

World Museum Liverpool Planetarium 'A Tale of Two Planets' transcript

Around four and a half billion years ago, in a very large but rather ordinary cloud of gas and dust, part way along the spiral arm, of a fairly average spiral galaxy something happened that would change the way this part of the universe would look forever.

The galaxy is our galaxy, the Milky Way. We're not sure exactly what happened. It may have been a nearby star exploding, or a collision with another cloud.

The result?

First the cloud started breaking up into smaller, denser patches of dust and gas known as nebulae then one of these nebulae began to collapse under its own gravity. As it did it began to spin faster and faster. The dust and gas spread out into a disc with a hot, dense core and cooler edges.

The core of the nebula continued to condense until it formed a star.

Near to the star only the rock and heavy elements could stand the intense heat, lighter elements settled in the outer regions of the disc.

Eventually the matter in the disk started to clump together, these clumps of dust and ice grew bigger and formed planets and moons.

The result was of course the formation of our solar system, and this is how it looks today, in the centre is the sun, the Solar System's power house, close to the sun are the inner rocky planets, Mercury, Venus Earth and Mars, further out are the enormous gas giants Jupiter, Saturn, Uranus and Neptune, and on the very edge is Pluto, a small rocky planet.

So we can see our Solar System is the home to two very different types of planet and recently space missions have been sent to investigate both types.

On October 15th 1997, NASA launched a mission to Saturn, Seven years later on July 1st 2004, after a journey of nearly and 3.5 billion km the unmanned space probe – Cassini – finally reached its goal.

Cassini also carried on board a separate probe, Huygens - to detach from the main craft and descend to the surface of the most mysterious moon in the Solar System – Titan.

Saturn has at least 35 moons some are very small and have only been discovered in the last few years. The largest, Titan is the 2nd largest moon in the solar system and it's bigger than the planet mercury.

Most of the moons are made from mainly water ice and some rock and nearly all take as long to spin on their axis, as they do to orbit Saturn so they always show the same face to the planet.

Some of the moons are heavily cratered and this one, Mimas has a huge crater that is 1/3 the diameter of the whole moon.

Iapetus is another strange moon, on one side it is very dark, but the other side is very bright, it is not known what causes this variation in colour.

Titan, is the most fascinating of Saturn's moons, it is the only moon in the whole Solar System that has an atmosphere and scientists think it may be very similar to the earths atmosphere before life developed.

We can see the atmosphere in these pictures here as a double layered purplish haze and here we can see a ring caused by sunlight scattering in the atmosphere.

Saturn is famous for its rings; there are many rings not just one, and the gravitational pull of some of Saturn's moons cause the gaps between them.

Although they appear solid, the rings are actually made up of a whole host of rocks and dust orbiting on their own paths. Some are as small as grains of sand, while others are as big as houses.

Saturn's rings are nearly four hundred thousand kilometres in diameter, but believed to be only one hundred metres thick.

The rings extend so far out from Saturn that it would take a hundred years to walk round the outer edge

Scientists believe understanding how and why the rings were formed and behave, may help us understand how the Solar System was formed.

Saturn takes 29 and a half years to orbit the sun, but rotates on its axis in under eleven hours.

It spins so fast that it is noticeably flattened at the top and bottom.

It's not surprising Saturn's year is so long – it is about a billion miles away from the sun.

Saturn's atmosphere is made mainly of hydrogen and helium; these gases are so light that if we could find a bathtub big enough the planet would just float on the water like a giant beach ball!

Saturn doesn't have a solid surface we could land on.

Below the outer layer of hydrogen and helium the pressure rises and the gases become more like a hot liquid. About halfway to the centre, the pressure reaches a million times that here at the earth's surface, the gases change state and behave like molten metal. At the very centre there is a rocky core about the size of the earth.

Of course we couldn't land on this core, the pressure would have crushed our spacecraft long before we even reached the liquid layers, and the high temperatures would melt what was left of it!

Moving closer to home and the most investigated planet in the Solar System, Mars.

Mars is approximately half the size of the earth and takes about twice as long to orbit the sun.

One Martian day lasts 24 hrs and 37 minutes and is called a sol.

No one knows who discovered Mars; there are records of the red planet in ancient Egyptian, Chinese and Assyrian writings and it is named after the Roman god of war.

The most striking thing about Mars is its red colour.

Mars is red because of what it is made from. Its surface is iron rich.

Long ago when Mars was warmer and wetter the iron rusted and the dust took on a rusty red colour.

From Mars' surface the sky appears a pinkish red colour and sunsets are blue.

This is because the surface dust has been blown into the atmosphere by the wind.

Mars has always been considered an omen of doom. In 1719 Mars was at perihelic opposition, this means that it was on the same side of the sun as the earth and was very bright in the sky, just like in 2003.

At the time, people thought the bright red star in the sky was actually a comet on a collision course with Earth.

On Halloween in 1938 thousands of Americans were terrified after a series of live news bulletins reported an invasion by hostile Martians but it turned out just to be a radio broadcast by Orson Welles of the book War of the Worlds.

Mars has two small moons that are believed to be captured asteroids their names; Phobos and Deimos mean fear and panic in ancient Greek.

Phobos is the larger of the two moons; it orbits closer to Mars and takes just seven and a half hours to circle the planet. This means that a Phobos month is shorter than a Martian day, and the moon rises in the west and sets in the east

Deimos, the smaller moon is much further away and appears as a bright star from Mars' surface, it sets in the west two weeks after rising in the east.

Ever since Galileo first trained his telescope on Mars in 1610 the planet has fascinated human kind with the advent of space travel the quest to reach Mars became a realistic possibility and in 1962 the Russian probe Mars 1 made the first attempt to reach the red planet the probe got there but unfortunately suffered a communications failure and was unable to transmit information back to us on Earth.

In 1965 Mariner 4 an American probe was the first to complete a successful flyby of Mars, and it sent back these, the first close up pictures of the red planet.

More missions followed, and in 1976 another American probe, Viking 1 was the first craft to land successfully and safely on the Martian surface, and along with its parent the Viking orbiter it sent back many fascinating pictures of Mars.

The most recent missions to the red planet are the Mars exploration rovers Spirit and Opportunity that reached the red planet in early 2004 and they have sent back these amazing images of the Martian landscape.

We can see red rocks and dust, and hills in the distance here we can see the shadow of Opportunity as it reviews the scenery and in this picture we can see the tracks left in the surface dust by Spirit.

Although Mars is a small planet, it has some very large features this is a picture of Valles Marineris, it is a huge canyon system seven kilometres deep and four thousand kilometres long, the largest canyon on Earth is the Grand Canyon at a mere one and a half kilometres deep and eight hundred kilometres long, here we can see that the Grand Canyon is about the same size as a small tributary river of Valles Marineris.

Mars also has the largest volcano in the Solar System, Olympus Mons. It is an amazing six hundred and twenty-five kilometres across and at twenty-five kilometres high is taller than three Mount Everests.

These cliffs, called scarps are six kilometres high.

Olympus Mons is so large that it actually appears as a bulge on Mars' outline.

Olympus Mons is in an area known as the Tharsis region; it is the largest volcanic area on Mars and contains twelve large volcanoes.

Although Olympus Mons is the highest, these three volcanoes are on higher ground and actually reach as high, they too can be seen as a bulge on Mars' outline.

When the first images of Mars were received from the Mariner spacecraft, scientists were disappointed that the planet appeared to be heavily cratered and very similar to the moon, we now know this is not true, not only are there huge volcanoes and canyons there are also flat lightly cratered plains and winding dried up riverbeds.

This picture shows the different heights of areas on Mars, these white spots are the highest volcanoes in the Tharsis region, this one is Olympus Mons, and these blue areas are low-lying regions.

There is quite an obvious line between the highlands in the south and the lowlands in the north, could this have been the edge of a huge ocean?

There is a multitude of evidence that water once flowed on Mars, though it is not known if it fell as rain or seeped up through the ground.

These winding channels look like ancient riverbeds could these gullies have been formed by water running down the side of this cliff?

These islands look like they were created when water rushed past either side of a raised crater rim, and here are some more pictures of patterns on the Martian surface that could have been caused by water.

There are also some extremely unusual craters on Mars' surface; known as rampart craters, or perhaps more descriptively, splash craters the material excavated by the meteorite impact surrounds the crater in one continuous ring, not at all like the usual pattern of bits of broken rock debris we see elsewhere in the Solar System and even on other parts of Mars.

The craters look a lot like a piece of rock has been dropped in some mud; scientists believe they may have formed when meteorites impacted ground that had water or ice under the surface. The force of the impact caused the ice to melt and the water to mix with the rock and dust to create these funny shaped craters.

As we have seen, water almost definitely flowed on Mars' surface, did the red planet once look like this?

In this picture we can see the Martian atmosphere, unlike Earth's atmosphere the atmosphere on Mars is very thin and it contains a lot of carbon dioxide, which is poisonous to humans.

Although the atmosphere is thin, Mars still has turbulent weather systems.

Here we can see clouds covering the tops of the highest volcanoes and here is a huge cyclone in the same area.

These sand dunes were produced by the winds at the surface of the planet, also caused by the wind are huge dust storms that race across the planet, and smaller dust devils that follow winding paths and leave trails in the dust.

It is extremely cold on Mars, like on Earth there are ice caps at the poles and some days the sun rises over frost covered terrain.

Let's take a look at the more unusual features on Mars.

This crater is known as the happy face crater, and these shapes probably look familiar too! The most famous though is the face on Mars first captured by the Viking orbiter spacecraft it sparked rumours of civilisations on Mars with the skills to create large sculptures from their surroundings, it turned out to be just a combination of a large lumpy hill, and sunlight and shadows!

Further out beyond the planets are the stars, every day the Earth rotates on its axis. During the daylight hours the sun, our closest star seems to move across the sky. It rises in the east in the morning, and climbs higher and higher, until it reaches its highest point, in the south at midday, then it spends the afternoon sinking lower in the sky until it sets in the west in the evening.

As the sun sets the sky begins to get dark and the stars start to appear, at first just a few, the very brightest stars can be seen but as the sky reaches its darkest we can see many more and if we are away from city lights and there is no moon in the sky, keen eyes can see nearly eight thousand stars, just in the northern hemisphere.

We can sometimes see Mars and Saturn and the other planets in the night sky, why not pick up a nightwatch sheet on your way out to find out which planets we can see this month.

Long ago the ancient Greeks saw patterns in the sky and named them after characters from their myths.

Most people recognise these three stars in a line, bright in the south in winter, they mark the belt of Orion the hunter, this star, Betelgeuse marking his shoulder is so big, that if it were placed where our sun is, it would reach almost to Jupiter, and this star Rigel is a blue giant.

If we follow Orion's belt down we come to Sirius, the brightest star in the sky, and if we follow it up we reach Taurus the bull, with the bright star Aldebaran marking his eye. This cluster of stars at Taurus' shoulder is a star cluster called the Pleiades; most people know it as the seven sisters but there are actually more than five hundred stars in this small patch of sky.

Above and to the left of Orion these two stars Castor and Pollux mark the heads of Gemini the twins.

If we look to the north we can see the familiar shape of the plough hanging low in the sky. These two stars are called the pointers because if we follow them in a straight line they point to this star, Polaris or the North Star, we can use this star to find the direction north.

This M shaped pattern of stars is Cassiopeia; Cassiopeia was a mythical queen of Ethiopia who boasted that her daughter Andromeda was more beautiful than the sea nymphs. This angered Poseidon the sea god and to punish Cassiopeia he placed her in the heavens doomed to spend half the year upside down.

Let's turn the earth and take a look at the stars of the summer sky.

We can see all the stars appear to move in circles around the North Star, this is because it is directly above the earth's north pole.

Now we can see Cassiopeia hanging upside down, in the summer she makes a W shape.

These stars, Deneb, Vega and Altair mark the three points of the summer triangle. The stars are actually members of three different constellations, Cygnus the swan, Lyra the lyre and Aquila the eagle, but they are so bright and form such an easily recognisable shape that they are known by another name.

Just below the summer triangle is this small but bright kite shaped group of stars, this is Delphinus the dolphin that saved Arion the musician and owner of the lyre.

This square of stars is known as the square of Pegasus and forms the body of the mythical winged horse.

If we use these three stars as an arrow we reach a fuzzy blob in the constellation of Andromeda, Cassiopeia's daughter, the fuzzy blob is actually the Andromeda galaxy, a huge spiral galaxy with over four hundred billion stars and at just over two million light years away is the closest galaxy to our own.

We can use the plough again to find our way around the night sky, by following the handle we reach this bright star Arcturus in the constellation of Boötes the herdsman, and nearby, this group of stars is Corona Borealis, the Northern Crown.

The sky begins to grow light, the sun is rising again, and it is the start of a new day. Already the wheels are in motion to return people to the moon to do research in preparation for manned missions to Mars; it may take 30 years but one-day people will walk on this cold desert planet, and maybe you could be the first person to walk on the mysterious moon titan.

Who knows, in hundreds of years time, future generations of people could call other planets in the Solar System home.