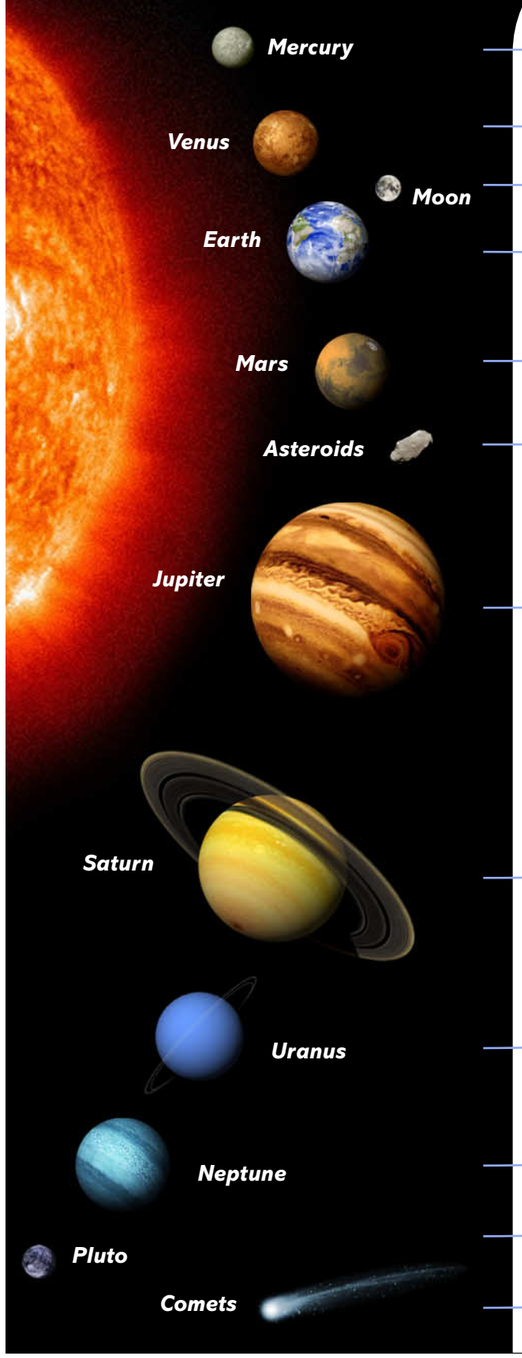
Solar System Exploration Timeline 2003-2006

Educational Product	
Teachers and Students	K - Post Doc

EP-2004-03-024-JPL

National Aeronautics and Space Administration



2003

09/27/03 SMART-1
Launch: Europe's First Moon Orbiter

06/02/03 Mars Express
06/10/03 Spirit
07/07/03 Opportunity
Mars Launches

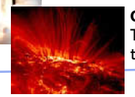
12/24/03 Mars Express
European Orbiter Arrives at Mars

05/09/03 Hayabusa (MUSES-C)
Launch: Japanese Asteroid Sample Return

09/21/03 Galileo
Jupiter Impact: End of 14-year Orbiter Mission

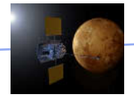
2004

05/04 MESSENGER
Launch: NASA Mercury Orbiter



06/08/04
Transit: Venus Crosses the Face of the Sun

08/04 LUNAR-A
Launch: Japanese Moon Orbiter



11/04 MESSENGER
Venus Flyby 1

09/08/04 Genesis
Sample Return: Mid-Air Capture of Solar Wind Capsule

01/03/04 Spirit
01/24/04 Opportunity
Twin NASA Robot Geologists Land on Mars

02/04 Ulysses
Jupiter Flyby

06/12/04 Cassini-Huygens
Moon Flyby: NASA Orbiter at Saturn's Phoebe

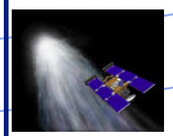
07/01/04 Cassini-Huygens
Saturn Arrival: NASA Orbiter & European Probe

12/24/04 Cassini-Huygens
NASA Orbiter Deploys European Probe

10/26/04 Cassini-Huygens
Titan Flyby

01/14/05 Huygens
Probe Descent: Huygens Explores Titan (3 hours)

01/02/04 Stardust
Comet Encounter: NASA Collects Samples from Comet Wild 2



03/02/04 Rosetta
Launch: European Comet Chaser

12/04 Deep Impact
Launch: NASA Comet Excavator

2005

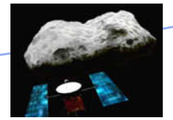
02/05 SMART-1
Moon Arrival: Europe's First Lunar Orbiter

8/05 MESSENGER
Venus Flyby 2

11/05 Venus Express
Launch: European Orbiter

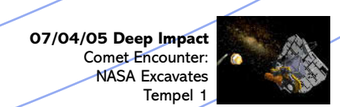
09/05 SELENE Launch: Japanese Lunar Probe

08/05 Mars Reconnaissance Orbiter
NASA Launch



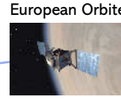
10/05 Hayabusa (MUSES-C)
Asteroid Arrival: Japan Collects Samples From Itokawa

03/09/05 Cassini
NASA Orbiter Begins Extended Saturn Tour with Enceladus Flyby. Activities Continue Through 2008.



07/04/05 Deep Impact
Comet Encounter: NASA Excavates Tempel 1

2006



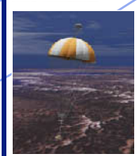
04/06 Venus Express
Venus Arrival: European Orbiter

10/06 MESSENGER
Venus Flyby 3

03/06 Mars Reconnaissance Orbiter
Mars Arrival

06/06 Dawn
Launch: NASA Asteroid Orbiter

01/06 New Horizons
Launch: NASA Pluto-Kuiper Belt Flyby Mission



01/06 Stardust
NASA Comet Sample Return

Extreme Exploration, Extreme Education

An unprecedented era of exploration is underway. A fleet of more than a dozen international spacecraft is making headlines from across the solar system. These back-to-back historic events offer teachers a unique chance to showcase the real science behind the headlines. NASA's education team has rounded up a suite of classroom activities - aligned to the National Science Education Standards - to help teachers capitalize on these teachable moments. To learn more, flip to the back of this poster.

For the whole story, visit: **http://solarsystem.nasa.gov**

ssetl_v12 - Last Updated: 03/03/04 | JPL 400-1075, Rev. 1

Join the Adventure

Right now, the most advanced scientific space fleet ever assembled is out there in our solar system hammering away at life's biggest - and toughest - questions: Where do we come from? Where are we going? Are we alone?

"The natural excitement that scientists feel in their continued exploration of the solar system reaches a crescendo over the next three years," explains Dr. Ellis Miner, a planetary scientist. "Never before have so many different spacecraft been poised to probe so many mysteries about so many different solar system bodies over such a short time span." Clues to these mysteries are scattered among the planets, moons, comets, and asteroids that make up our solar system. Evidence of the earliest days of the solar system may exist in rocks on the cratered surfaces of Mercury, Mars, and Earth's moon. Chemical clues to our origins may linger in the icy hearts of comets or in the hazy atmosphere of Saturn's giant moon, Titan.

Just as the robotic spacecraft of the 1960s pioneered a safe path for astronauts to walk on the Moon, today's advanced robotic explorers are charting a course that will take humanity back to the Moon and beyond.

It won't be easy. These exploring machines must endure extreme heat and cold and intense radiation during long journeys across mind-boggling distances. Even at speeds up to 80,400 kph (50,000 mph), a one-way ride to Pluto takes about nine and a half years. If all goes well - and there are no guarantees in space travel - we will be among the first generations to see Pluto up close. We will have to wait until NASA's New Horizons spacecraft arrives at Pluto in 2016 for that particular view. Fortunately, there's plenty to do - and to see - in the meantime.

Extreme Space

Through Thick and Thin
If Earth had giant, beautiful rings like Saturn, they would stretch across the night sky in a thin band almost a third of the way to the Moon. Even though Saturn's main rings are more than 273,600 km (170,000 miles across), most are less than 10 kilometers (6 miles) thick.

Swell Comet
When they are far from the Sun, most comets are insignificant specks less than 10 km (6 miles) across. But when a comet gets close to the Sun, the cloud of gases surrounding it can swell to the size of Jupiter - more than 10 times the diameter of Earth. Comets also sprout beautiful tails that stretch for millions of kilometers away from the Sun.

Strange Days
At high noon on Mercury, the sky is filled with a Sun almost three times as large as the pleasant yellow orb we see from Earth. Meanwhile, way out on Pluto high noon would look more like a moonlit night here on Earth. Sunlight on Pluto is about 1,000 times dimmer than what we see on Earth.

Hard Life
Our solar system may seem like a pretty harsh place for humans to survive, but that doesn't mean there is no life out there. Scientists here on Earth have found extreme organisms that live in boiling water and in the frozen soil of Antarctica. Could similar super tough organisms live on other worlds?

Speed Brakes
To survive a landing on Mars, a spacecraft must shave three zeroes off its speed in only six minutes - from about 19,000 kph (12,000 mph) in space to less than 19 kph (12 mph) at the surface.

Careers@NASA

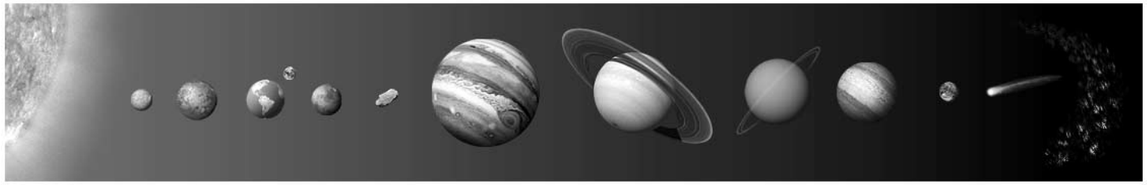
Not everyone who works for NASA is an astronaut. David and Ramona work for NASA's Deep Space Network, NASA's worldwide system of sensitive antennas that control and communicate with interplanetary spacecraft. They're enjoying an exciting - and extremely busy - couple of years as the 2003-2006 space fleet sends back information from across the solar system.

I'm **David**, and I'm a member of the Navigation and Mission Design section at NASA's Jet Propulsion Laboratory. We analyze data used to fly spacecraft from Earth to planets, moons, and comets. My job is to help determine where the Mars Global Surveyor and Mars Odyssey spacecraft have been, their current positions and speed, and where they will be in the future. This information is useful to scientists who want to know where to point their spacecraft instruments (such as cameras and other sensors). I have a Bachelor of Science degree in aeronautics/astronautics from the Massachusetts Institute of Technology.

My name is **Ramona**, and I work as a telecom analyst for several NASA missions. My job involves monitoring the health and status of the spacecraft telecommunications subsystem and ensuring that the spacecraft can communicate with the Deep Space Network at all times, even in an emergency. The part of my job I enjoy most is seeing data appearing on my computer screen, knowing that it is being broadcast by a spacecraft on its way to Mars, Jupiter, Saturn or even near the edge of the solar system. Some of that data is processed to produce pictures of scientific importance. I have bachelor's and master's degrees in electrical engineering from the Massachusetts Institute of Technology.

For more information on student programs and opportunities to work with NASA, visit:
http://www.nasa.gov/about/career/index.html

How Far Away Are the Planets?



Our solar system is huge. Distances between the planets span millions and even billions of kilometers. Instead of writing out all those zeroes all the time, scientists developed a special way to measure distances between the planets – the astronomical unit (AU). One AU – 150 million kilometers (93 million miles) – represents the average distance from the Sun to the Earth. Mars is 1.5 AU from the Sun. Saturn is 9.5 AU from the Sun. And Pluto is 39.5 AU from the Sun.

Knowing this, can you figure out the distance from Earth to Mars, then to Saturn and to Pluto in AU, kilometers, and miles?

Think About It:

Is this diagram of the solar system to scale?

What changes would you make to it?

Learning Through Exploration

Solar System Timeline Activity

In the first activity, Strange New Planet, students view unusual planets in the classroom using ordinary cardboard tubes. Students gather new information as they plan and enact flybys, orbits, landings, and sample returns. The second activity, Exploring Solar System Missions, allows students to symbolically depict the mission events of 2003-2006. After researching the missions and placing images of planetary bodies on a large bulletin board (or wall), students place appropriate symbols by the planet where the events will take place (example: a ring = orbiter).

Learning Goals:
Students identify solar system objects and depict scientific robotic exploration. Students will also create a display of solar system bodies and related missions.

National Science Education Standards:
Earth in the Solar System
Objects in the Sky
Science Teaching Standards - Development of Environments that Enable Science Learning

Get this lesson and others related to current missions at:
http://solarsystem.nasa.gov/educ/extreme.cfm

Searching for Habitable Worlds

Students are asked what makes a planet or moon a good place for life. Then the class discusses how the properties of worlds in our solar system relate to what life needs. Students, working individually or in groups, review a set of habitability cards for solar system planets and moons. They rank each body as likely, possible, or unlikely habitats for life and explain the reasons for their selections. Many of NASA's missions seek to answer the question "Are we alone?" How do the student rankings compare with the planets and moons NASA has selected to look for signs of life?

Learning Goals:
Students learn the characteristics of planets and moons that could make them habitable to life as we know it and evaluate our solar system for other possible habitable worlds.

National Science Education Standards:
Characteristics of Organisms
Populations and Ecosystems
Matter, Energy, and Organization in Living Systems

Get this lesson and others related to current missions at:
http://solarsystem.nasa.gov/educ/extreme.cfm

More Teacher Resources

For more information, lesson plans and education products, visit:
NASA's Solar System Exploration educator resources: ***http://solarsystem.nasa.gov/education***
NASA's Central Operation of Resources for Educators (CORE): ***http://core.nasa.gov***
NASA CORE toll-free order line: ***(866) 776-CORE***
NASA's Education Program homepage: ***http://education.nasa.gov***

EP-2004-03-024-JPL