

Tessmann Planetarium Presents

---

# A Brief Guide to Comets

---



*Comets are like cats: they have tails, and they do precisely what they want. - David Levy*

# Just What is a Comet?

## WHAT IS A COMET?



A comet is a big dirty snowball. Some comets have more ice and water than others. Comets are also made up of frozen gases, such as carbon monoxide, methane and ammonia, plus organic materials (materials that form life) such as hydrocarbons and amino acids. These materials were created during the birth of our solar system. The solid core of a comet is called the nucleus. The solar winds push this icy material out to the far regions of the solar system. These regions are known as the Kuiper Belt and the Oort Cloud.

## HOW DOES A COMET FORM A TAIL?

When a comet comes closer to the Sun, closer than the orbit of Jupiter, it forms a tail. The Sun's radiation or solar wind begins to vaporize the comet. Gases and dust stream from the comet. The solar wind pushes some of the material away and a tail forms. The tail is made up of mostly water and dust.

## WAIT A MINUTE....

## WHAT IS THE SOLAR WIND?

The sun sends out streams of charged atomic particles called electrons and protons. The stream has a lot of energy and is called plasma. Plasma moves faster than the speed of sound. It is responsible for the Northern Lights and pushes the tail of a comet so that it always points away from the Sun.

### HOW LONG IS THE TAIL OF A COMET?



### ARE COMETS BAD LUCK?

### DO COMETS FLY BY OUR PLANET

### MORE THAN ONCE?

Some comet tails have been observed to extend more than 93 million miles. This is the distance between the Earth and the Sun. This distance is known as one astronomical unit or AU.

*Did you know... Comet is a Greek word meaning “having long hair,” which is a good way to describe the tail of a comet.*

It was once believed that comets were signs of terrible events that would happen. An appearance of a comet in the sky might foretell the death of a king, a defeat in battle or a natural disaster like an earthquake. No one really knew what comets were until a few hundred years ago. Now we know that comets are just one of the building blocks of our solar system. They are the material left over from the birth of our Sun.

Yes! Probably the most famous comet to return is Halley’s Comet. Halley’s Comet returns every 76 years. Comets that return in 200 years or less are called short period comets.

Some comets don’t return for hundreds or even millions of years. Comet McNaught’s next visit to the Sun will be in 92,000 years and Comet Hale-Bopp will return again in two or three millennia. Some comets, such as Comet Encke, circle the Sun, but do not even reach the orbit of Jupiter at their farthest part of their orbit. Ecnke-like comets may return in less than 20 years.

*Hence I dare venture to foretell, that it will return again in the year 1758. - E. Halley*

---

# Some Famous Comets

## HALLEY'S COMET

---



Almost everyone has heard of Halley's Comet. It wasn't actually discovered by Edmond Halley, but he was the first scientist to predict that comets could return on a regular basis. Halley's Comet is well remembered as it was widely visible in 1910. What is not generally known is that another comet, known as the Great Comet of 1910, was even more impressive. Somehow as the years passed, people began to mistakenly think that the Great Comet was Halley's comet

## SHOEMAKER-LEVY 9, THE STRING OF PEARLS COMET

---



Maybe as famous as Halley's Comet is SL9 (Shoemaker-Levy 9), also known as the String of Pearls comet. SL9 occupies an important position in the history of comets as it broke into 23 pieces in 1993. Each piece struck the planet Jupiter the following year, and the world watched with awe as the Hubble telescope took pictures of the impacts. The collision with Jupiter and its aftermath was one of the most observed astronomical events in human history up to that date. Every backyard astronomer aimed their telescope at Jupiter to see the dark splotches left behind by the collision. It was the first time a major comet striking a planet was ever observed in our solar system.

## HALE-BOPP



Comet Hale-Bopp was one of the most impressive comets of the last part of the 20th century and was visible with the naked eye for 18 months. It may have been only the fourth time it circled our Sun. Hale-Bopp was the first great comet of the internet age, and astronomers posted photographs daily (some quite spectacular) on the internet.

## DEEP IMPACT



In 2005, the Deep Impact spacecraft launched a probe to purposely collide with comet Tempel 1. The spacecraft captured photos of the event. The mission discovered that a comet's water/ice is not always on the surface of a comet, but is sometimes deep within its interior. *See image of the moment of impact, left.*

## IS PLUTO A GIANT COMET?

The solar wind appears to blow material off of Pluto's surface, just like it does with comets. Was Pluto a giant comet captured by the Sun's gravity as it passed through our solar system? Its orbit is different than those of the other planets, tilted to the ecliptic. Neil deGrasse Tyson, head of the New York City Planetarium, claims that if Pluto was placed in the Earth's orbit, it would develop a tail like a comet.

Pluto is certainly made up of a lot of ice. But much more research is needed to determine if it is a comet. When the New Horizons spacecraft reaches Pluto in 2015, we will learn much more about this dark, cold world.

*If you must bet, bet on a horse, not a comet! - Fred Whipple*

# Comets and Meteor Showers

## METEOR SHOWERS AND COMETS

As a comet passes through space, material such as dust and rock from the comet's tail is scattered behind and left in patches around the solar system. When the earth passes through these patches, small particles of dust and rock burn up in streaks of light in our atmosphere, producing meteors or "shooting stars." The larger particles produce impressive streaks, called bolides. Some of the larger particles may reach the Earth in the form of meteorites. The Earth passes through these patches at regular intervals and meteor showers can be predicted. For example, every August, the Earth travels through the path of the particles left behind by Comet Swift-Tuttle. This meteor shower is known as the Perseids. In October, we pass through the material left behind by Halley's Comet.

## THE LESSON OF COMET KOHOUTEK



In 1973, astronomers predicted that Comet Kohoutek would be a great comet. The comet had an active nucleus and would orbit close to the Sun, leading comet hunters to believe that it would provide a spectacular view. It was anxiously awaited by the public and intensely covered by newspapers and television before the age of the internet. But Kohoutek didn't live up to expectations and fizzled out in the media. However, two years later, another comet that had little expectation of being visible from Earth, Comet West (image at left) put on a spectacular show. However, the media failed to report on it and the public missed out on a chance to see an impressive comet.

## WILL WE EVER BE HIT BY A COMET?

---



The collision of SL-9 striking Jupiter revealed that comets can still strike planets in our solar system. Fortunately for us, Jupiter and the Sun, because they have a lot of gravity, act like giant vacuum cleaners and can pull in comets that travel through the inner solar system.

However, a giant comet or maybe an asteroid struck the Earth 65 million years ago, and may be responsible for the death of the dinosaurs. Other comets have also struck the Earth. If a comet struck the Earth again, it could cause a large catastrophe. However, scientists have not discovered any comets that, at present, are headed toward our planet. We now have several robotic telescopes around the world searching the sky for comets and asteroids that might endanger us.

Videos have recently appeared on the internet claiming that a comet collision is imminent. A lot of these videos claim the government or NASA is covering up the truth. But as we say to people getting medical advice, always look for a second opinion. Keep in mind, that if a large object is spotted in our solar system, telescopes and cameras used by backyard astronomers allow them to see these objects also. Not just the big telescopes can see them, as was the case in centuries past. If a large comet is heading toward us, you can be sure a lot of ordinary amateur astronomers around the world would see it as well, and it certainly wouldn't be a secret for long.

There is always a danger that we might be struck by smaller asteroids, but so far, the robotic telescopes haven't discovered any asteroids or comets that are heading our way.

...or like Icarus who, flying close to the Sun, forgot that his wings were made of wax... -D. Longnecker

# Sungrazers

## A TALE OF TWO COMETS



Some comets travel close to the Sun. Some just barely skim past and others meet a fiery fate.

A comet named C/2011 W3 (Lovejoy) appeared to plunge into the Sun in December of 2011. But the comet survived the plunge and reappeared on December 25. The comet was observed in Chile, where the people called it “the Christmas miracle.” See *Lovejoy*, upper left.

Comet Ison was not so lucky. ISON appeared to have the makings of a great comet. On Thanksgiving Day 2013, however, it had a close encounter with the Sun and was reduced to a cloud of debris. Scientists continue to observe the debris as ISON may still reveal the secrets of what material makes up a comet. See *ISON before its plunge into the Sun*, lower left; photo by David Levy.



*Did you know that some winemakers once believed that the appearance of a comet just before the grape harvest made a great wine? For example, winemakers in 1811 believe that the appearance of the Great Comet of 1811 helped weather conditions produce great champagne and cognac that year. These days, we know that there's no connection between comets and the weather, but winemakers put images of stars on their labels back then to honor the great comets!*

# WHY ARE COMETS IMPORTANT?

**COMET ORBITER/LANDER ROSETTA**

ARTIST'S RENDERING OF ROSETTA'S LANDER ON THE SURFACE OF THE COMET NUCLEUS (CREDIT: ESA)

After 10 years in space, the Rosetta probe closes in on its cometary prey. Rosetta will go into orbit near the nucleus of comet 67p/Churyumov-Gerasimenko. The probe is carrying a small lander designed to settle on the comet nucleus, take samples and conduct experiments.

**ROSETTA ORBITER**

Rosetta is the first mission designed to both orbit a comet and deposit a lander on its surface. Part of Rosetta's mission is to catalog the elements and molecules that exist in the comet's dust. A previous sample return mission to a different comet found particles of organic matter that are the building blocks of life.

COMMUNICATIONS ANTENNA

HUMAN TO SCALE

SOLAR PANELS

INSTRUMENTS AND SENSORS

SPACECRAFT DIMENSIONS: 9 by 6.8 by 6.5 feet (2.8 by 2.1 by 2 meters)

WINGSPAN ACROSS SOLAR PANELS: 105 feet (32 m)

TOTAL LAUNCH WEIGHT WITH LANDER: 6,620 lbs. (3,000 kilograms)

**PHILAE LANDER**

The lander was named after Philae Island in the Nile River. A comet nucleus has very low gravity, so the lander relies on harpoons and ice screws to secure itself to the surface.

SOLAR PANELS

SAMPLE DRILL

MAGNETOMETER (MEASURES COMET'S MAGNETIC FIELD)

HUMAN TO SCALE WITH PHILAE

SPACECRAFT DIMENSIONS: partial hexagonal cylinder, 3.3 feet by 2.6 feet (1 m by 0.8 m)

LAUNCH WEIGHT: 220 lbs. (100 kg)

SCIENCE PAYLOAD: 10 instruments

TRIPOD LANDING GEAR

DRILL BIT

ALPHA PROTON X-RAY SPECTROMETER (ANALYZES CHEMICAL COMPOSITION OF SURFACE)

THERMAL PROPERTIES PROBE

ICE SCREW IN EACH FOOTPAD SECURES LANDER TO COMET SURFACE

**ROSETTA'S 10-YEAR MISSION**

Rosetta took a winding path through the solar system, performing slingshot maneuvers past the Earth and Mars to use those planets' gravity for a speed boost. The probe examined two asteroids – Steins and Lutetia – before closing in on its primary prey, the comet known as 67p/Churyumov-Gerasimenko.

1. March 2, 2004 Launch
2. March 4, 2005 Earth slingshot
3. Feb. 25, 2007 Mars slingshot
4. Nov. 13, 2007 Earth slingshot
5. Sept. 5, 2008 Steins flyby
6. Nov. 13, 2009 Earth slingshot
7. July 10, 2010 Lutetia flyby
8. May 22, 2014 Comet rendezvous
9. Nov. 10, 2014 Comet landing

SOURCES: EUROPEAN SPACE AGENCY; JET PROPULSION LABORATORY

KARL TATE / © SPACE.com

You might be asking, just why do we study comets? Well, for one thing, material in comets – ice, rock and gas – is material from the very beginnings of our solar system. It is material ejected from the Sun when it was born. And because some of material is in a deep freeze, it may be still be pure enough for us to find out what the original solar system was really made of. These survivors from the birth of our solar system give us clues about how our solar system was formed. Comets are like fossils of our early solar system.

Another reason is that some scientists believe that some or all of the water on Earth may have come from comets. So we want to learn about how comets have struck the Earth and changed life here. Perhaps comets even brought life to Earth long ago.

NASA and other space agencies around the world like ESA (European Space Agency) and JAXA (Japanese Space Agency) are planning missions to visit and even land on comets.

We still have much to learn about these icy visitors from the Oort cloud. Keep watching the skies.

*Zoom in on the graphic at left, to learn about the Rosetta spacecraft and its mission to land on a comet in November 2014.*

# Resources

## Astronomy Picture of the Day

Many images of comets. Click the Archive link.

<http://apod.nasa.gov/apod/astropix.html>

## Wikipedia

Use the search engine to look up individual comets (e.g., Comet ISON) or other information (e.g., Sungrazers)

<http://en.wikipedia.org/wiki/Comet>

## NASA

NASA posts an enormous amount of on-line resources. Here's a link that's a good place to start:

[http://www.nasa.gov/multimedia/videogallery/  
Video\\_Gallery\\_Archives.html](http://www.nasa.gov/multimedia/videogallery/Video_Gallery_Archives.html)

## Magazines

*Astronomy*

website: <http://www.astronomy.com>

*Sky and Telescope*

website: <http://www.skyandtelescope.com>

***Search on-line for your local astronomy club!***

## Books

*COMETS!: Visitors from Deep Space*

by David J. Eicher and David H. Levy

*Comet*

by Carl Sagan

*Comets, Meteors and Asteroids*

by Seymour Simon

*Comets, Stars, the Moon, & Mars*

by Douglas Florian

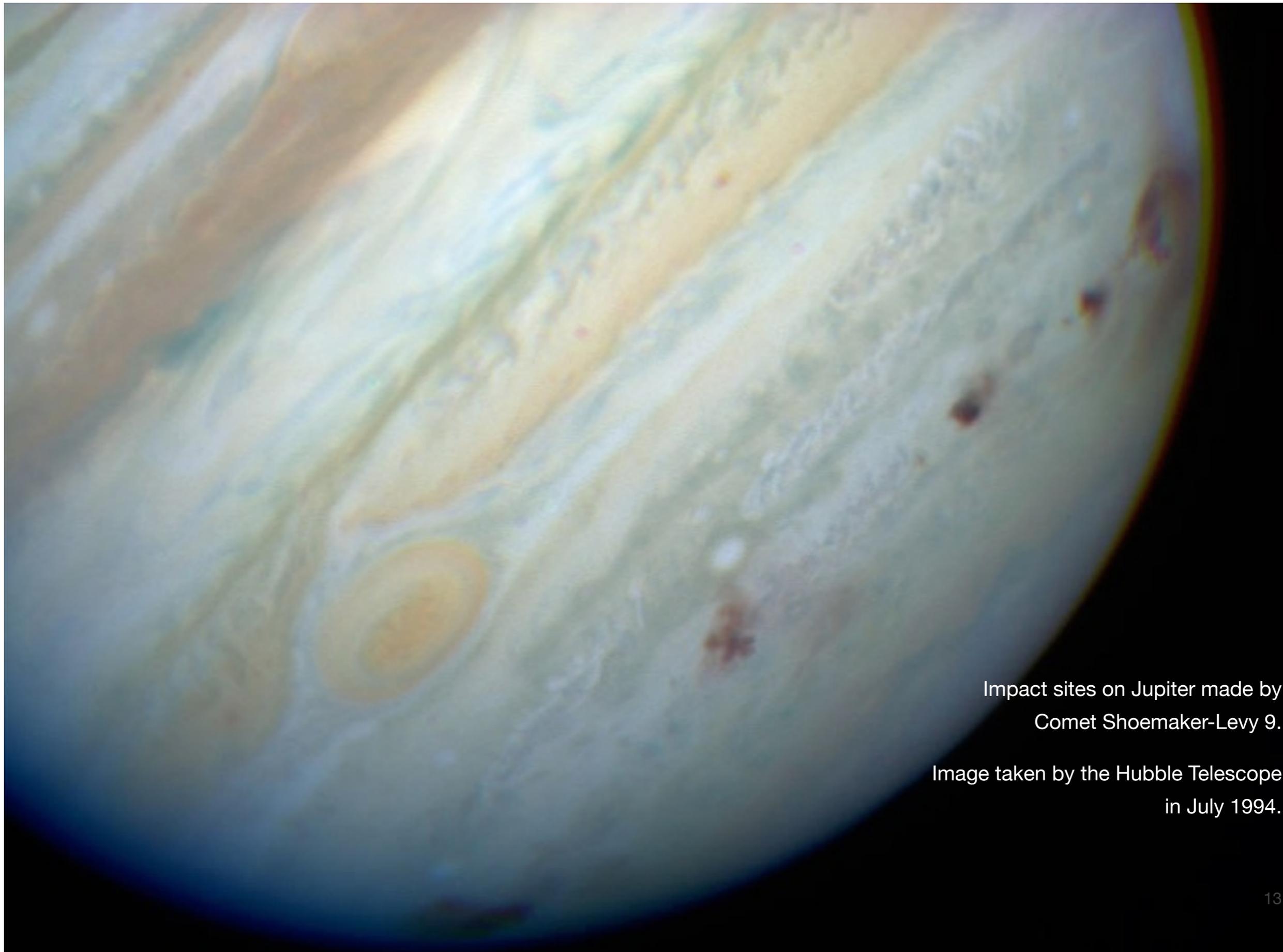
*The Everything Kids' Astronomy Book*

by Kathi Wagner Sheryl Racine

***Visit your local and school library!***

*Information and photos used in this document was culled from and used through the courtesy of NASA, ESA and JAXA websites, Wikipedia and from books mentioned on this page.*

copyright 2014 Tessmann Planetarium and Santa Ana College  
all rights reserved



Impact sites on Jupiter made by  
Comet Shoemaker-Levy 9.

Image taken by the Hubble Telescope  
in July 1994.