

CATCH A STAR

"COMETS, VAGRANTS OF THE UNIVERSE"



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Abstract

"Comets, vagrants of the Universe" is a project based on research on comets. The students have done a study to find about comets are, their composition, where they are, their movements, differences between other stars, history of different "famous" comets and curiosities.

The team has compiled all the information into a 'Notebook field researcher' for good planning and development work.

We had the great opportunity to talk with Mirjana Povic, astrophysics who clarified many doubts for us.

To do this project we have made various activities: a night out to observe the comet Ison, a presentation to introduce the topic to their classmates, a 3D mural involving their school friends for elaboration, an informative mural about the spacecraft Rosetta where you could send messages into space, performing "Kites of comets", a presentation and to disseminate what they have learned and to make all students and teachers of the school participants in this research project.

Comets are celestial bodies composed of ice, dust and rocks that inhabit the Oort Cloud and the Kuiper Belt, formed while the Solar System. As the comets approaches the Sun, the characteristic tail is generated, that makes it as attractive as an object of observation and study from human throughout history.

Development

Comets are celestial bodies which have made humans curious, fascinated and fearful over the whole story. Our object of study was defined when the comet Ison was a news as it could be seen from the Earth and its approach towards the sun could disintegrate it.

Comets are space rubbish; they are remains from the formation of the solar system 4.600 million years ago. They consist of water, dry ice, ammonia, methane, iron, magnesium and silicates. They are fragile, dynamic and small, their diameter may measure about 10 kilometres. Comets have 3 parts: nucleus, coma and tail hair.

The nucleus is the solid part and it has ice and rock, while frozen its appearance is very similar to an asteroid. It is surrounded by a nebula called hair or coma, it is formed when a comet approaches the Sun, part of the ice is evaporated and, along with dust, this begins to transform to a visible cloud surrounding and covering the nucleus.

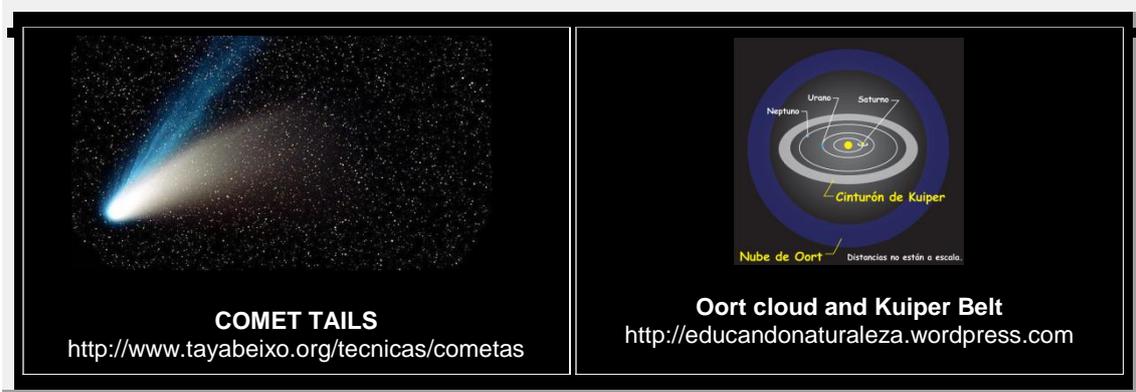
Comets have different types of tail: the ion tail or gas that can extend million kilometres and dust tail. The ion tail is always directed in the opposite direction of the

sunlight and the dust tail retains part of the orbital momentum and it tends to be curved, as if embracing the sun.

Comets are in the Oort Cloud and the Kuiper Belt.

The Oort Cloud was named thanks to the Dutch astronomer Jan Oort in 1950 as he investigated and determined its existence. The cloud is spherical and is located on the edge of the Solar System. A hundred billion objects are in it probably. It is the source of long-period comets.

The Kuiper Belt is a disk-shaped region that is beyond Neptune's orbit and is considered to be as the source of short period comets. The giant planets (Jupiter, Saturn, Uranus and Neptune) perturb the orbit of a Kuiper object throwing it into the orbit of Neptune and they will eject from the Solar System or sent into the orbit of another giant planet.



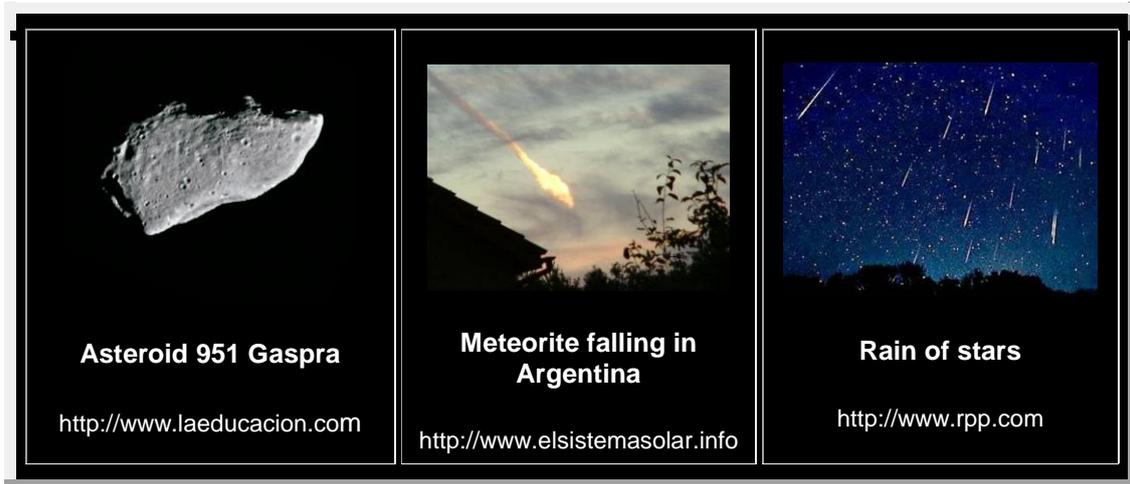
Comets travel in elliptical orbits elongated and in a different plane of the Solar System. They move at high speed, increasing as they approach the Sun, because the gravity that attracts them is greater; they move more slowly in its remote orbit.

Comets can be classified by time in describing its orbit around the sun: the short-period comets, needing less than 20 years to describe a complete orbit, they are small, they can be of about 2 kilometres in diameter and these are losing their components, the long-period comets take over 200 years to complete their orbit and middle period comets can take between 20 and 200 years.

Comets can be confused with other celestial bodies, for example with an asteroid, meteor, a shooting star and even a planet, but there is always a difference.

The main difference between asteroids and comets is that they are made of different materials. Asteroids don't contain ice and they have different minerals. They were formed at the same time but asteroids did much closer to the Sun. They are usually larger; they can have a width of 100 meters to 960 kilometres.

Meteorites can be more confusion because they are too bright and they have a tail. Its brilliance is due to the burning when entering the Earth's atmosphere, they are known as shooting stars. There are times when hundreds of shooting stars for hours and even days occur. They are called meteor shower and they often coincide with comets, so astronomers think they are remains of any of these.



Among the many billions of comets some are more famous. We have selected Halley, Hale Bopp and Ison.



Halley comet is named by the English astronomer Edmond Halley, (1656-1742), he observed and calculated its orbit, and he predicted its return in the end of 1758, his theory defended the existence of comets which made an elliptical trajectory around the Sun.

Halley comet has a period of orbit of about 76 years, but it's impossible to calculate the exact date because the gravitational pull of the giant planets alter its orbit and because the reaction of the gas when it passes near the Sun.

Giotto, ESA spacecraft, could take photos of his dark nucleus. It measures about 16x8x8 kilometers and its weight is little. Halley comet will return to the inner Solar System in 2061.



Ison comet was discovered by Vitali Nevski, from Belarus, and Artyom Novichonok, from Russia, on September 21, 2012. It was thought to be the comet of the century because it could become one of the brightest. Ison reached perihelion just passing 1165000 km from the Sun and it was entirely volatilized on November 28, 2013. SOHO spacecraft detected a small part on November 29, it may be the nucleus but it's difficult to demonstrate because it had lost a lot of its brightness.

On December 2, the CIOC (Comet ISON Observing Campaign, Campaign Ison Observer Ison) said it had disintegrated, finally, NASA confirmed the disappearance of the nucleus.

We did a direct observation on November 29, at 5:30 a.m., but the sky was cloudy and we couldn't watch Ison.



Marina, Hugo and Gabriel. November 29, 2013
Planetarium, Madrid

Hale Bopp comet was discovered by two American astronauts: Alan Hale y Thomas Bopp, on July 23, 1995, when Hale Bopp was beyond the orbit of Jupiter.

The nucleus was of 40 Km in diameter. Its nearest approach to Earth has been 194 million kilometres. It takes 2364 years to go round the sun. It is the brightest comet since Comet West in 1976 and it has been the best visible from Earth with the naked eye, for 19 months.



HALE-BOPP

<http://apod.nasa.gov/apod/ap080302.html>

In August 1998, the astronauts of the Space Shuttle Discovery studied the coma and tail and their behavior in the solar wind. In the Observatory of the Roque de los Muchachos in La Palma, Canary Islands, it was observed for first time a neutral tail and molecules which weren't seen before in any comet.

Astronomers continue to monitor the comet. In January 2005 it was beyond the orbit of Uranus and, although weak, they were still watching its tail using large telescopes. They hope they can keep watching it until 2020, and then it will be very difficult because there are a large number of distant galaxies which have a similar brightness.

Comets have occupied a place in the history of humanity because they have always aroused admiration and fear; some cultures have associated comets with events, usually tragic. The word "comet" comes from Greek and means "star with hair".



Nativity. Birth of Jesus, Giotto, 1267-1337
Note the comet on the top of the painting.

www.selvinitappetico.com

There have been references about comets since the second millennium before Christ. The ancients believed that comets were atmospheric phenomena, but Seneca (4 BC-65 DC) understood that they were celestial bodies. The Danish Tycho Brahe showed that comets came from the space beyond the orbit of the Moon. Edmund Halley showed the frequency to check that the comet which was observed in 1682, it was the same that it had been seen in 1456, 1531 and 1607, every 76 years or so.



SENECA

www.poesiadelmomento.com



TYCHO BRAHE

www.biografiasyvidas.com



EDMUND HALLEY

<http://en.wikipedia.org>

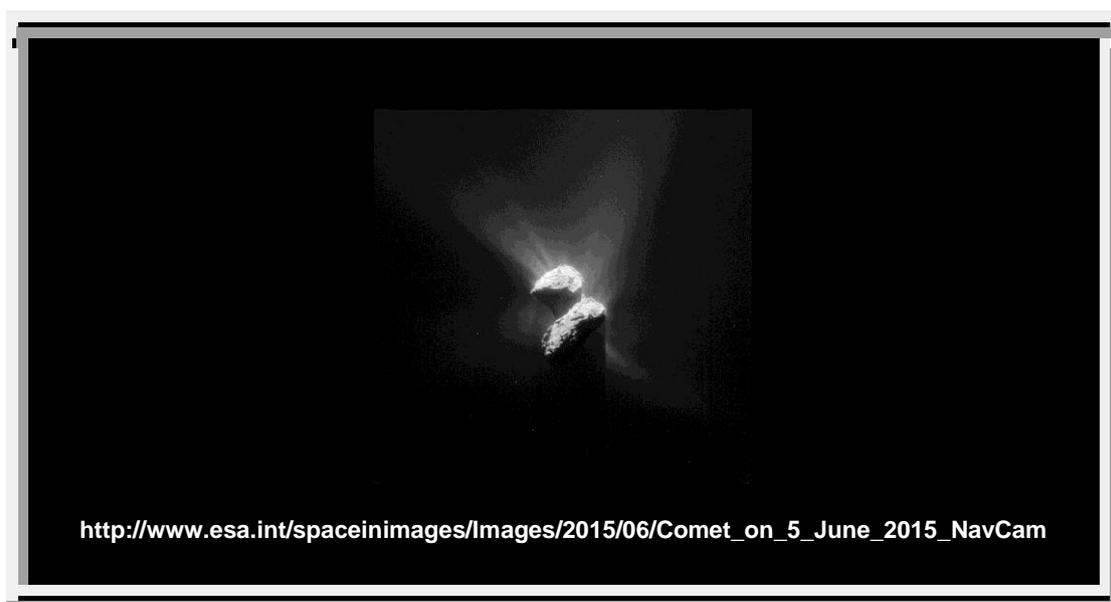
The future of research and study of comets is already happening. The ESA Rosetta Spacecraft was launched to Churyumov-Gerasimenko comet on March 2, 2004 and has taken 10 years to catch up.



On November 12, 2014, Rosetta released a lander, called Philae, to be anchored at its nucleus for a photographic studio and other experiments but Philae fell into a shady area and sunlight doesn't get there, so Philae isn't working, at the moment.

Rosetta continues around Churyumov-Gerasimenko and it is observing all the changes that the icy comet is making as it approaches the Sun.

In May 2014 Rosetta got the closest approach to the comet and began to maneuver into orbit.



In August 2015 Churyumov-Gerasimenko will reach its closest approach to the Sun and the mission will end in December 2015.

The name of the spacecraft and its module is inspired by Egyptian names; the Rosetta Stone was used to decode the mysteries of Egyptian writing. Also it is expected to Rosetta and Philae will resolve many mysteries about comets.

Practical activities

- 1. FIELD NOTEBOOK:** Each of the team members has been working on a field researcher notebook where they have been collecting all the information, questions, trivia, photos ... It was a very interesting idea because it facilitated the definition of our project and everyone has reflected their originality and vision of the subject.
- 2. VIDEO CONFERENCE:** On December 4, 2013 we had the great opportunity to talk with Mirjana Povic, astrophysics. This video conference was a prize that some school students won participating in "Catch a star" organized by the European Association for Astronomy Education (EAAE). Mirjana was explaining to us her work and we asked her a lot of questions about the universe and specifically about comets.



December 4, 2013. Mirjana Povic answering our question about comets.

3. **OBSERVATION:** As it has already been explained before, on November 29, 2013 the team assisted an observation of the comet Ison, it was organized by the Planetarium of Madrid. It didn't happen because of the weather, the sky was full of clouds. We hope to try it again, when Ison comes back to Earth, but the comet was disintegrated upon reaching the perihelion.
4. **PRESENTATION TO THE CLASSMATES:** The team conducted a little explanation about comets to their classmates of 4th grade. They were guided with slide and drawings on the blackboard of the class and they explained to them what a comet is, its composition, where they come from, how they move ... and they answered questions.



Explanation about comets to their classmates

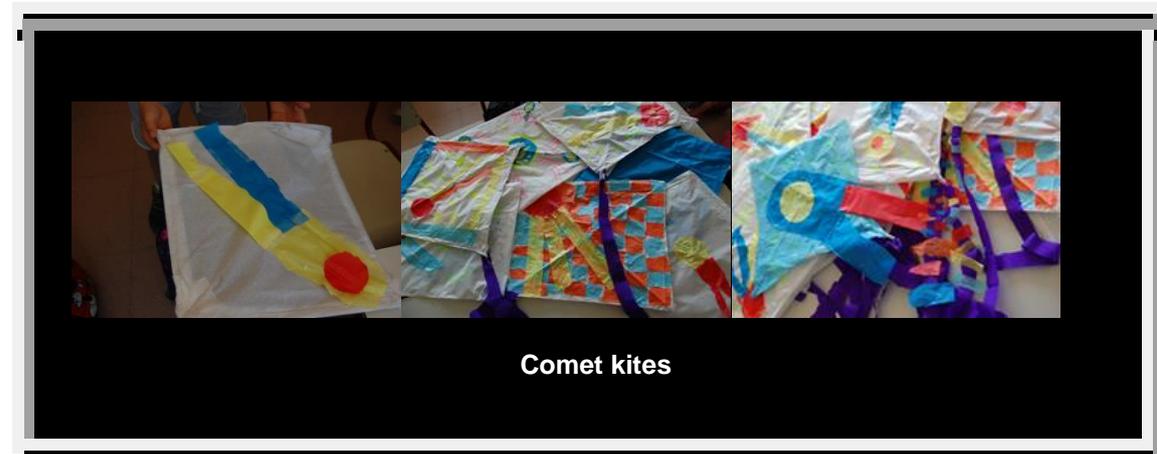
5. **MURALS OF COMETS:** Once the students of 4th grade got to know information about comets, they made murals with recycled material (Corks, bottles, milk and juice boxes, buttons, ribbons ...) We decided to create these murals with this type of material (land waste) because comets are made with space waste, too. A large mural was formed with all the murals decorating the entrance to the school.



6. MURAL ABOUT ROSETTA: We conducted a large mural representing Rosetta to all students in the school. This included information on Churyumov Gerasimenko on the spacecraft, its name and chronology. All students could send a message into space by sticking a post-it on solar panels. The results were very interesting, some examples of the messages are "good trip!", "Happy landing!", "I want to go to space", "Send us photos", "Living space!"



7. COMET KITES: We have discovered that whether comets and the kites have something in common, it seems that not, but we have found a similarity in form, so we have developed "comet kites" in the classes of 4th degree with colored tissue paper, sticks and string.



8. **CONFERENCE:** The culmination of the project is to show everything that we have learned about comets, by sending this work and all the information to the entire educational community of CEIP Salvador de Madariaga.



We will continue to work until the end of the course. Making a small experiment, "Cooking kites" to see how a comet works as it approaches the sun and we are developing a model of the space probe "Rosetta" and Philae module.

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