

## **Comets**

Comets are celestial bodies that orbit the Sun. They are often called “dirty snowballs” because they are made up of ice, dust and frozen gases. Astronomers have concluded that comets are left over from the beginning of our solar system, approximately 4.6 billion years ago. Comets may contain material that existed at the time of planetary formation.

(<https://www.nasa.gov/centers/ames/multimedia/images/2005/comets.html> ) Comets have been studied for many generations. Chinese astronomers kept very detailed records and drawings about comets and their tails. They also recorded how often the comets appeared, disappeared and where they were located in the night sky. These logs became an important resource for future astronomers.

Many comets may have formed in the area that is now Uranus and Neptune. This is known as the Kuiper Belt. Comets that originate from the Kuiper Belt, which is located inside our solar system are short period comets. These comets have an orbit of 200 years or less. These comets pass by the Sun more often. Many of the comets were discharged much further away from the sun. These comets formed a spherical cloud called the Oort Cloud around our solar system. The Oort Cloud lies about a light year away from the Sun, and outside the solar system. The comets that originate in the Oort cloud are long period comets. These comets only come

near the Sun for short periods of time. Some of these comets pick up debris and space junk and can have orbits that can be thousands of years. There are only 3,535 known comets, however, astronomers believe there are trillions of comets orbiting our sun in the Kuiper Belt and Oort Cloud. (<https://solarsystem.nasa.gov/small-bodies/comets/in-depth/> )

Previously, comets were called for the person that discovered them. However, currently there are specific rules that governed by the International Astronomical Union (IAU). There are very strict rules on how to register the name and discovery of a comet. There is always a P/year of discovery (for periodic comets) or C/year of discovery for non-periodic comets. Following that can be the names of up to three people who discovered it. (<https://space-facts.com/comets/>)

According to David Levy, a scientist who has discovered close to 40 comets including the Shoemaker-Levy-9 comet, “On average a dozen comets are found each year.”

(<https://www.nationalgeographic.com/science/space/solar-system/comets-age/> )

There are three parts to a comet. The nucleus is the solid part of the comet and it is composed of rocks, ice and a small amount of dust. The nucleus is very stable and solid. The nucleus is the smallest and most compact part of the comet. When comets are by the Oort Cloud or Kuiper Belt it is only made up of the nucleus. When comets make their way closer to the Sun, they warm up and the ice, frozen carbon dioxide and dust that are trapped inside starts to evaporate and sublimate (go from solid to gas bypassing liquid). A special feature about comets is that when they get closer to the Sun, they develop a part that is known as a coma. The coma is made up of dust that is recently ejected from the nucleus. The coma looks like a giant cloud of dust that surrounds the nucleus. At the head of the comet a Hydrogen cloud also appears which can be even larger than the coma. ( <https://kidsastronomy.com/solar-system/comet-facts/> ) The coma is made up of the vaporized ice and dust and can be thousands of miles long. The mixture

of all these things causes the ice crystals and dust to flow out of the comet nucleus in the solar wind and creates two tails. The dust tail is what we usually see when comets are visible from Earth. This tail is curved and wide. The second tail is made up of plasma and cannot be seen with the naked eye. This tail is usually pointing away from the sun. Most comets require specialized equipment to see it when they pass by the Sun. However, when comets can be seen with the naked eye, it is because of the light refracting off the dust in the tail and causes it to be bright at night.

The size of comets varies. When comets are frozen they can be the size of a small town but when they get closer to the Sun, they become much larger. Once comets are heated up by the Sun, they begin to travel very fast. They can fly by the inner planets at a speed of approximately 100,000 miles per hour. Each time the comet visits the Sun, it loses some of its mass and ice. Eventually, these comets may sublimate to nothing.

One of the most famous comets is Comet Halley which has an orbit of 76 years. Astronomers may have seen and recorded Comet Halley since 240 BC, however it made a well-known appearance in 1066 AD right before the Battle of Hastings. This is seen in the famous Bayeux Tapestry that recalls the Norman Conquest of England (Mardon and Mardon, 2002). Comet Halley was the first comet to have its orbit predicted. Sir Edmond Halley first made this prediction. Halley used Sir Isaac Newton's work that related to the force of gravity on the comet in 1680. He was able to connect these ideas to the similarities of the comets that were observed in 1531, 1607, and 1682. He predicted the comet's orbit to be 76 years and predicted the return in 1758-59. Because Halley was accurate in his premonition the comet was named after him. Comet Halley's last visit was in 1985-6. The next visit will be in the year 2061. Another famous non-periodic comet was Hale-Bopp (c/1995 O1). This comet was very bright

and spectacular. When studying the components of Hale-Bopp, scientists have discovered many carbon molecules and small amounts of nitrogen, sodium, and sulfur. These findings help support the theory that the building blocks of life were delivered to Earth by comets. Other well-known comets were Hyakutake (C/1996 B2), McNaught (C2006 P1), and Lovejoy (C/2011 W3). These comets were very bright when seen over Earth and then they disappeared into the night sky.

(<https://space-facts.com/comets/>)

NASA's Spitzer Space Telescope detected comet dust around other stars. Evidence of comets has also been seen around dying stars in other solar systems. There are some theories that state that a small portion of our oceans were formed from the ice of comets that may have crashed into Earth. The Herschel Space Observatory which was built by the European Space Agency (ESA) is a special telescope that can see the universe in infrared light. The Herschel Space Observatory has made a very interesting discovery. Herschel was studying and analyzing the water molecules in the coma of Comet Hartley. They have discovered that the composition of water molecules of water mimic those in Earth's oceans. (

<https://spaceplace.nasa.gov/comet-ocean/en/>) This is something that needs to be studied further to be certain.

Comets are one of the most exciting and widely studied aspects of our solar system. Newly discovered comets as well as studying other returning comets can help us learn about the origins of our planet and our Universe.

There are many questions that still need to be answered and researched.

How can we determine that comets are remnants of planetary formation?

How can we research the theory that comets possibly provided some of the water in our oceans?

Besides time and point of origin, what are the differences between short term and long-term comets?

How can we determine if comets are periodic or non-periodic comets?

What is the role of comets that orbit around other stars in our galaxy and beyond?

### Resources

1. <https://www.nasa.gov/centers/ames/multimedia/images/2005/comets.html>
2. <https://kidsastronomy.com/solar-system/comet-facts/>
3. <https://solarsystem.nasa.gov/small-bodies/comets/in-depth/>
4. <https://space-facts.com/comets/>
5. <http://coolcosmos.ipac.caltech.edu/page/comets>
6. <https://sciencing.com/parts-comet-8136471.html>
7. <http://nineplanets.org/comets.html>
8. <https://spaceplace.nasa.gov/comet-ocean/en/>
9. <https://www.timeanddate.com/astronomy/comets/>
10. <https://www.nationalgeographic.com/science/space/solar-system/comets-age/>
11. Mardon, A., & Mardon, E. (2002). The Bayeux Tapestry and the Appearance of Halley's

Comet in 1066 A.D. *Meteorites and Planetary Science*,37, A94. Retrieved October 21, 2018.