Comets

**Narrator:** Listen to part of a lecture in an astronomy class.

**Professor:** OK. We have been looking at some of the smaller members of our solar system, comets. You already know about the structure of comets. Let’s continue our discussion now by talking about orbits, especially those of the so-called periodic-orbit comets. These are the comets that circle around the Sun pretty regularly. They return again and again, predictably, after a certain period of time. That’s why we say their orbits are periodic. Probably the most famous and brightest of these is Halley’s comet.

Halley’s comet comes from far out in the solar system, goes in close to the Sun, and then out again. At its closest approach to the Sun, Halley’s comet is about twice as close to the Sun as Earth is. And at its farthest. It's about thirty-five times farther from the Sun than we are, which puts it out beyond Neptune. Basically, the idea here is that a periodic comet, with its very elongated orbit, just keeps coming back around again and again. With Halley’s comet, well, it returns every 75 years, roughly.

But where is Halley’s comet during most of this time? Well, like all orbiting bodies, a comet moves faster when it’s closer to the Sun. So it only spends about a year or two in our neighborhood, inside the orbit of Jupiter. Most of its time is spent way out beyond Jupiter’s orbit, poking along near the farther reaches of it own orbit. Because of this, we can only see Halley’s for a few months every 75 years, first on its way in toward the Sun, and then on its way out again.

Now, you remember from our previous discussion that a comet’s nucleus, its core, is made up of ice and dust, like a frozen snowball. And as it approaches the Sun, it starts to heat up. And some of the ice vaporizes into gas and spreads out from the nucleus. The gases that vaporize from the comet, the comet never collects them back again, so on every orbit, the comet leaves part of itself behind.

OK. How old is this solar system? Four and a half billion years, remember? And Halley’s is going around the Sun once every 75 years and losing stuff each time. So the comet should be long gone by now, right? I mean, how come Halley’s is still there? After four and a half billion years. How could it be? Well, the answer is that this comet hasn’t always been in such a short periodic orbit, since once a comet gets into an orbit that keeps it coming in close to the Sun quite frequently. Well, that comet’s probably not going to be around too much longer. So this kind of periodic orbit is only a phase in a comet’s life. A phase that just precedes its final breakup. We’ve seen comets do that, going toward the Sun and then come back around, torn into pieces.

But lots of comets aren’t like that. They come in, pass behind the Sun, and then travel back out. But with an orbit so large, and its farthest place so far away from the Sun that we just don’t know how far out it goes. We just can’t determine that very accurately from the close-in part of the orbit that we do see. So these are often called parabolic-orbit comets. Parabolic means the orbit is open at the far end. Actually the orbit probably does close and return the comet to the vicinity of the Sun eventually, but the period might be tens of thousands of years. And basically, we can’t determine it. So we just, we refer to them as open-ended parabolic-orbit comets.

So, what can change a comet with one of these long orbits where they only come by the Sun occasionally into a much more frequent periodic visitor? Well, gravitational interaction with planets, right? If a comet on one of these long period orbits at some point comes close to Jupiter or Saturn or one of the other planets, then the pull of that planet’s gravity might alter the orbit, maybe make it much shorter. So this comet, if it happens to pass by a planet just the right way, it can be drawn into a new orbit, one that’ll capture it and keep it coming back around the Sun much more often.

The moon (1) appears to be a dry and dead place. Scientists have long believed that Earth's (2) satellite lacks the ability to hold water near its surface because it has no (3) atmosphere. So the announcement by the United States space (4) agency shocked many in the scientific community.

"Widespread water has been detected on the surface of the moon."

That was Carle Pieters, a professor at Brown University, in Providence, Rhode Island. She is the investigator for a NASA team studying the lunar findings.

The NASA scientists discovered water (5) molecules mainly in the moon's extreme northern and southern areas. The researchers note, however, that they could also be seeing evidence of another molecule, hydroxyl.

Hydroxyl is the combination of one (6) hydrogen atom and one oxygen atom. Water is made of one oxygen atom and two hydrogen atoms. The NASA team still is not sure how much of what they have found is water and how much is hydroxyl.

Instruments on three separate spacecraft have now shown evidence of lunar water. NASA's Moon Mineralogy Mapper provided the most recent (7) evidence. It was one of eleven scientific devices carried by the Chandrayaan spacecraft of the Indian Space Research Organization.

The mapper is a spectrometer, a device that measures (8) reflected light wavelengths. It is able to show scientists what an object is made of from great distances. Similar devices on NASA's Cassini and Epoxi spacecraft also reported the (9) presence of water. But those observations were made years ago and NASA scientists had not trusted the results without clear (10) confirmation. Now, Ms Pieters calls the new results completely conclusive. The findings were published in the journal *Science*.

The Moon Mineralogy Mapper can only observe lunar soil to a depth of a few millimeters.

And the amount of water present in that layer is very small. Jim Green is director of NASA's Planetary Science Division. He points out that even the driest deserts on Earth have more water than the surface of the moon near its poles.

Still, the discovery raises some important questions. Was water brought to the moon by space rocks and icy bodies called comets? Or could processes deep within the moon produce water? If that is the case, it may be possible that the moon could hold enough water for future explorations or even colonies.

Indian space officials lost contact with Chandrayaan-1 late in August. But another NASA project, the Lunar Crater Observing and Sensing Satellite, or LCROSS, could provide answers to what lies deeper beneath the moon's surface.

That project involves crashing a rocket stage into the moon's south pole. LCROSS will then study the soil thrown up to ten kilometers above the lunar surface before it too crashes into the moon. NASA scientists hope to extend their search for water as deep as five meters beneath the surface of the moon. LCROSS is expected to crash into the moon next month.

(F) 1. The announcement that the moon is a very dry place shocked the scientific community.

(T) 2. The water molecules were mainly discovered in the moon's extreme northern and southern areas.

(F) 3. Hydroxyl has more hydrogen atoms than water.

(F) 4. The mapper is a device that detects light waves.

(F) 5. The mapper also reports the presence of water.

(T) 6. The Moon Mineralogy Mapper can observe the soil on the moon only to a depth of a few millimeters.

(T) 7. The surface of the moon near its poles has less water than the driest deserts on Earth.

(T) 8. Scientists still don’t know for sure how water was brought to the moon.

(F) 9. LCROSS stands for the Lunar Craft Observing and Sensing Satellite.

(F) 10. NASA scientists are now searching for water as deep as five meters beneath the surface of the moon.

Have you ever wished you could travel through time? Well, it's not as far-fetched as you might think. The reality is, most of us have already traveled through time in our daily lives, and that we may be somewhat younger than we think as a result. According to Albert Einstein's special theory of relativity, our perceptions of time and space are defined by motion and speed. In other words, time actually moves slower for someone traveling in higher speeds, relatively someone standing still. So believe it or not, every time you take a flight on an airplane, you actually jump a tiny fraction of a second into the future. In fact, it's called time dilation. And as you fly, the more pronounced the time shift would be.

Scientists set out to prove this theory in 1971 by loading an atomic clock on the jet and sending it around the planet at five hundred miles an hour. Another atomic clock was kept at the airport. Surprisingly, when the jet returned, the clock on the plane that essentially registered the time was 16 nano-seconds earlier than the one left on the ground. Now you'd have to be traveling extremely fast for there to be any real significant time shift. Even at the spatial rocket in the space at seventeen thousand miles an hour for a full year. The crew would still only jump amazingly 3.8 seconds into the future.

So, why don't we just build machines that can go a lot faster than that? First, the speed needed for a dramatic time jump is far beyond our current technology. And second, the Laws of Physics say it's impossible to travel that fast. To make a really significant time jump, we need to travel faster than the speed of light over 186 thousand miles a second, which scientists say it's impossible. But then again, we thought no one could surpass the speed of sound until Chuck Yeager did it in the late 1940s.

If we could eventually break the light barrier, scientists believe that some really strange things might start to happen. First, as we approach the speed of light, it's believed we will jump further and further into the future, but then, once we surpass the speed of light, some scientists think we might actually start going backwards in time. Everything would appear to go in reverse. Skeptics believe strange time travel theories like these are preposterous. 'Coz the Laws of Physics will never allow us to approach and surpass the speed of light. But Chuck Yeager once proved skeptics have been wrong before.

**1. What is this passage mainly about?**

A) Space travel.

B) Travel to the future.

C) Travel through time.

D) Travel to the past.

1. **You may be younger than you think because \_\_\_\_\_\_\_\_\_.**

A) you travel faster than others

B) you travel slower than others

C) you develop slower than others

D) every time you travel by air, you actually jump a little into the future

1. **According to Einstein’s special theory of relativity, \_\_\_\_\_\_\_\_\_.**

A) our perceptions of time and space are defined by motion

B) our perceptions of time and space are defined by speed

C) our perceptions of time and space are defined by speed and motion

D) our perceptions of time and space are defined by gravitational laws

1. **Why was the two atomic clocks placed differently?**

A) Because scientists want to find out how accurately each clock went.

B) Because scientists are skeptic of the notion that time will go faster when people travel fast.

C) Because scientists want to figure out the qualities of the clocks.

D) Because scientists want to confirm that the clock on the plane would go faster.

1. **The astronaut would jump 3.8 seconds into the future if \_\_\_\_\_\_\_\_\_.**

A) he travels at 17,000 miles an hour

B) he travels at 17,000 miles an hour for a full year

C) he travels at 500 miles an hour

D) he travels at 500 miles an hour for a full year

1. **Chuck Yeager was mentioned to imply that \_\_\_\_\_\_\_\_\_.**

A) someday we might go faster than the speed of light

B) someday we might be able to travel at supersonic speed

C) space travel is possible

D) time travel is possible

1. **If we can travel faster than the speed of light, \_\_\_\_\_\_\_\_\_.**

A) scientists believe that we will shift further into the future

B) we might actually be going backwards in time

C) everything would seem to go reversely

D) All of the above.

1. **Skeptics means \_\_\_\_\_\_\_\_\_.**

A) to be doubtful about things

B) to believe in everything they have seen or heard

C) to be positive about life

D) to be negative about life

1. **The laws of physics suggest that \_\_\_\_\_\_\_\_\_.**

A) it’s impossible for people to travel at a speed exceeding that of light

B) natural law must be revered

C) we are allowed to travel almost as fast as light

D) we are allowed to travel as fast as light

**10.** **According to this passage, can we build machines that can go faster than light?**

A) Highly possible.

B) Unlikely, but not absolutely impossible.

C) Impossible.

D) It’s possible to achieve this with the supersonic technology.