
Comets

Name: Joe

Lab Partner: None

Science Lab Report • MCS Adolescents • May 30, 2022



NASA/ESA and The Hubble Heritage Team (STScI/AURA)

PURPOSE: To answer the following questions:

1. Who discovered what comets are made?
2. What are comets made of?
3. When the comets get close to the sun why don't they get pulled in to the sun by the sun's gravity?
4. When do comets disappear/die/explode/meet their end?
5. Where do comets come from?
6. If comets are ice why don't they burn up after coming near the star they orbit a few times a few times?
7. How does the gravitational pull of planets affect the orbit of comets?
8. How do astronomers find out what comets are made of.

HYPOTHESIS:

If comets are ice why don't they burn up after coming near the star they orbit a few times a few times?

I hypothesize that comets do not disintegrate after orbiting the sun or any star because they are protected by an outer layer of rock.

How does the gravitational pull of planets affect the orbit of comets?

I hypothesize that when a comet encounters the gravitational pull of a planet it spins off into a new area of space. The comets we see are not affected by the gravitational pull that much so we are able to see them without them going out of control.

How do astronomers find out what comets are made of?

I hypothesize that astronomers have figured out the contents of comets because some have made it through our atmosphere and we have been able to study them.

When the comets get close to the sun why don't they get pulled in to the sun by the sun's gravity?

I hypothesize that the comets that are currently in orbit do not get pulled in because they are a certain distance from the sun so that its gravity is not to the degree where the comet gets pulled in by the star.

What are comets are made of?

I hypothesize that comets are mainly made of rock and ice.

Who discovered what comets are made of?

I hypothesize that one single astronomer discovered the contents of comets.

When do comets disappear/die/explode/meet their end?

I hypothesize that comets lifes end when they are pulled in by a star or planet or are just burn up after many years.

Where are comets made?

I hypothesize that comets are created from the remnance of a destroyed planet or star.

DATA:

Who discovered what comets are made of?

In 1951, Fred Whipple introduced the dirty snowball model. And that a comet actually spins, and the trajectory of the comet changes based on its spin. This theory was later proved by a space craft called stardust that collected comets particles.

What are comets made of?

Comets consist of a crust of dark dust on the far outside, and a deep mix of snow and dust are inside the nucleus. When the comet gets close to the sun or any star jets of gas and dust are released from the surface when it is heated. The dirt that surrounds the comet is silicate rock in the form of small dust particles. When the comet endures extreme amounts of heat the snow is immediately converted from the solid state it was originally, into a gaseous state by the extremely high levels of solar radiation when it is close to a star.

When the comets get close to the sun why don't they get pulled in to the sun by the sun's gravity?

The reason why comets don't immediately spiral straight into the star that is pulling it is because of the way the star bends space-time. If the comet enters the gravitational pull of a star, the star grabs a hold of the comet and depending on the way the comet entered the pull of the star, the comet could either remain in the pull of the star and then fly out of reach into another area of space. Otherwise it will remain in the pull of the star for the rest of its life.

When do comets disappear/die/explode/meet their end?

As comets passing close to the sun, the sun heats the comet (which is made of ice and rock) and this makes gases come out of the comet taking particles with it creating the tail. Sometimes this dispensing of particles is violent enough to break the comet to pieces. The other way comets often disappear is they lose all of their particles and ice so they can no longer make a tail. At this point the comet is a big hunk of rock more like an asteroid.

Where do comets come from?

Comets can come from two places that we know of, the Oort cloud and the Kuiper Belt. The Oort cloud is a spherical ring around the solar system made of comets around 50,000 AU away. The comets in the Oort cloud have long orbital periods and can enter our solar system from many different directions. The Kuiper Belt is a group of icy objects surrounding Neptune. These icy objects lie mostly in the plane of the solar system. Objects in the Kuiper Belt are still being discovered. However we are not certain where comets originate.

If comets are ice why don't they burn up after coming near the star they orbit a few times a few times?

Comets don't burn up immediately because they are very cold but they are heated and they give off gas that blows particles off the surface making the comet a little smaller. So in a sense comets do melt as they pass the sun just they only melt a little each time they pass the sun.

How does the gravitational pull of planets affect the orbit of comets?

When a comet travels near a planet, there is always a gravitational force between the comet and the planet. This force provides a centripetal (moving towards the center) acceleration, which changes the comet's path so that it either begins to orbit the planet or is shot off into space from the acceleration. The larger the mass of the object that is interfering with the comet's path the more easily the comet's path is changed and the more

likely it is to be captured. This means that a massive planet could catch a comet easier than a smaller planet.

How do astronomers find out what comets are made of?

In 1999 NASA launched a craft that went out and trailed a comet called Wild 2. Then it extended a net that looked a lot like honeycomb. Each little section was filled with a substance called aerogel. This aerogel collected the particles that were blown off of the comet as it heated. This aerogel sheet was then folded in to a capsule and returned to earth in January 2006. This material provided us with a sample of a comet so that we can study what they are made of better than ever.

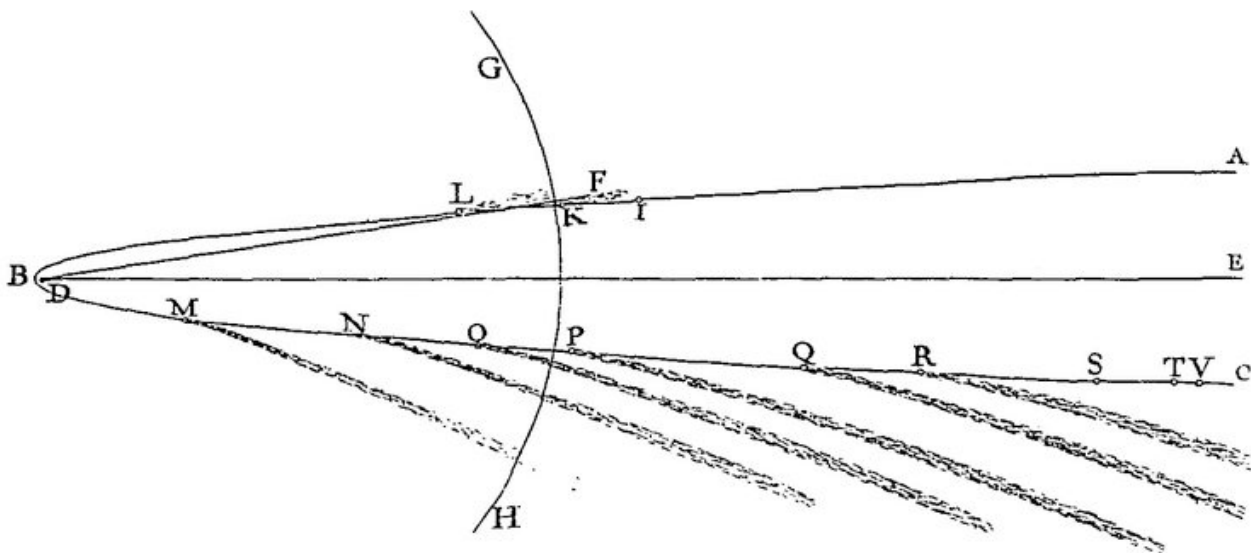
DATA REVIEW:

A comet far from the sun consists of a very dense solid body, which can get to a few miles in diameter called the nucleus. As the comet approaches the sun this dense nucleus becomes surrounded by luminous cloud of dust and gases which is known as the coma. The reason for this luminosity is caused by molecules in the comet absorbing and reflecting the intense radiation of the sun.

According to the icy conglomerate theory that was proposed by Fred Whipple in 1949, “The nucleus consists of frozen water and gases with particles of heavier substances interspersed throughout, thus being in effect a large, dirty snowball.” This was somewhat disproved when the stardust probe passed near a Comet in 2004 and collected particles from the coma, and returned two years later in 2006. It found evidence that many of the dust particles that were collected from the coma of the comet were formed in high temperatures not found in the Oort cloud (which are small, icy bodies about 1.5 light years from the sun).

As a comet approaches the sun, the solar wind drives particles and gases from the near surface of the nucleus and coma to form a tail that can extend to an amazing 100 million miles in length. Thus the tail always streams out in the direction opposite the sun, because of the direction the comet’s particles are thrown about. ☒

As for the history, the Newtons Sketch origin of comets is not yet



My graph of a parabola

Formula	X Value	Y Value
$Y = 1 \times 1$	1	1
$Y = -1 \times -1$	-1	1
$Y = 3 \times 3$	3	9
$Y = -3 \times -3$	-3	9
$Y = 5 \times 5$	5	25
$Y = -5 \times -5$	-5	25
$Y = 10 \times 10$	10	100
$Y = -10 \times -10$	-10	100

certain. For a very long time they were thought to have been created outside of the solar system. However more modern theories suggest they are formed during the formation of the solar system and are permanent members of it.

The orbit of a comet has a lot to do with its classification. Short-period comets orbit the sun in the same direction as the planets. Most have orbital periods of about seven years, and get no farther from the sun than Jupiter. These short-period comets were captured into the inner solar system by the gravitational influence of Jupiter. If they remain in these small orbits, they will decay quickly. However, some will be ejected by Jupiter into much larger orbits, and the possibly recaptured.

Intermediate and long-period comets have orbital periods greater than 20 year. Their orbital planes are inclined at random to the plane of the solar system. Many of these comets travel huge distances into the interstellar regions (in between stars which could have developed solar systems). Most of the recorded comets get close to the Sun, where they de-

velop comae (plural of coma) and tails which makes them much easier to discover. There are obviously vast numbers of comets on more distant orbits that are too faint to be found.

Isaac Newton made observations of the Great Comet of 1680. At the time, a conventional view held that comets traveled in straight line and passed through the solar system only once. Based on his observations, Newton realized that he had seen a comet traveling around the Sun on a parabolic curve (which means it resembled a parabola which can be graphed using the formula $y=x^2$).

In 1687, in the *Principia*, Newton used his study of comets and other phenomena to confirm his law of universal gravitation. He also showed how to calculate a comet's orbit from three accurate observations of its position using geometry.

The first comet discovered that was recorded was Halley's comet in 240 B.C. Halley's comet is likely to be the most known as well. In 1696, Edmond Halley, England's second Astronomer Royal, reported to the Royal Society in London that comets that had been recorded in 1531, 1607, and 1682 had very similar orbits. He concluded that this was the same comet returning to the inner solar system about every 76 years, moving under the influence of the newly discovered solar gravitational force.

I actually did not know that Halley's comet was the first that was recorded. I thought that it was just a very well known and common comet that we were able to see frequently. But according to my research it's not a very commonly seen comet, and passes by around every 76 years, which compared to some of the other comets is very often but for us is a once in a lifetime occasion.

Halley predicted that the comet would return in 1758. Halley's Comet was the first periodic comet to be discovered. This indicated that at least some comets were permanent members of the solar system. Orbital analysis has revealed that Halley's comet has been recorded 30 times, the

first known sighting being in Chinese historical diaries of 240 B.C. The last appearance, in 1986, was 30 years after the start of the space age, and five spacecraft actually visited the comet.

Some ancient superstitions people regard comets as portents of death and disaster. Before Edmond Halley's work, all comets were unexpected. They were often compared to flaming swords. England's King Harold II was worried by the appearance of Halley's Comet in 1066. By what was a bad omen for him was a good sign for the Norman Duke William, who conquered Harold at Hastings.

I think that the mere presence of science and scientific thinking can help resolve some of the worlds problems. For instance in the time of Harold II they were not aware of what Halley's comet actually was. So they formed their own myth about something that could be easily explained by science, which caused them some harm.

I also think that this can be seen in other instances too. For instance their was an edge of the world, it could once again be explained with simple geometry and science.

CONCLUSION:

My hypothesis was for the most part correct. I had a few minor errors, one of them being that comets stay relatively the same not because

of the exterior of rock that surrounds them. I learned what comets were made of, and where they were most likely formed. I learned how comets are influenced by other objects such as stars and planets.

I learned how comets behave in different environments. I learned what the life cycle of comets was like, and how they live and die. I learned some of the methods people used of discovering comets paths and how they behaved when they were approaching a star as well as when they were at the far reaches of the stars gravitational pull. Finally, I learned that sometimes things don't work out like they were supposed to, but sometimes it ends up working out for the best.

Comments:

-In the last sentence of my conclusion I was referring to Graham not working with me because our schedules didn't match, but it worked out for the best because I ended up putting together a piece of work that was far better than what we could have done together. I'd also like to mention that Jonny helped me get started and influenced me to do very good work, he also helped write a portion but I ended up not needing it. Thank you...