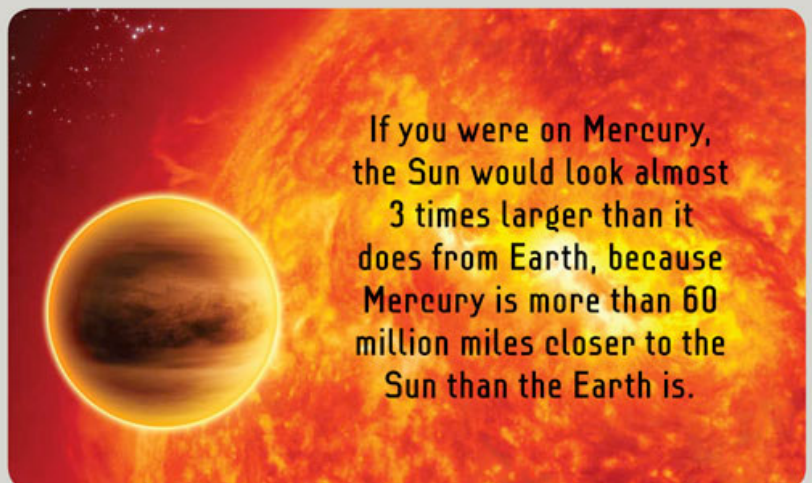
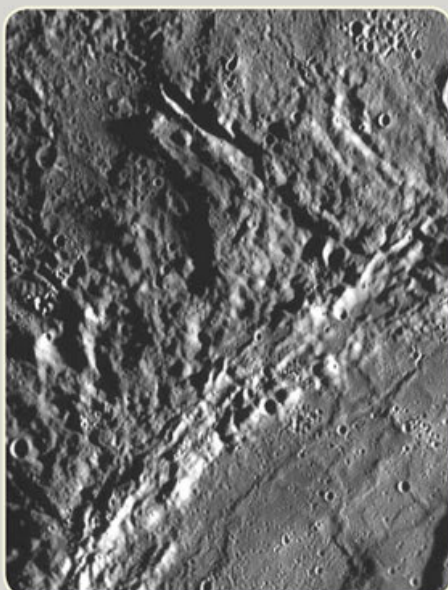
Mercury doesn't have an atmosphere to break the fall of fast moving objects. As a result, it is pockmarked with thousands of craters. Most of these collisions—actually more than any other terrestrial planet suffered—were with small rocky bodies when the Solar System was young.



Mercury has temperatures that fluctuate from some of the hottest in the Solar System, at 800°F, to some of the coldest, at -280°F. As a result of these extremes, scientists think there may be sulfur remnants (deposited by meteorites thousands of millions of year ago) or even water ice (deposited by comets) on Mercury.



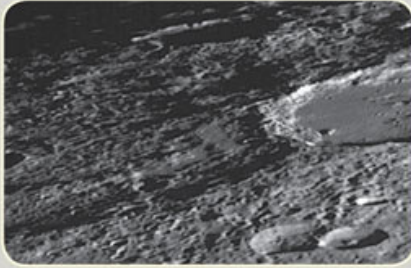
They believe these may be discovered deep within a few of the permanently shadowed craters at Mercury's poles, which have never been warmed by the Sun!
Burrooooooooooooooooooooooooooooooooooooo!



If you were on Mercury, the Sun would look almost 3 times larger than it does from Earth, because Mercury is more than 60 million miles closer to the Sun than the Earth is.

The Mercury Messenger spacecraft recently revealed...

Mercury's crust probably formed when lava, spit out by volcanoes, spread and then

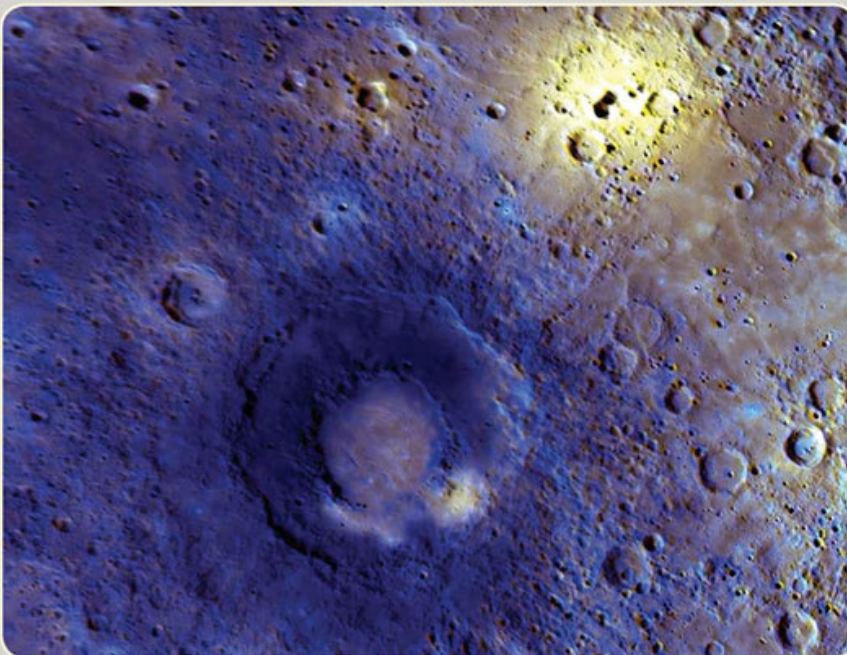
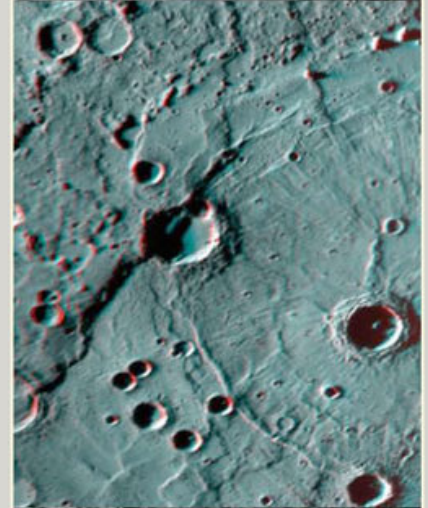
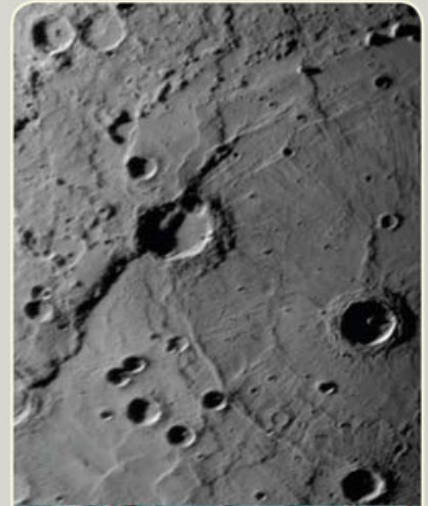


dried on its surface.

Like Earth, Mercury has a magnetic field with two poles that acts like a giant bar magnet and protects Mercury's surface from the force of the solar wind. Messenger also discovered an unusual impact basin on Mercury called the



Rembrandt Basin. At 3.9 billion years old, the Rembrandt Basin is the same age as the Caloris Basin, where the Spider crater was found, but Rembrandt is unusual because part of the original floor of the basin has survived without being filled in by lava flows, so the floor has a pattern of very interesting landforms like wrinkled ridges and troughs, and curved cliffs that scientists think were created when Mercury cooled and shrank thousands of millions of years ago.



This enhanced color image shows a smooth double-ring basin that appears to be the result of effusive volcanism. Also, the yellow spot in the upper right is a rimless depression, which is a candidate for explosive volcanic activity.

The top & bottom images show Mercury's Rembrandt crater with a twenty degree difference between the two. The central image is an anaglyph, or 3D images made by overlaying the two outer images (top in red and bottom in green).

Do More!

Make your own impact crater.
Crash! Bang! Boom!
Pages 60-61

Missions to Mercury

Mariner 10 (Launch: 1973)
Messenger (Mercury Surface,
Space Environment, Geochemistry,
and Ranging) (Launch: 2004)



Mercury

www.planetary.org/explore/topics/mercury/
Learn more about the planet Mercury. Click on the link "Facts and Pictures" in the left side menu, under "Our Solar System" and "Mercury".

Messenger News

www.messenger.jhuapl.edu/
Learn all about the Mercury MESSENGER Mission. Click on the "Gallery" link on the left for images taken by this spacecraft.



Jammer's Neat Facts

Mercury orbits the Sun faster than the other planets.

If Earth were the size of a baseball, Mercury would be the size of a golf ball.

Several of Mercury's craters are named after artists, writers, and musicians, like Michelangelo, Mark Twain, and Beethoven.

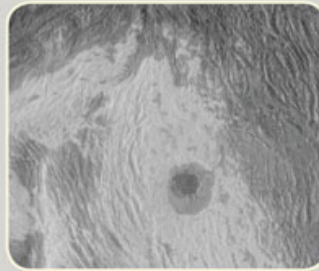
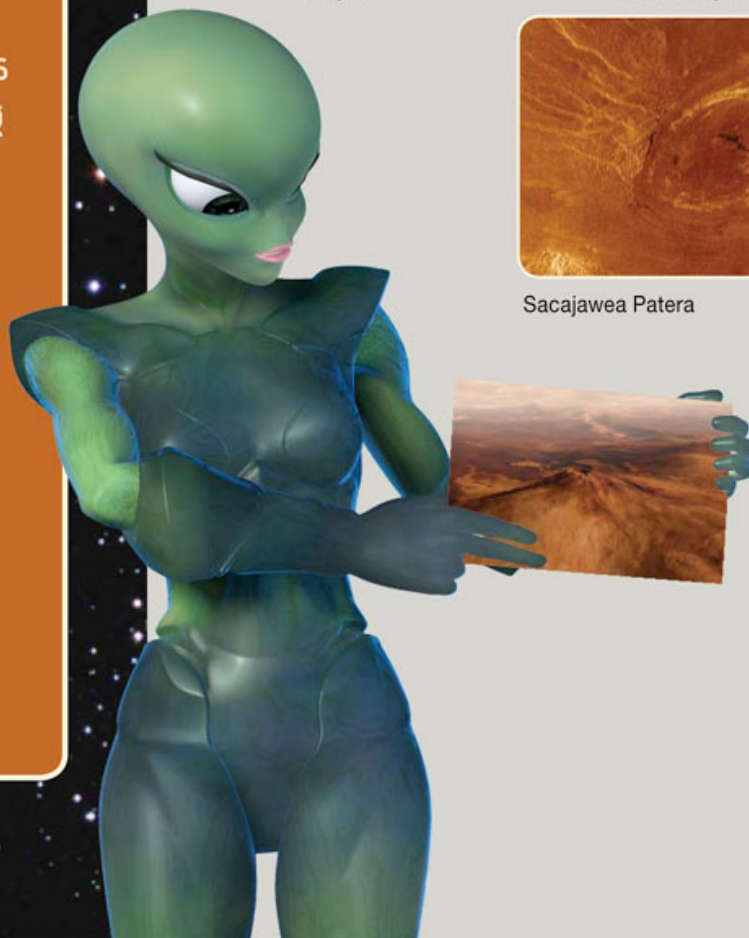
Mercury is difficult to see from Earth because it is always in the Sun's glare. The best time to look for it with your unaided eye is in the early spring, just after sunset or in the early fall, just before sunrise.

Mark your calendars! Mercury crosses the Sun 13 times every century! The next cross will be on May 9, 2016!

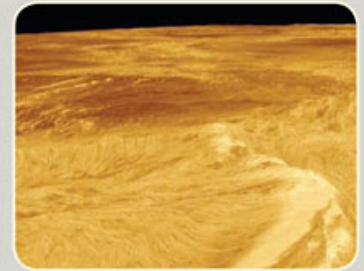
VENUS

Hey guys! It's Rayna the neutrino, from Quantum Quest! Check out Venus from the film on this postcard! This is a volcano on the planet Venus, which was created in the film using actual radar data maps made by the Magellan spacecraft!

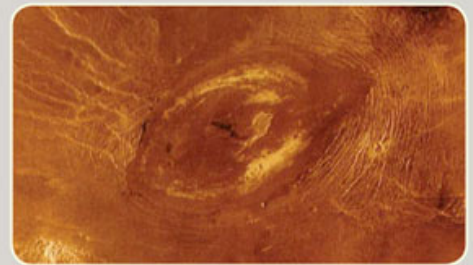
Most of the features on Venus are named in honor of gifted women and goddesses like Cleopatra, Sacajawea, and Aphrodite. Wow! Maybe they'll name one Rayna some day!



Cleopatra



Venus' Aphrodite



Sacajawea Patera

PLANETARY SOCIETY HOT SPOT

Compare Mercury with the other planets!

http://www.planetary.org/explore/topics/compare_the_planets/

Sulfuric acid clouds • Carbon dioxide atmosphere

Poison! Poison! Poison! Hot! Hot! Hot!

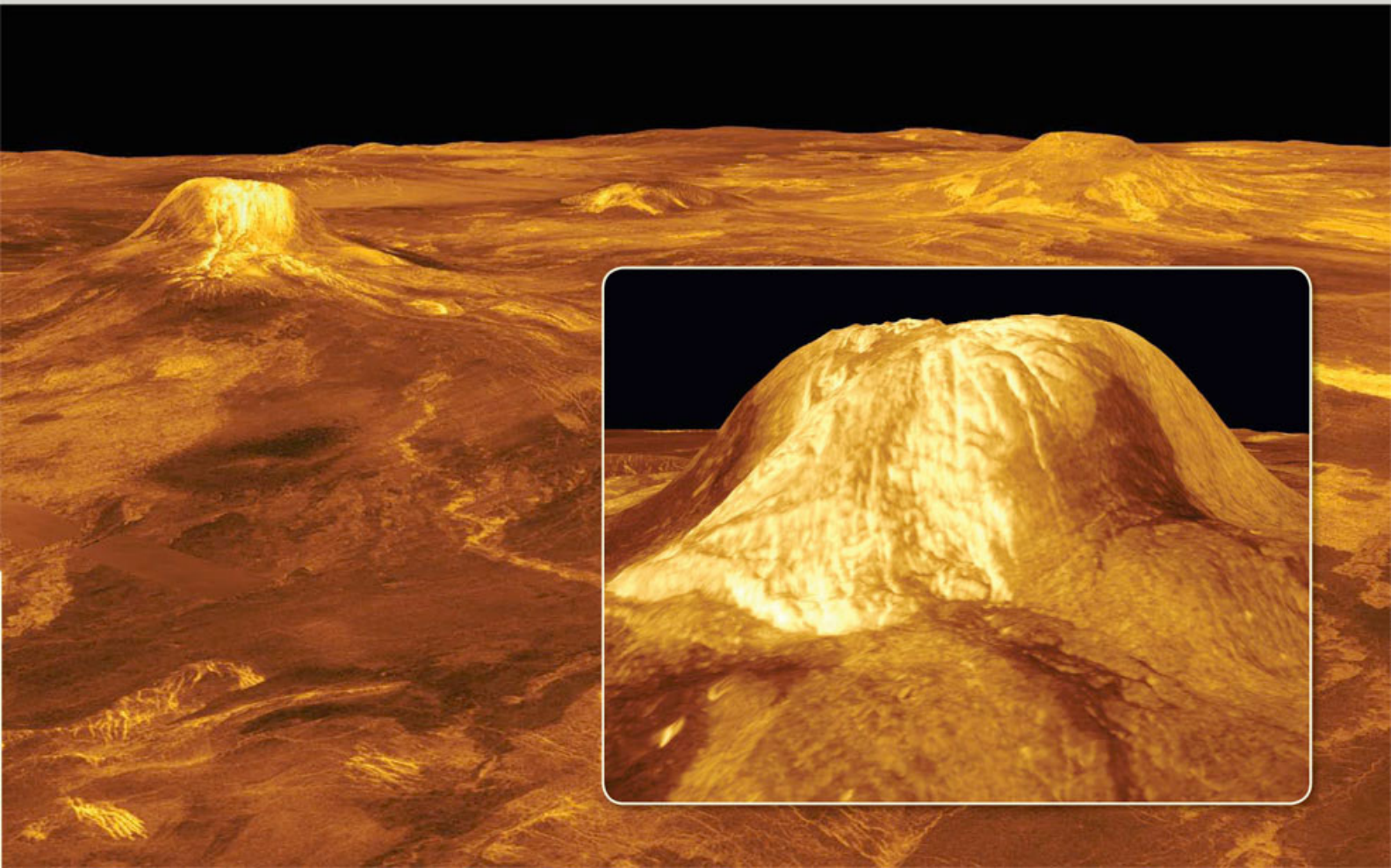
No moons • No rings • 850°F Average temperature

The Real Venus

You might think Venus is pretty when you see it in the sky. It is visible most of the year, but, in reality, it's a toxic inferno, with volcanoes, 200 mile-per-hour winds, sulfuric acid clouds, and a carbon dioxide atmosphere that traps heat from the Sun in and never lets it out.

If you were on the planet Venus, you'd fry like a piece of bacon and get squished like a bug all at the same time, because the average daily temperature on Venus is a sizzling 850°F, and the atmospheric pressure there is 90 times greater than it is on Earth.

According to what scientists have been able to see so far, Venus has more volcanoes on it than any other planet in the Solar System. This one is named Maat Mons. It's low and dome shaped, and classified as a shield volcano, just like volcanoes found in Hawaii.





Venus v.s. Earth

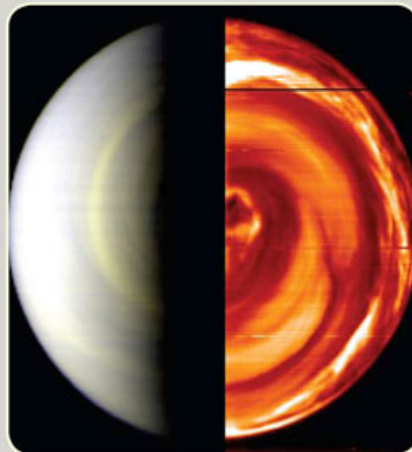
Look at Venus and Earth in this picture! They're almost the same size, but Earth is a beautiful planet to live on and Venus is a poisonous oven. Scientists are trying to figure out why Venus is so different, so they can better understand the causes of climate change and the threat of global warming on Earth.

Venus Express found lightning on Venus. The discovery is exciting because lightning on Earth is connected to clouds containing water, but lightning on Venus is connected to clouds containing sulfuric acid, which is battery acid on Earth! The spacecraft also revealed a strange weather feature,



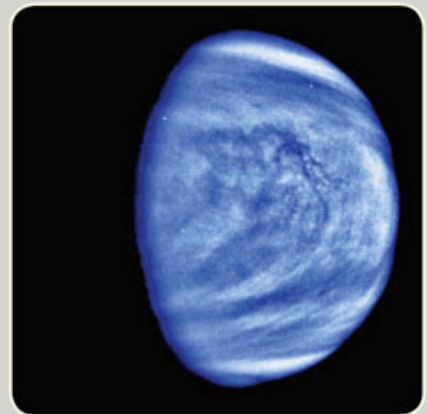
similar to a hurricane, over the south pole of Venus. Scientists described it as a huge, "double-

eye," atmospheric vortex, similar to one that has been seen at Venus's north pole!

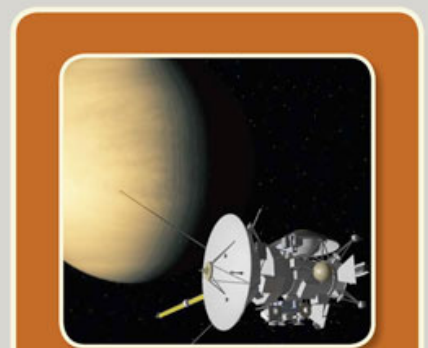


A vortex is a funnel shape, created by the motion of spiraling energy, similar to a bathtub full of water once you pull the plug.

Venus Express also found the molecule hydroxyl on Venus. Nicknamed mother nature's broom, hydroxyl helps clean pollutants from the atmosphere on Earth, so finding it on Venus might mean that Venus is more Earth-like than scientists thought.



Cloud patterns on Venus



The Cassini spacecraft, one of the stars of the cast in Quantum Quest, flew above Venus at least twice on its way to Saturn. Cassini got a boost in speed from Venus's gravity. Scientists call that kind of "boost" a gravity assist!



Jammer's Neat Facts

The ancient Greeks called Venus Eosphorus when they saw it in the morning, and Hesperus when they saw it at night, because they thought it was two different stars!

Venus and Pluto spin backwards on their axes. If you look at Venus through a telescope, it will appear to have different shapes, because the sunlit areas of the planet are visible from Earth at different times.

Mark your calendar! Venus is going to cross the Sun on June 6, 2012. The best places to see it will be: Hawaii, Russia, Alaska, northwest Canada, Australia, New Zealand, New Guinea, the Philippines, China, Korea, Japan and the islands of the western Pacific Ocean!

Do More!

Make Your Own Lava!
Pages 64-65

Lunar and Planetary Science About Venus

www.nssdc.gsfc.nasa.gov/planetary/planets/venuspage.html

Learn about the various missions to Venus. Click on any of the links under "Current and Past Missions" for information and images.



Venus Express Images

www.esa.int/esaMI/Venus_Express/SEM71Z808BE_0.html

Learn about this mission to Venus conducted by the European Space Agency. Click on the left side links found under the heading "About Venus" to learn about the planet, and "Multimedia" to see images taken by this spacecraft.

Missions to Venus

We've been exploring Venus since 1962. Some of the most recent missions are these:

Magellan - NASA Venus Radar Mapping Mission (1989-1994)

MESSENGER - NASA Mercury Orbiter (Launch: 2004) (Two Venus Flybys)

Venus Express - ESA Venus Orbiter (Launch: 2005)

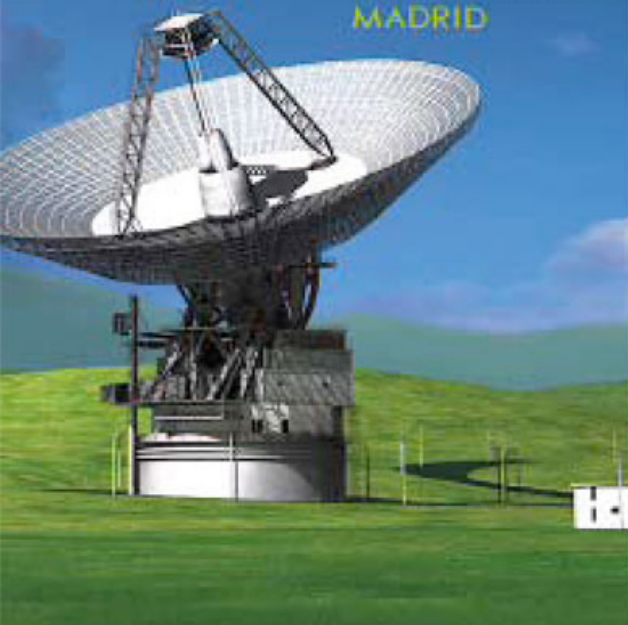
Planet-C - ISAS Venus Orbiter Launch:2010)

EARTH



Hey, it's Rayna, on your home turf: planet Earth! The Quantum Quest gang and I call Earth the Beautiful Blue Marble, because 71% of it is covered with blue, saltwater oceans.

DSN ANTENNA
MADRID



There's no doubt about it, human-made satellites are cool. You can even get a satellite image of the neighborhood your school is in by logging on to Google Earth (<http://earth.google.com/>) and typing in your school's address!

PLANETARY SOCIETY HOT SPOT

Learn More About How Satellites are Helping Your Home World.

Check out www.planetary.org/programs/projects/observing_earth/

Water! Oxygen! Life! • Nickle-iron core • Plate tectonics

The First Planet with Known Life!

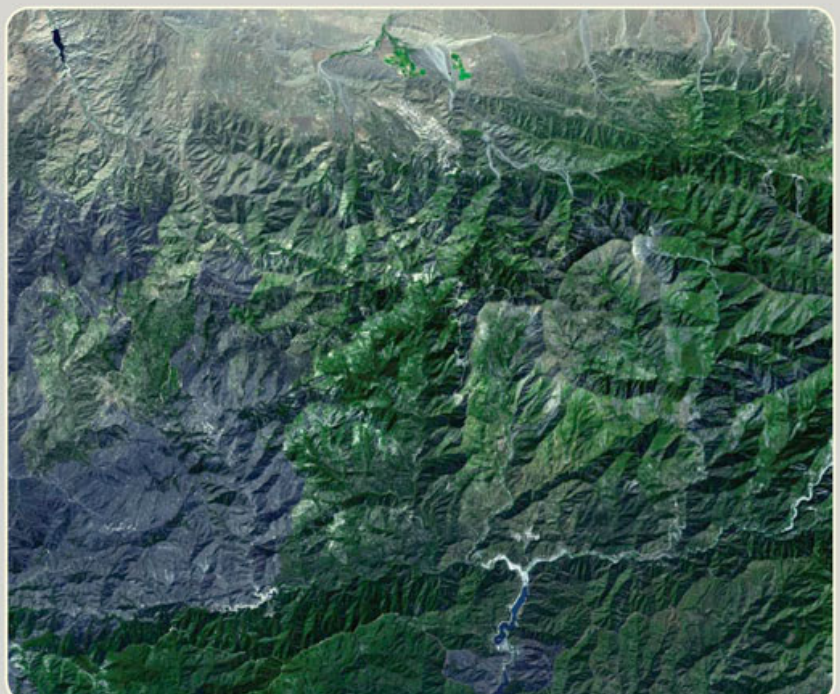
No rings • One moon • Carbon dioxide • Traces of nitrogen and oxygen

Your planet is alive. How cool is that?

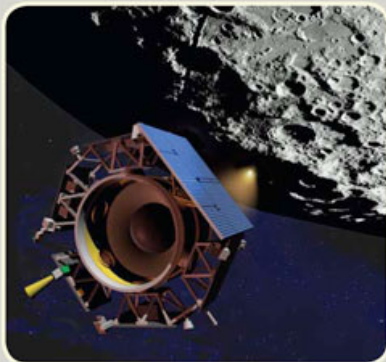
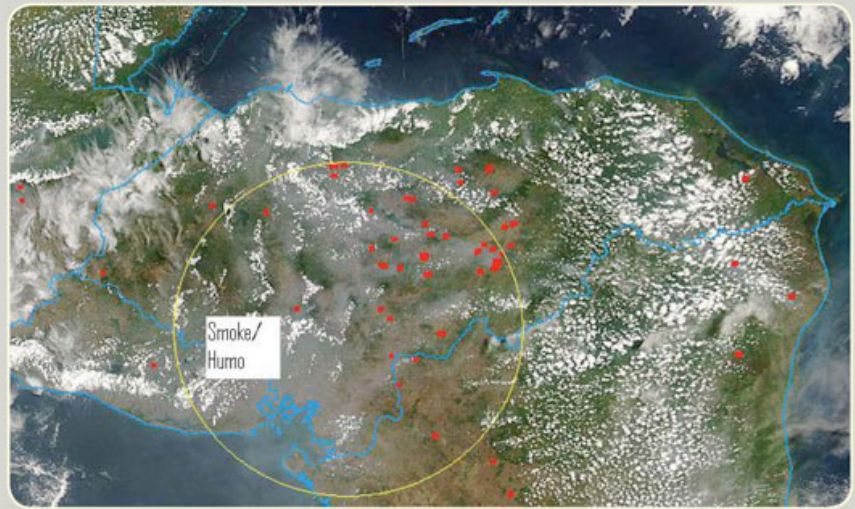
Driven by the commotion of melted rock in its mantle, Earth has been geologically alive since it formed 4.6 billion years ago. The destruction and renewal of Earth's crust, caused by the movement of certain sections of the crust known as plates, is called plate tectonics. Plate tectonics causes the surface of Earth to be constantly rearranging and also results in earthquakes, volcanoes, and climate change.

Every so often the Earth is victimized by a natural disaster that affects its weather, food production, and water distribution. In order to help Earthlings prepare for, and respond to, these natural disasters, scientists use computer models and data from human-made satellites to study everything from the chemical composition of the atmosphere to earthquake faults.

Every 8 days, an instrument on the Terra spacecraft produces a global map of where and how much carbon dioxide plants gobble up during photosynthesis. Photosynthesis is the process that plants use to manufacture energy and oxygen (which Earthlings can't live without), by combining sunlight, water, and carbon dioxide. [as pictured below]



After combining ground-based observations and display maps with satellite data from a state-of-the-art Earth observation system called SERVIR, scientists were able to save lives by getting immediate help to the victims of a deadly 7.3 earthquake that rocked the Central American country of Honduras in May 2009.

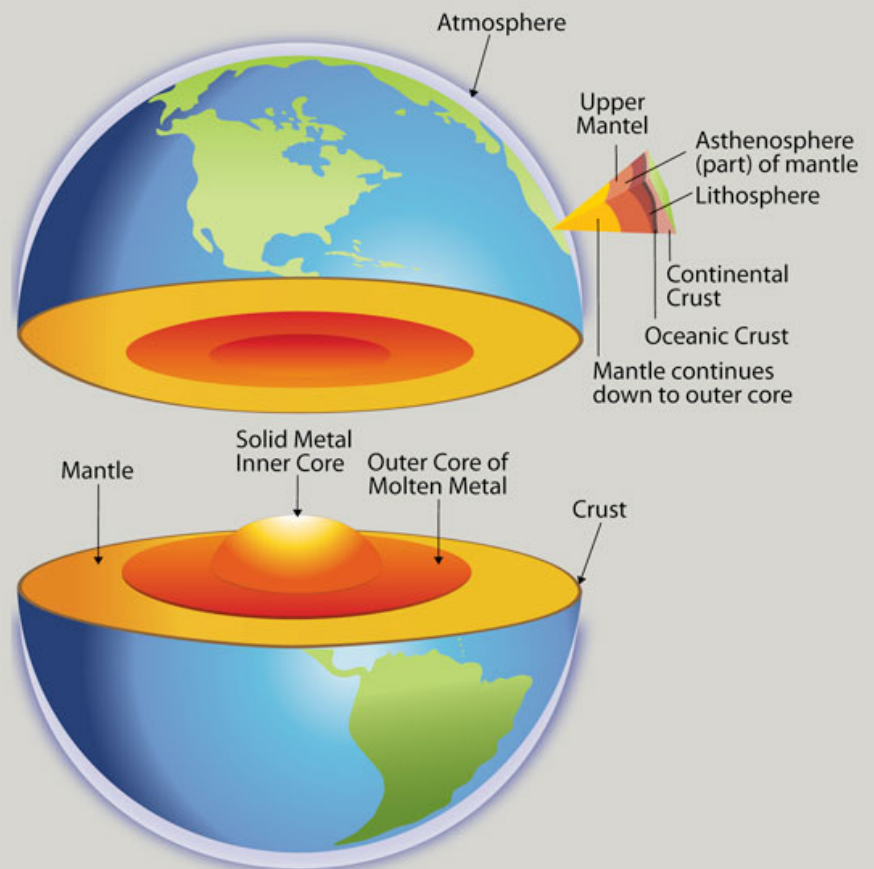


Lunar Reconnaissance Orbiter) and LCROSS (the Lunar Crater Observation and Sensing Satellite).

The LRO is busy mapping the Moon's surface. LCROSS was launched to look for water-

ice in one of the permanently shadowed craters at the Moon's south pole. Finding it would mad-cool, because if the ice came from a comet, it could spill the beans about early conditions in the Solar System.

In 2009, after the European Space Agency, China, Japan, and India sent missions to the Moon, NASA went loony too, and launched two robotic Moon missions at once — LRO (the





Earth

www.planetary.org/explore/topics/earth/
Learn about what Earth looks like from space. Click on the left side "Images" under the "Earth" heading.

Do More

Look Up! Track a Satellite!
Page XX

Satellite Programs Observing Earth Today

SERVIR Initiative
The Landsat Program
TERRA

Earth Observing System EOS

www.eospso.gsfc.nasa.gov/
Learn about what Earth looks like from space. Click on the "Multimedia" link on the top, or the links to current images on the right hand side.

The Landsat Program

landsat.gsfc.nasa.gov/
Learn about NASA satellites view of the Earth. Click on the link "Images" on top

TERRA

www.terra.nasa.gov/
Learn about this important NASA mission to study and protect our planet. Click on the "Images and Date" on the top.



Jammer's Neat Facts

As you read this, a human-made satellite is monitoring Earth's vital signs.

Earth's seasons are caused by the tilt of its axis, not by how close the Earth gets to the sun!

Earth is the only planet known to have WATER in all three forms: liquid, solid, and vapor.

Earth's magnetic field and the ozone layer help shield Earth from deadly radiation!

I had a dream that the Quantum Quest kids and I landed a robot on the Moon. The robot traveled 1,640 feet (500 meters), sent images and data back to Earth, and we won the Google Lunar X Prize competition! The only bummer was we couldn't surf, because the Moon doesn't have an ocean.

MOON

Missions to the Moon

Kaguya (Launch: 2007)

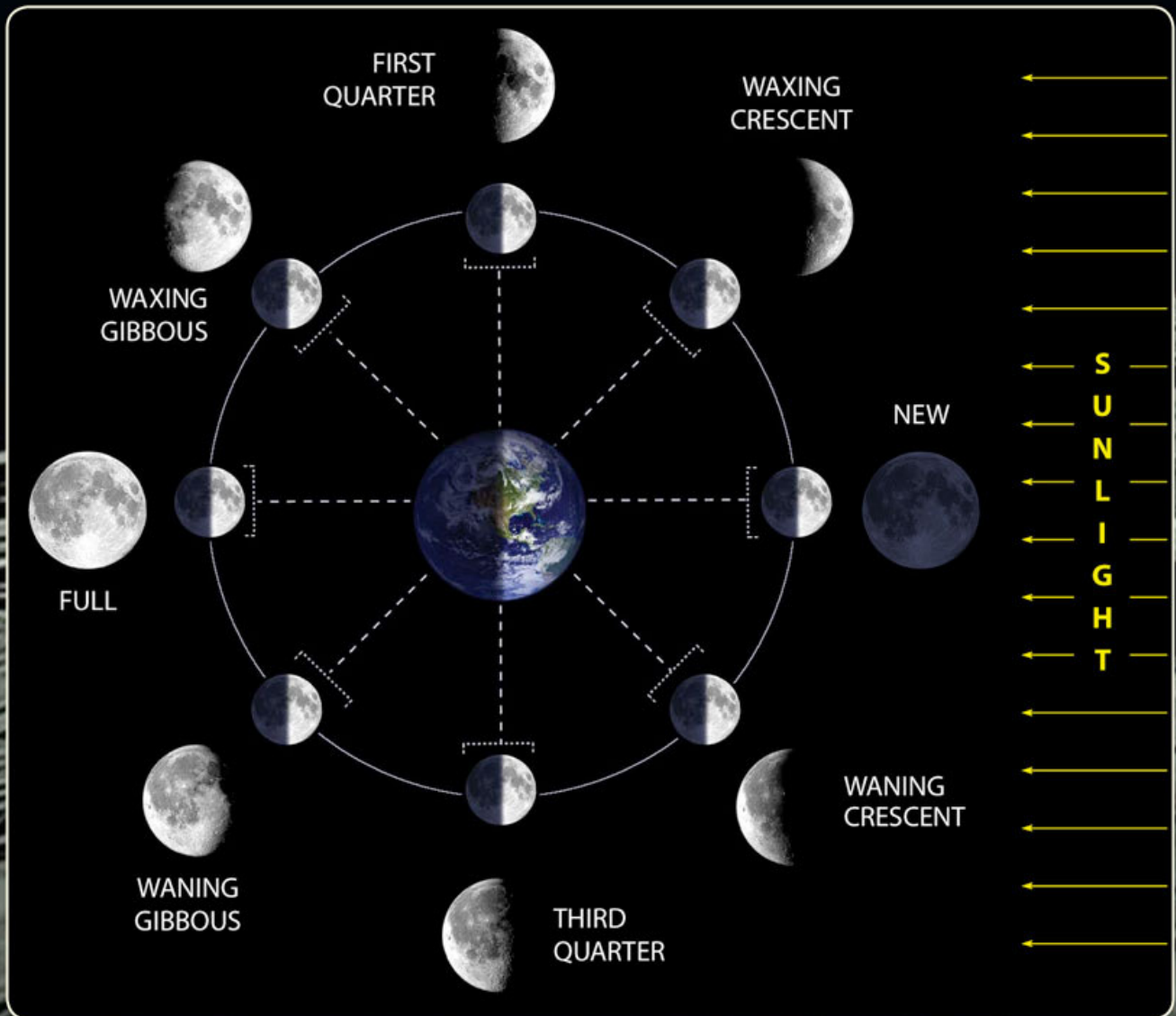
Chang'E (Launch: 2007)

Chandrayaan-1 (Launch: 2008)

LRO: (Launch: 2009)

LCROSS (Launch: 2009)

The Phases of the Moon as it rotates around the Earth in relation to the Sun



millions of craters • no air • no liquid water • no sound

Zoom! Zoom! Check Out the Moon!

Boiling hot days • Freezing cold nights • Stars in the sky day and night

Chandrayaan-1

www.isro.org/chandrayaan/htmls/home.htm
Learn about the first lunar mission from the country of India. Click on the "Image Gallery" link on the left side.

The Lunar Crater Observation and Sensing Satellite

www.lcross.arc.nasa.gov/
Learn about one of the newest NASA missions to the Moon. Click on the "Observations" link on the top for current images.

International Lunar Decade

www.planetary.org/programs/projects/lunar_decade/
Learn about the decade-long international exploration of the Moon. Click on the link "Missions to the Moon" and "Explore More" to learn where we have been up to now.

Complete Sun and Moon Data for One Day

www.aa.usno.navy.mil/data/docs/RS_OneDay.php
Learn the sunrise/set, moonrise/set for any location on any day. Simply fill out the boxes on Form A.

Lunar Reconnaissance Orbiter

www.lunar.gsfc.nasa.gov/
See images from the current NASA orbiter at the Moon. Click on the "Images and Multimedia."



Jammer's Neat Facts

The same side of the Moon always faces Earth. Only 12 humans have walked on the Moon.

The dark patches on the Moon, which formed about 4 billion years ago, are dried up lava beds called maria (which means seas in Latin).

The line that separates day from night on the Moon is called the terminator.

Even though the Moon is not blue in color, when there are two full moons in the same calendar month, the second full moon is called a Blue Moon.

MARS

Yo, Earthlings! It's Jammer, coming to you from the Red Planet—Mars! I've been doing some all-time sick moves around Valles Marineris, just like I did in the movie Quantum Quest. The filmmakers created the awesome ride that the gang and I took through the Valles using real scientific footage from NASA's Mars Odyssey and Mars Global Surveyor orbiters. Make sure you check it out in the film!



PLANETARY SOCIETY HOT SPOT

Thanks to a program sponsored by the Planetary Society, hundreds of thousands of people from all over Earth sent messages from Earth to Mars via spacecraft like the Phoenix lander. Find out more at: <http://www.messages.planetary.org/>

Half the size of Earth • Thin atmosphere • Two moons • Dust storms • Freezing temperatures

Water's been found...it's frozen the ground!

Sand dunes • Impact craters • Polar ice caps glow and shrink with the seasons • Salmon pink sky

Valles Marineris (see below — an actual image from Quantum Quest) is the largest canyon in the Solar System. On Earth it would stretch all the way from New York to Los Angeles! Mars is also the home of Olympus Mons, the biggest volcano in the



Solar System. At 88,600 feet high, it's three times taller than Mt. Everest, the tallest mountain on Earth!

Mars has two, small, heavily cratered moons, both of which may be captured asteroids. Their names are Phobos (shown below), which means fear, and Deimos, which means panic. In the future, either one of them could be used as a stepping-stone for astronauts on their way to Mars! You got a good look at Phobos in the film Quantum Quest. If you'd like to make a 3D



model of Phobos, go to this cool link: <http://planetary.org/blog/article/00001348/>

The launch of a new rover by NASA, called the Mars Science Laboratory, will be the next big step in exploring Mars. It will sport the biggest and toughest robotic arm the Red Planet has ever seen! The job of the arm will be to test Martian rocks and soil for clues as to whether Mars did, or ever could, support life!



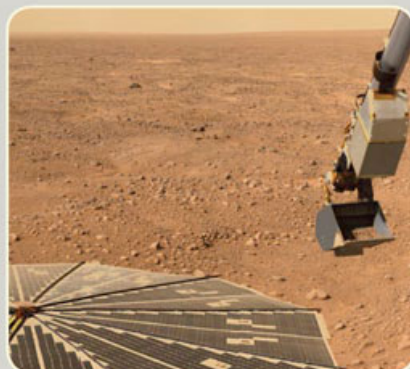
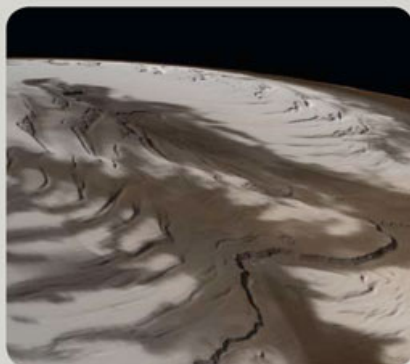
Latest News

The Mars Reconnaissance Orbiter team discovered layers of water-ice in impact craters recently made by meteorites. They think the ice is a relic from several thousand years ago when the climate on Mars was more humid!

During the Martian summer, the Phoenix lander used its robotic arm to dig into the loose rock and dirt at its landing site in the northern arctic plains of Mars, and scooped up samples of permanently frozen soil known as permafrost!

The Phoenix lander also found evidence of snow falling from Martian clouds! It isn't the kind of snow you use to build a "snow Martian." This snow falls at night during the Martian

winter and is similar to ice crystals in Earth's atmosphere, called diamond dust, that fall in the Arctic.



The Phoenix Lander [above] taken through the Surface Stereo Imager camera. This view is a vertical projection that combines hundreds of exposures taken from June 5th through July 12th 2008. The black spot is where the camera itself is mounted.



The Victoria crater [left] in the Meridian Planum region of Mars was taken by the high resolution imaging science experiment camera from NASA's Mars Reconnaissance Orbiter. Colors have been enhanced.

Future Explorations

Mars is the ultimate destination for human exploration Programs are in the works to prepare human explorers for a journey to Mars within the next 50 years. Stay fit and study hard and maybe you'll be one of those explorers!

Missions to Mars

We have been sending spacecraft to Mars since the 1960s. Here are some of the most recent missions:

Mars Odyssey
(Launch: 2001)

Mars Express
(Launch: 2003)

Mars Exploration Rovers
(Launch: 2003)

Mars Reconnaissance Orbiter
(Launch: 2005)

Phoenix Mars Mission
(Launch: 2007)

Mars Science Laboratory
(Launch: Fall of 2011)

Mars Reconnaissance Orbiter

www.marsprogram.jpl.nasa.gov/mro/

To learn more about this mission click on "Mars for Kids" and "Mars for Students" on the left side menu.

Phoenix Mars Mission

www.phoenix.lpl.arizona.edu/

To learn more about this mission, click on "Gallery" link on top, and then select links from the menu on the right side.

Do More

Make Martian Dust!
Page XX

Explore
More

Mars Exploration Rover Mission

www.marsrovers.nasa.gov/home/index.html

To learn more about this mission click on "Mars for Kids" and "Mars for Students" on the left side menu.

Mars Science Laboratory

www.marsprogram.jpl.nasa.gov/msl

To learn more about this future mission, click on the round buttons on the bottom to get information about what is planned.

"I can't wait to go snorkeling on Mars!"

"Sorry, Snorkeling is OUT, General Ignorance. There's NO liquid on Mars! There's carbon dioxide ice at the poles though, so try ice skating"



Jammer's Neat Facts

Mars looks rusty-red because it's covered with iron oxide. (on Earth iron oxide is rust)

If you weigh one hundred pounds on Earth, you'd weigh only thirty eight pounds on Mars, because Martian gravity is one third of Earth gravity.

A day on Mars is called a Sol. A Sol is longer than an Earth day by thirty nine minutes and thirty five point two seconds, so scientists working on Mars missions wear special Mars-time watches!

The closest that Mars ever gets to Earth is at opposition, which is the closest Mars gets to Earth in it's orbit around the Sun. Mars Opposition occurs every twenty six months.



JUPITER



Jupiter is the King of the Planets; the fourth brightest object in Earth's sky, after the Sun, the Moon, and Venus. It's an enormous ball of gas, and with its orbiting entourage of 63 moons, it resembles a miniature Solar System!

Made mostly of hydrogen and helium, Jupiter's upper layers are gaseous. However, a core of rocky materials, about 3 times hotter than the surface of the Sun, lies at Jupiter's center!

Jupiter's atmosphere consists of 3 main cloud covers. The colors that Earthlings see in pictures of Jupiter are the result of chemical reactions. These are fueled by the planet's interior heat, ultraviolet radiation, auroras, and lightening at varying depths below the cloud tops.

Missions to Jupiter

Galileo (Launch: 1989)

Juno (Launch: planned for 2011)

Europa Jupiter System Mission/NASA and ESA (Launch: planned for 2020)