TICKET TO MARS

Cover designed by Rebecca Hayward

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Introduction

Welcome to Ticket to Mars! This guide will give you all the information you need for a trip to the red planet. Our team of intrepid reporters have searched high and low to find out all sorts of facts - from where you might go on Mars to what life you might find when you get there. And, if getting to Mars seems just too difficult, check out our home page, which features great ways to bring Mars to you. Enjoy your travels!

Why is Mars Red?

Andrew Wood, 14

The planet was originally called Mars because it was red - the colour of blood. It was named after the god of War during the Roman period. Over the centuries myths and legends told of great battles in the sky, involving mortals, gods and aliens. Others speak of the planet as an omen for plagues of pests, wars to commence and apocalyptic disasters to take place, due to its placement in the sky.

The true reason lies in the dust that covers the planet in layers over the rock. A mineral called magnetite is found in the planet's rock. This red form of iron oxide is usually formed on Earth when iron is in contact with water for a prolonged period of time (known as rust). This could suggest that in the past, large amounts of water have been present on the surface of Mars, and the red iron oxide has often been used as evidence of this. However, over the large and varied surface the dust is only red for a maximum depth of two metres, and in most places is never more than a few millimetres thick, so water can't be the cause.

The real answer was discovered during an experiment at the Mars Simulation Laboratory, at the Aarhus University, Denmark. Turning the quartz crystals that make up the rocks of the planet for 7 months forms dust. This is what would have happened during the many storms on the planet during the winter. When they added magnetite, found in the rocks at the Martian poles, the dust took on a red colour, because the red mineral hematite was produced. So, the red rock was formed by storms, not oceans.

2 Fun Facts!

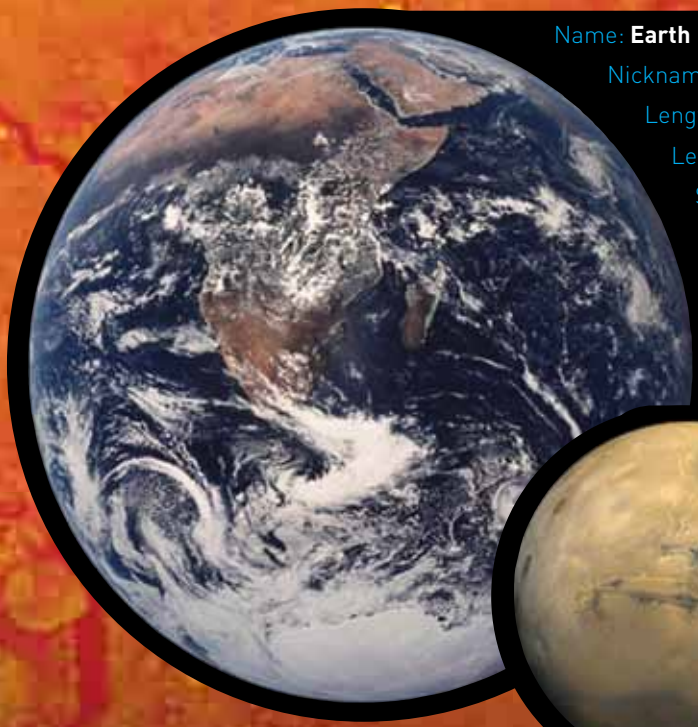
Did you know that: Mars has two moons: Phobos and Deimos and they go around Mars in the opposite direction to most other moons in the Solar System.

3.5 billion years ago: After a period of volcanic activity, Mars was fully established.

365 BC: Mars appeared to pass behind the Moon, as seen by the Greek philosopher, Aristotle.

Mars vs. Earth

Check out the differences between the two planets.



Name: **Earth**

Nickname: **The Blue Planet / Terra**

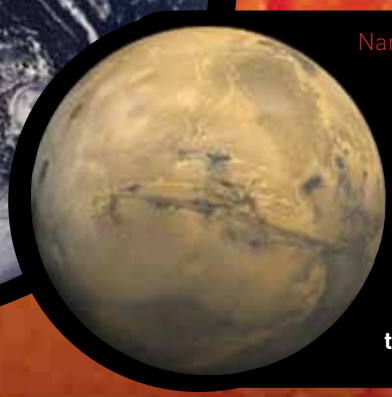
Length of Day: **24 hours**

Length of 1 Year: **365.25 days**

Size (at Equator): **40,075.017 kilometres**

Location from Sun: **3rd (149 million kilometres)**

Atmospheric Pressure: **101.325 kilo-Pascals**



Name: **Mars**

Nickname: **The Red Planet**

Length of Day: **24 hours 40 minutes**

Length of 1 Year: **686.971 days**

Size (at Equator): **21,344 kilometres (53% the size of Earth)**

Location from Sun: **4th (228 million kilometres)**

Atmospheric Pressure: **0.636 kilo-Pascals (0.6% of that of Earth)**

From the fact files we can see that despite their difference in looks, Earth and Mars are similar in many ways.

This is one of the main reasons that some scientists think it possible that life exists, or once existed, on the red planet. The key difference is the atmosphere that surrounds the planet itself. The atmosphere on Earth is thick - thick enough to trap the incoming heat from the sun, and keep the cold of space out. It is this atmosphere, coupled with the Earth's magnetic field, that stop flares of solar radiation from the sun ravaging our planet and killing all life on its surface. Mars currently does not have a magnetic field, and in the commonplace event of a large solar flare reaching it, the radiation would be completely disastrous for most types of life, with everything being entirely engulfed in the fiery storm. However, deep within the rock the remnants of a magnetic field can be sensed. Could this be proof that life may once have lived there? Even better, is it possible that life has evolved to cope with these solar flares, and has remained undetected for all these years...

Did you know that: **Phobos orbits Mars three times in a Martian day and is so far the only moon to be discovered that goes around a planet faster than that planet turns.**

WHAT 2 EXP WHE

The weather hasn't stopped opportunity yet!

2nd century AD: Claudius Ptolemaeus, a Roman living in Egypt, discovers Mars, which appears to travel backwards, due to the Earth's motion!

1961: Yuri Gargarin undertakes the first manned mission into space on the Vostok 1.

seasons on mars

Andrew Wood, 14

Mars' seasons are similar to Earth's. There are four: spring, summer, autumn, and winter, and each season is twice as long as it is on Earth, as is the length of the year. The tilt of Mars' axis, which determines the seasons and its weather, is 25.2°, very similar to the Earth's 23.6°, meaning similar conditions.

The winter on Mars is the most drastically different season. The temperatures drop, regularly reaching -140°C. The polar ice caps expand hugely, with each of the poles covering a third of the planet. Colossal dust storms also cover the whole planet savaging the landscape. They block out the Sun, meaning that solar panels do not work, so any scientific Rovers operating will be forced to go into hibernation, and wait for the sun. Frost forms at night and then melts during the day, leaving water vapour.

Spring follows the winter season, which sees the ice caps getting smaller and the days longer. The autumn is the opposite of the spring: the ice caps start to expand, and the days shorten.

During the summer the dust settles, the temperatures are warmer, usually around 20°C, and the Rover missions take place. The Sun shines all the time due to the very thin atmosphere, and the visibility is good. During this time the ice caps recede to the poles, and they can disappear from the view of the satellites completely.

The seasons greatly affect the outcome of a mission. Both Spirit and Opportunity, the current NASA Mars Exploration Rovers, have outstayed their estimated mission time due to good weather, and the late arrival of winter. Spirit is unfortunately stuck, and we have lost contact with it, but Opportunity plans to continue for as long as the seasons will permit it.

4 FUN FACTS!

Did you know that: The month of March is named after Mars.

ect
en you get there

Martian Geography

1964: Mariner 4 flies by the planet.

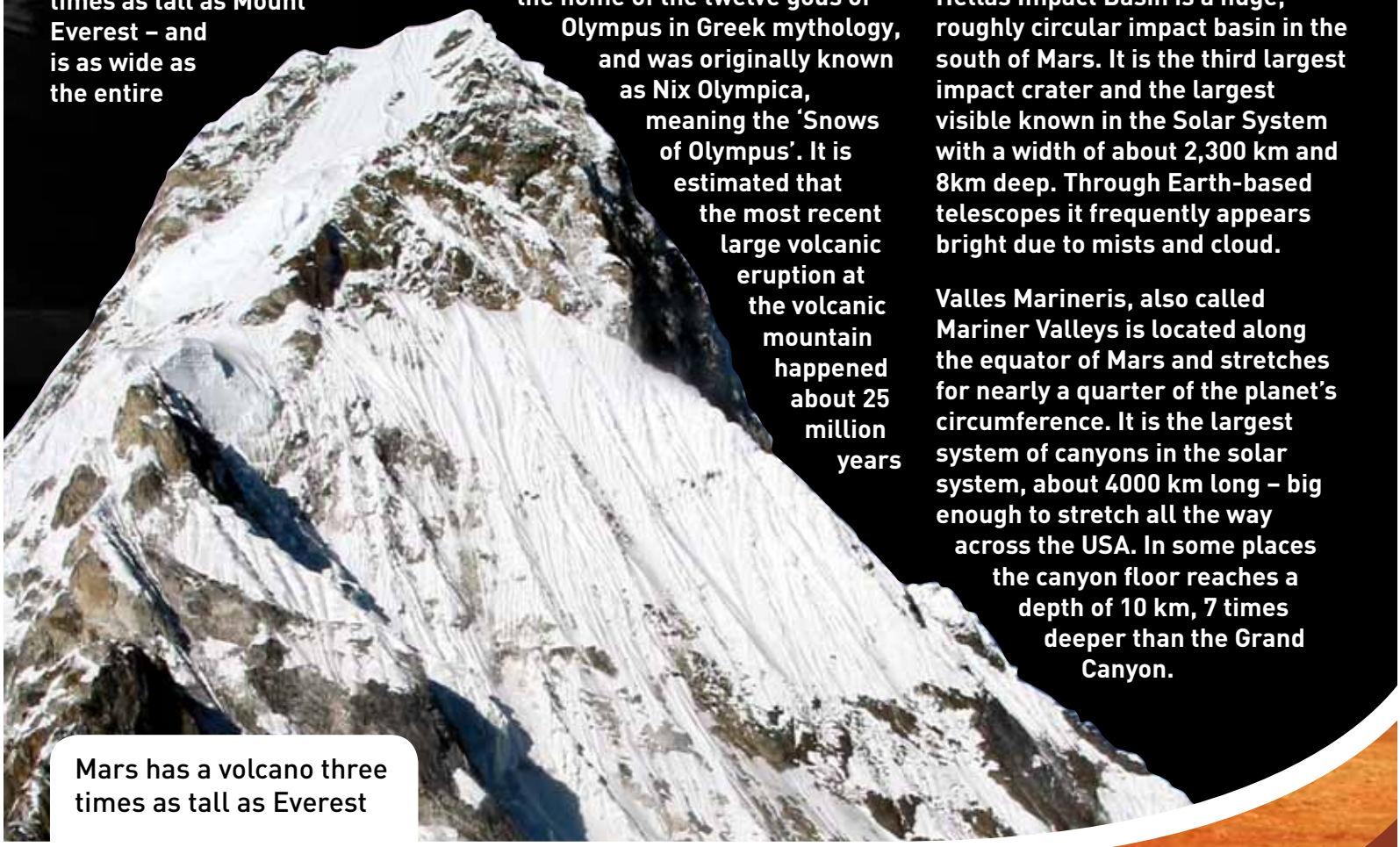
Hiba Chaudry, 18

So do you know what the largest volcanic mountain is on Mars, and in fact the whole Solar System, is? The answer is...Olympus Mons. It has an estimated height of around 21-29 km – that's nearly three times as tall as Mount Everest – and is as wide as the entire Hawaiian Island chain. We think it's less than 100 million years old because there are very few craters on its slopes. This tells us that its very young compared to other areas on Mars.

Olympus Mons was named after the home of the twelve gods of Olympus in Greek mythology, and was originally known as Nix Olympica, meaning the 'Snows of Olympus'. It is estimated that the most recent large volcanic eruption at the volcanic mountain happened about 25 million years ago but the oldest activity could be much older than this and would have been buried by lava.

Have you heard of Hellas Plantia or Valles Marineris? No? Well on Mars these are the must-see tourist sites! Hellas Plantia, also called Hellas Impact Basin is a huge, roughly circular impact basin in the south of Mars. It is the third largest impact crater and the largest visible known in the Solar System with a width of about 2,300 km and 8km deep. Through Earth-based telescopes it frequently appears bright due to mists and cloud.

Valles Marineris, also called Mariner Valleys is located along the equator of Mars and stretches for nearly a quarter of the planet's circumference. It is the largest system of canyons in the solar system, about 4000 km long – big enough to stretch all the way across the USA. In some places the canyon floor reaches a depth of 10 km, 7 times deeper than the Grand Canyon.



Mars has a volcano three times as tall as Everest

Did you know that: The symbol for Mars looks like the shield and a spear belonging to the war god Mars. It is also the symbol for the male gender.

1969: Neil Armstrong & Buzz Aldrin become the first people on the Moon, while Michael Collins travels to the Dark Side of the Moon.

1971: The Russian probe, Mars 3, sends a lander to the surface of Mars.

Kathryn Coldham, 15

For centuries humans have gazed up at the stars and wondered: is there anyone out there? We have imagined receiving a visit from aliens that want to invade our world and kill all humans that try to stand in their path. There have been claims about humans being sucked up by a blinding bright light, taken into a UFO and having strange experiments carried out on them. But could aliens actually exist somewhere out there? We may be closer to the answer than ever before...

On the 12th August 2005, NASA launched the Mars Reconnaissance Orbiter towards Mars. Its goal: to search for evidence that water has existed, in the past or present, on the little red planet. But why is the search for water so important? Well, life cannot exist without water so if water is found, there could be a chance that there's Martian life living on, or under, the planet's dusty surface.

What devices does it have? Well, the orbiter contains 4 cameras, a spectrometer, a radiometer, three engineering instruments, solar panels and radar. The spectrometer splits some of the light in its images so the different types of minerals found can be identified. The radiometer detects changes in temperature and the concentration of water vapor in the atmosphere. The radar shows if there is water ice more than one metre below the surface and the solar panels provide power for the spacecraft. The three engineering instruments enable the orbiter to move and communicate. Finally, the cameras are used to take pictures and allow the orbiter to "see".

But what types of life might it see? Well, some astronomers in the nineteenth century believed that the linear features which can be seen on the planet's surface were canals built by an intelligent Martian civilization but we now know this isn't true. Today, scientists think that the most likely form of life that could be found is bacteria. This is because Mars is far too cold for any life to survive on the surface- the average temperature during the day is a teeth-chattering minus fifty degrees Celsius- but bacteria are more likely to survive in warmer areas under the surface than any other form of life. If life is found there will be a higher chance of other forms of life living on other planets.

You're probably thinking: how does the orbiter collect the information? Well, nearly seven months after its launch, on the 10th March 2006, the orbiter finally reached Mars and placed itself in an oval-shaped orbit (which scientists call "elliptical") around the planet. Twenty days later, the orbiter started the aerobraking process - a type of movement that uses drag to slow the spacecraft down- in order for it to orbit closer to the planet. Since November 2006, the orbiter has been taking pictures and collecting other information about the Martian landscape and has been sending the data back to Earth by using radio signals.

So, are there any results? Yes! On the 4th August 2011, NASA announced that finger-like markings have been detected

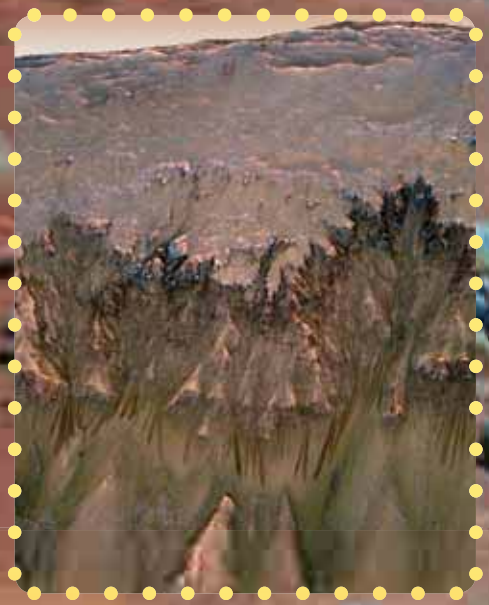
LIFE ON M

FUN FACTS! **Did you know that:** The atmosphere is mostly made up of carbon dioxide gas and it is so thin that water cannot exist in liquid form—it can exist only as water vapour or ice.

1975: The American orbiter/ lander duo Viking 1 and 2 arrive at Mars

which could be salty water spilling over the edges of some craters and slopes. These finger-like markings, which range between 50cm and 5m in width and are hundreds of metres in length, appear in the Southern Hemisphere on Mars during late spring. Then, they fade during winter and re-appear the following spring. Scientists think that the water could be just under the surface, as the atmosphere is so thin, liquid water would evaporate very quickly.

What happens now? Well, the orbiter is still collecting data from Mars but it could finally give us an answer to the age-old question: are we really alone in the universe?



Travel report:

Kieran Hashmi, 16

Mars in a day

Greetings Earthly Travellers, it's time for you to go sight seeing.

During your visit, you will find that a Martian day is a full 37 minutes longer than usual, because of the slower rotation of the planet. Now that you have more time, there are more activities waiting for you to discover. Try climbing the largest volcano in the solar system, Olympus Mons, or playing on low gravity basketball courts, with just 40% the gravity of Earth. How about some Martian archaeology? You never know, you may even find the remains of an old alien race! Finally enjoy a beautiful sunset as the sun descends into the Martian landscape. There are many things out there!

Weather

For your trip to mars, you need to to know what the weather will be like.

You don't want to get caught up in all the extreme weather do you now? So what is the best time to travel? Mars has very unusual weather that can change very quickly even though the atmosphere is only 1% as dense as the Earth's. During the summer, the daytime temperatures can be as warm as 20 C and at night drop to -90 C, so don't forget to wear lots of clothes at night! Meanwhile during winter, temperatures can stay as low as -140 C. This means it never rains on Mars, it only snows (as carbon dioxide ice). If you would like to go to Mars, I would recommend you go in the summer, otherwise you will freeze!

Did you know that: Mars' crust is thicker than Earth's and is made up of one piece, unlike Earth's crust which consists of several moving plates.

Technology Corner

Roving Around

Andrew Wood, 14

Rovers have dominated modern space exploration, journeying everywhere where man cannot go. Starting as transport for astronauts, they now carry out the missions themselves, watched, but acting independently.

Technically, the first Rover was the Lunar Roving Vehicle, nicknamed the Moon Buggy, which had a range of just one mile per charge, due to the two 36-volt batteries that powered its electric motor. However it still required two astronauts to operate it, each sitting on a garden deckchair. Today, the Rovers are autonomous, with controllers on Earth checking, not doing, the actions. The Rover must look, decide and then act for itself.

Historically, several Rovers had to be used for one common mission. Two thirds of all the Rovers that have ever gone to Mars never carried out their mission. Things are improving and the amount of failures is dropping. In order to stop the faults the controllers have handed the Rovers their independence, removing the amount of time it takes controllers to send signals to the machines (which can be anywhere from 17 minutes to 2-3 days). Now they just give the Rover guidelines, and it decides what is best.

The ExoMars mission is currently still being designed. It is a joint NASA and ESA (European Space Agency) mission, which is aiming to, amongst other things, search Mars for gases, such as methane, which would help prove that life exists, or once existed on the red planet. Gases will also help show the geological movement, and therefore the composition of the planet. Cutting edge technology will be used for Rovers such as liquid brakes, a new material for thermal insulation, and a radar altimeter. They will be used in its quest for water, gases, and rock compositions. But there is word in the scientific community, a glimmer of hope for those waiting. If life is on the Red Planet, ExoMars will find it.

2003: Beagle 2, a spacecraft designed to study the geology of Mars, takes off successfully, but is later declared lost.

2016: Scheduled launch of the two-stage EXO Mars Mission, intended to study the composition and landscape of the planet.

A long trip

Hiba Chaudry, 18

Can you imagine being isolated for 640 days? 6 mock astronauts are flying on a stimulated trip to Mars and back without ever leaving Earth, where the crew are left on their own inside a pretend spaceship near Moscow. The simulation aims to recreate an entire trip to Mars in the hope of preparing future astronauts for the real journey and assessing how humans cope with the long, lonely spaceflight that it would take to travel to and from the Red Planet. A total of 640 experiment days were divided into three stages. The first 15 day stage involved testing the technical equipment, facilities and operating procedures for the voyage. The second, 105 day stage included living in the experiment's isolated living complexes and the third, longest and last stage of the experiment was intended to simulate a complete 520 day mission.

Fun Facts!

Did you know that: Mars' seasons are twice as long as those on Earth because it takes Mars 687 days to orbit the sun, twice as long as Earth's 365-day journey.

meet the mars expert

Natalie Hogg, 16

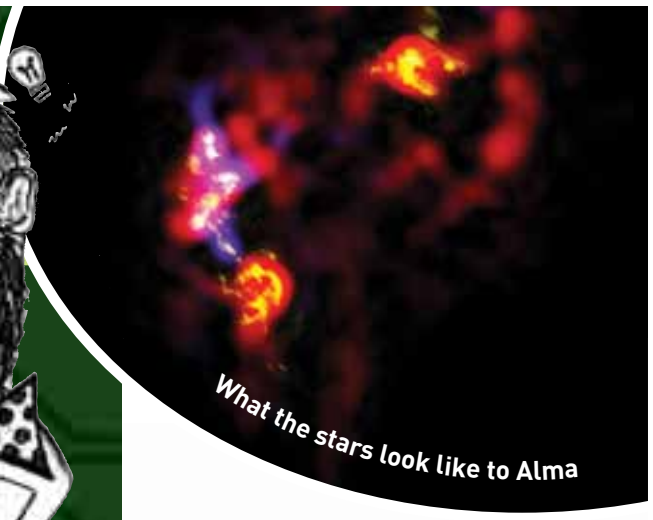
Craig Leff is a scientist and engineer who designs the cameras that go on the Mars Rovers. He's always been interested in science- although as a boy, he was more interested in studying moths than space! Both his father and grandfather were engineers, but he soon found that he was more interested in the scientific side of his work and a friend invited him to help design the first Mars Rovers.

Consequently, Craig knows lots about all different areas of science; he advises young people to "Do well in STEM subjects,"- that's Science, Technology, Engineering and Maths- "And make sure you like it!" he stresses. You need to put in a lot of hard work, so make sure you choose subjects you enjoy.

Craig's work on the rovers is very important; after all, without "eyes" the rovers couldn't get very far on the Martian surface! Three different types of cameras are used: hazcams, low-resolution cameras which detect nearby objects; navcams, which are used to pinpoint the rover's location and pancams, which can see as well as a human eye! They are used to look at the surrounding area in detail.

We asked Craig why he thinks people are so interested in Mars. "Well, there's no such thing as bad publicity," he says and he's certainly right. Even if Mars has in the past been seen as a source of evil rather than good, it's undeniably the most popular planet in books and films.

Of course, some people don't think spending lots on space exploration is a good use of money, but Craig disagrees. "Only around 0.6% of the US yearly budget is spent on NASA. It's not the money you have, it's how you spend it." Some of NASA's funds are spent on producing apps for smart-phones. Craig particularly recommends the NASA News and NASA Images apps and also often uses NASA websites, especially mars.jpl.nasa.gov. Another fantastic website to check out is Google Mars; the equivalent of Google Earth for the red planet.



What the stars look like to Alma

Alice Ardis, 10

Have you ever gazed out of your bedroom window at the stars above, or been captivated by the pictures taken from space by the famous Hubble telescope? Well, now the next generation of telescopes is coming to life.

The first of this group of telescopes, ALMA – Atacama Large Millimetre Array – is currently being constructed in the Chilean Andes, the towering mountain range in Latin America. This location has been selected owing to the dry atmosphere, meaning that radio waves, which would be absorbed by moisture at a lower altitude, can be detected.

The seven hundred million pound project will start working in 2012 and the pictures which the ALMA will transmit to us from space have been estimated to be ten times clearer than those from Hubble, thanks to the fact that parts of the newly designed telescope will be at the freezing cold temperature of Absolute Zero (-273°C), the point at which molecules slow almost to a stop. The molecules being almost still means that information is not jumbled.

So, next time you admire the clusters of stars from your window, remember that the ALMA will soon be in operation 5 kilometres above sea-level. Just imagine how many planets its pictures will reveal, orbiting continuously around each star, from our galaxy and beyond.

Beyond Mars: the ALMA Telescope

2037: Some sources report that the first manned mission to Mars will be conducted by NASA.

Did you know that: On August 27, 2003, Mars made its closest approach to Earth in nearly 60,000 years. The next time it will be that close again will be in 2287.

MAKING A MARS ROCKET

You will need:

- Mints
- Toothpicks
- Card
- Diet Fizzy Drink

You can also decorate your rocket if you want to.

1. To make your rocket, roll a piece of card into a tube, making it slightly larger than the top of the bottle. Tape your tube together.
2. To prevent your mints falling down the tube, push a toothpick through the tube near the bottom.
3. Put as many mints as you want into the tube.
4. Using a small piece of card make a cone nose for your rocket and tape it to the tube.
5. Open the bottle and put the lancher over it.
6. Pull the toothpick allowing all the sweets drop, then move away quickly!
7. Watch your rocket fizz away to Mars!

We have lift off!

Did you know that: The Director of Science and Robotic Exploration at the ESA is British. His name is Prof. Dr. David Southwood and he is a graduate of Imperial College, University of London.

Mars in our culture

Natalie Hogg, 16

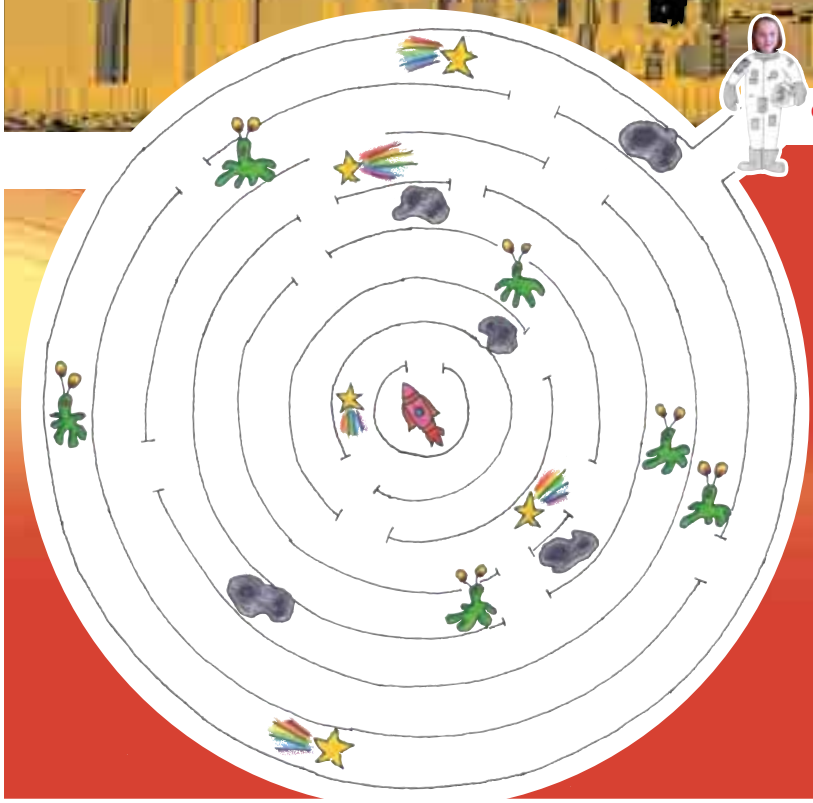
Gustav Holst wrote a piece of music about it. H G Wells wrote a novel. The Romans named it after their God of War. So what's all the fuss about Mars?

Humans have been fascinated with the Red Planet since the dawn of time. It's bright red and close to the Earth, so Mars is visible without the use of binoculars or a telescope. Even prehistoric man could have looked to the heavens at night and gazed in wonder at the glowing red orb above. Its colour reminded the Ancient Greeks and Romans of bloodshed and battle, so they named it after their god of war and violence. When the two moons of Mars were discovered in the 1800s, they were named Phobos (fear) and Deimos (panic) after the two horses that pulled Mars' chariot.

Interest in Mars died down after the fall of the Roman empire and the spread of Christianity, but the spark was re-ignited in 1877 when Italian astronomer Giovanni Schiaparelli described seeing "canali" on Mars. The correct translation of this word is "channels", but people mistakenly thought he had seen canals. The Suez Canal had been completed just eight years before, so many people believed that there was intelligent life on Mars, capable of everything humans were at the time. The public's imagination ran wild.

Perhaps the most famous example of this fascination with Mars is the novel War of the Worlds by H G Wells. Written in 1897, it depicts what happens when Martians escape their dying planet and come to Earth, killing everyone in their path. However, the technologically advanced Martians are defeated by Earth's bacteria, which they have no natural resistance to. In 1938, Orson Welles adapted the book for radio, and the first broadcast of it caused widespread panic throughout America, because people thought Earth really was being invaded by Martians.

It seems that Mars has been an inspiration throughout the ages to human culture. In the words of Buzz Aldrin: "Mars is there, waiting to be reached."



Help Evie the explorer get back to her rocket

Trace a line with your pencil to show Evie the way to her rocket.

Did you know that: The unofficial names of many rocks on the surface of Mars are a bit strange, such as Barnacle Bill, Yogi, Pop-Tart, Shark, Half Dome, Moe, Stimpy, and Cabbage Patch. Scientists chose these names because they were convenient to remember.

The next Giant Leap?

Becky Hayward, 10

Meet Evie, an 8 year old who wants to be the first person on Mars.

• What inspired you to want to become the first person on Mars?

I have always loved Mars, it is somewhere very different from here. I would like to have the experience of landing and walking on a different planet to Earth, and possibly find some form of life there.

• What interests you about the planet Mars?

I like its colour and the fact that its temperature is close to ours so we may be able to live there someday, and it is closer to Earth than many other planets. I like being able to spot faces in the photographs the Rovers have taken. The day there is slightly longer than on Earth so you get an extra half hour in bed in the mornings.

• What would you recommend other children do to develop their interest in Mars?

There are lots of great books on Mars which you can get from the library and there are also many documentaries on Mars and space on the TV which tell you a lot about it. I have a telescope which I can sometimes see Mars through, and that is a great way of seeing it and making it feel closer.

• If you could ask a Martian one question what would it be?

Do you mind if I put the heating on ?

Meet the team

Andrew Wood
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Natalie Hogg
Liz Phillips
Kathryn Coldham
Joe Prentice
Kieran Hashmi
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