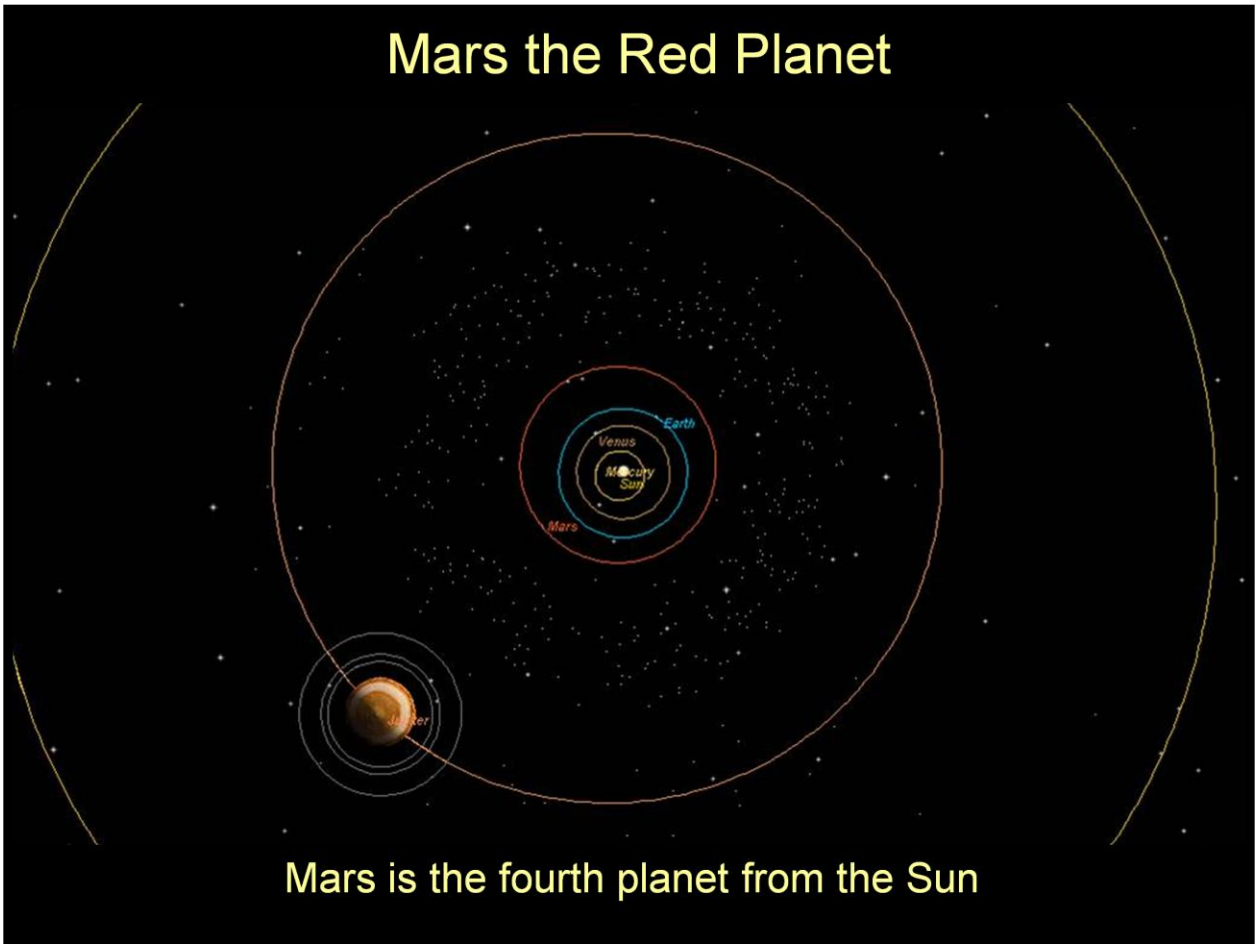

Mars – Our Next Door Neighbour
Is paying us a visit ‘Opposition’
Steve Harris

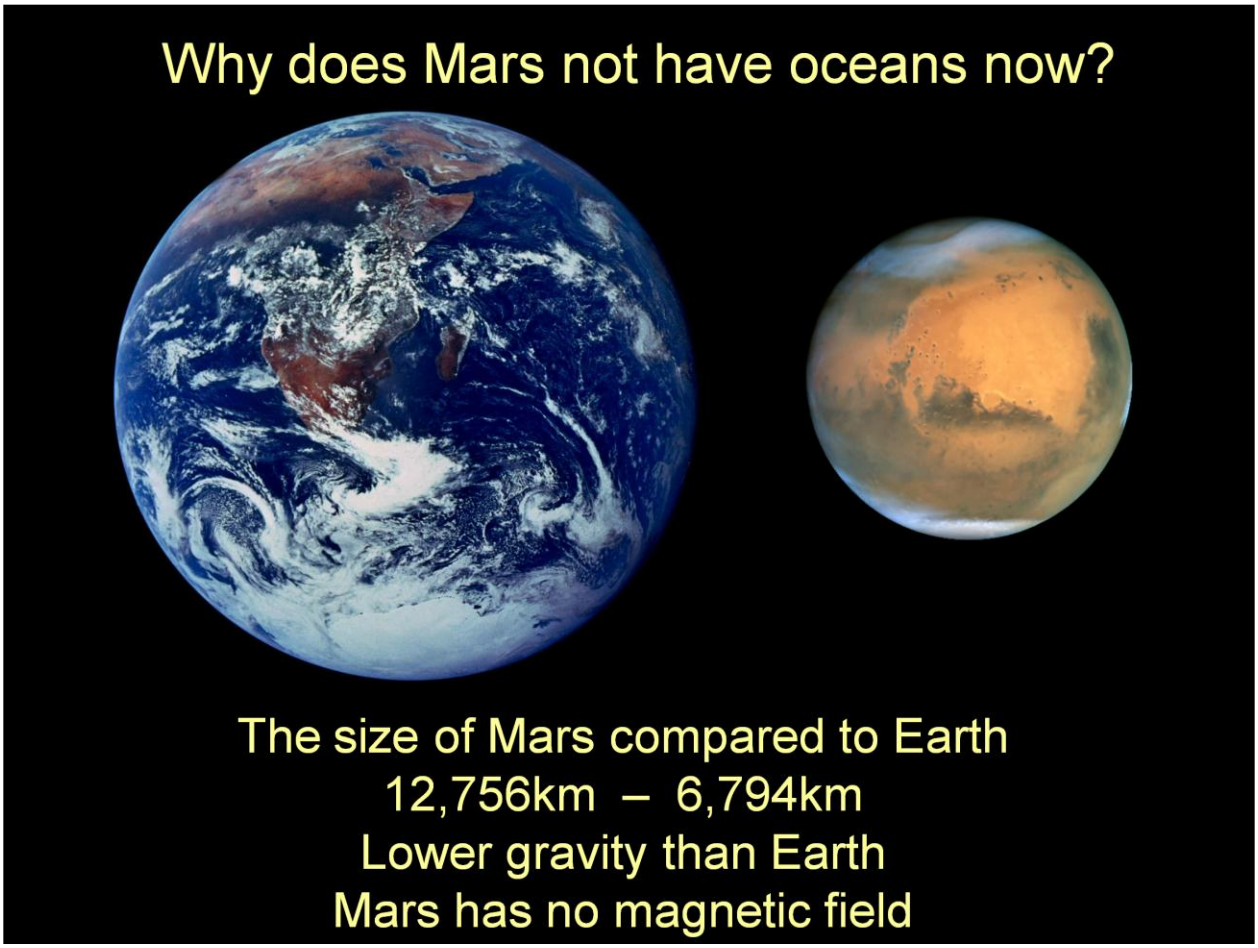


Mars is the 4th Planet out from the Sun, the next out from Earth and the second smallest planet in our Solar System after Mercury.

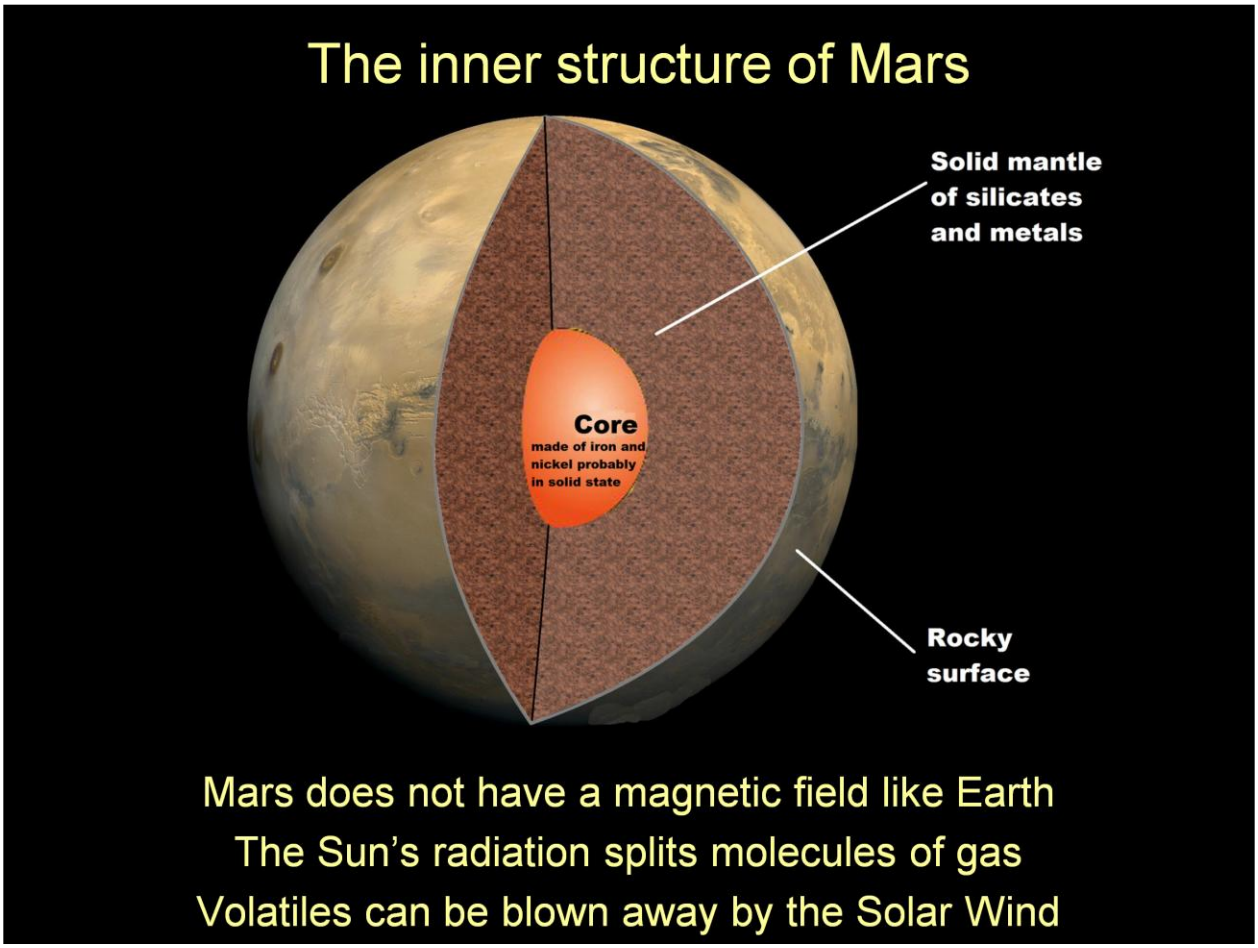
Earth orbits the Sun at an average distance of 146.6 million km and Mars orbits at an average distance of 229.9 million km.

Due to the eccentricity of their orbits the distance between Earth and Mars can vary.

Their closest approach (Opposition) can vary from about 50 million km to about 100 million km.



Mars is approximately half the diameter of Earth at 6756 km (Earth 12,756 km).

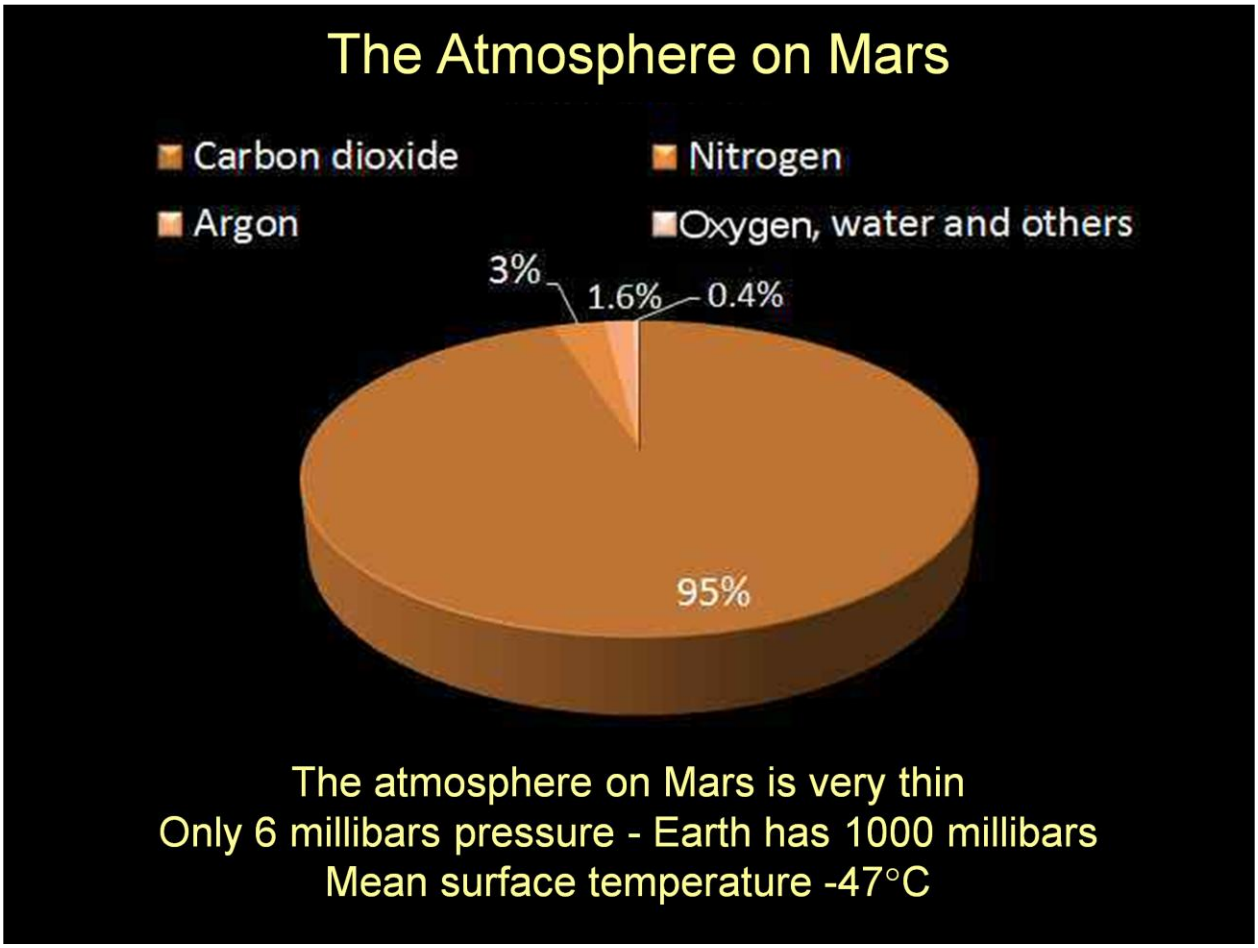


Mars has an Iron core but it is probably not hot enough to be liquid.

As the core is solid it does not produce a magnetic field.

Consequently radiation from the Sun is not directed around the planet like Earth's magnetic field does.

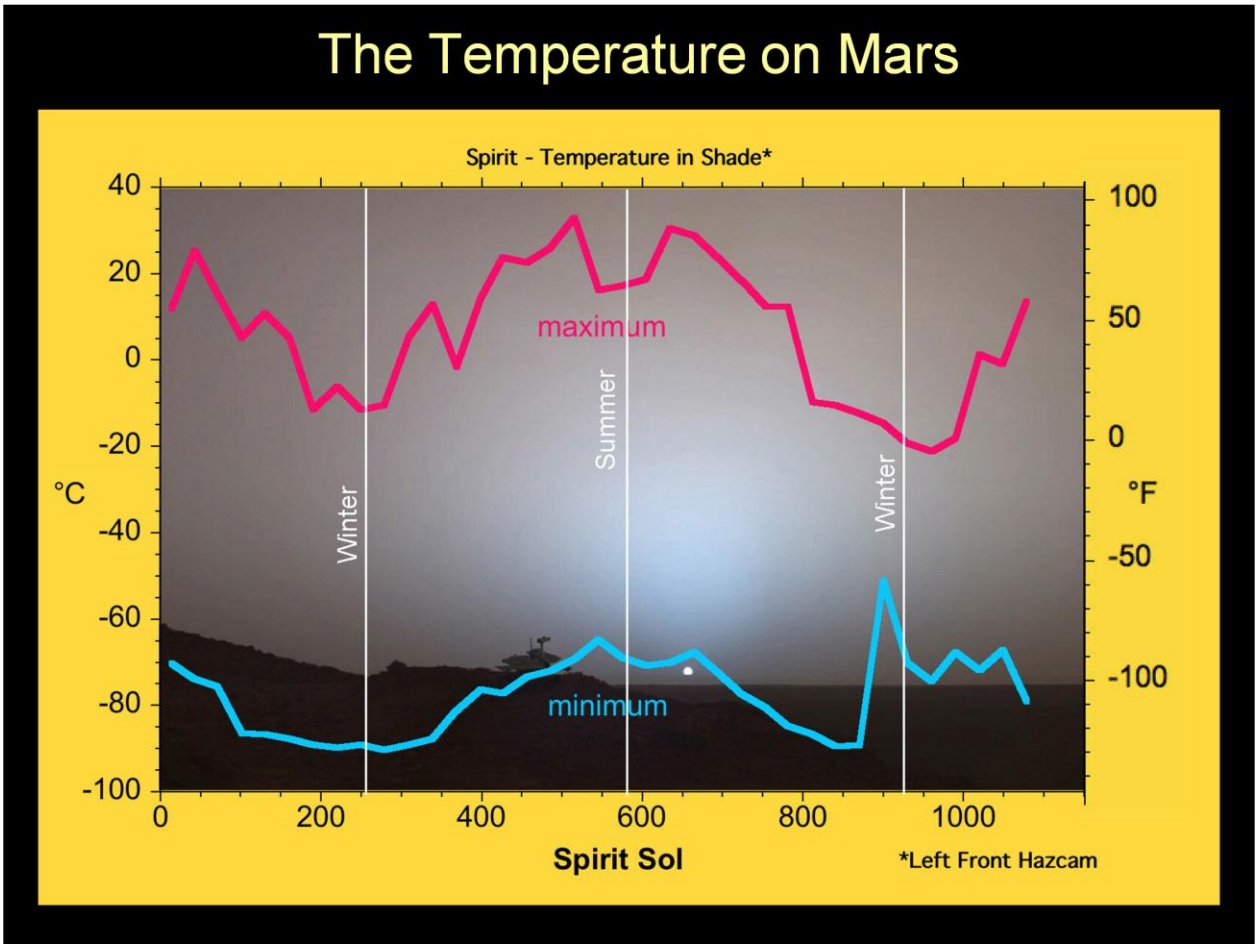
Any water that may have existed on Mars has been evaporated a very long time ago and been blown away by the Sun's Solar Wind.



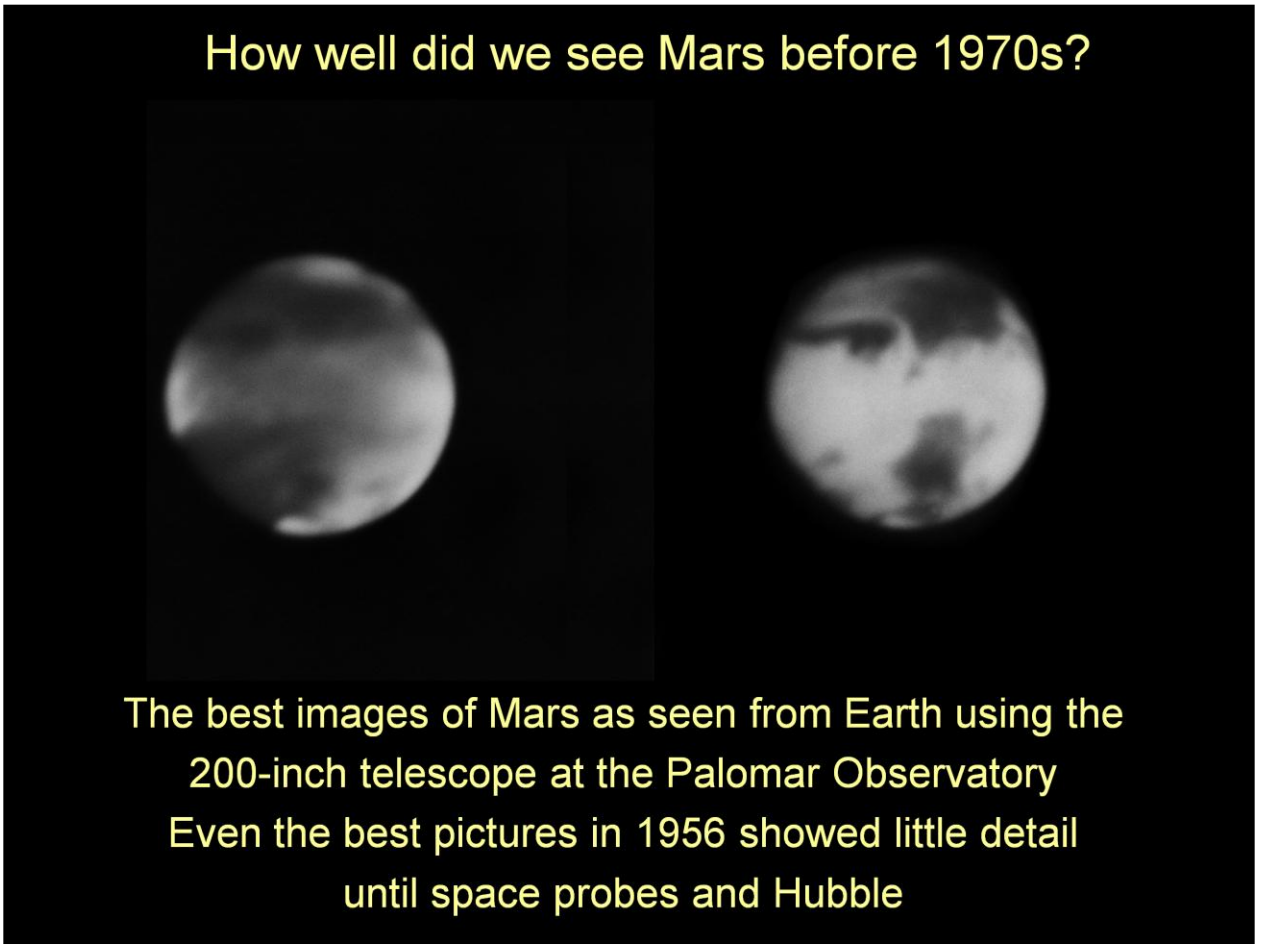
Mars does have a very thin atmosphere mainly composed of Carbon dioxide (CO_2) about 95%.

The surface pressure on Mars is 6 millibars this is just 0.06% of the atmospheric pressure on Earth.

The overall average surface temperature is -47ºC.



The chart above shows the surface temperature measured by the Spirit Mars Explorer.



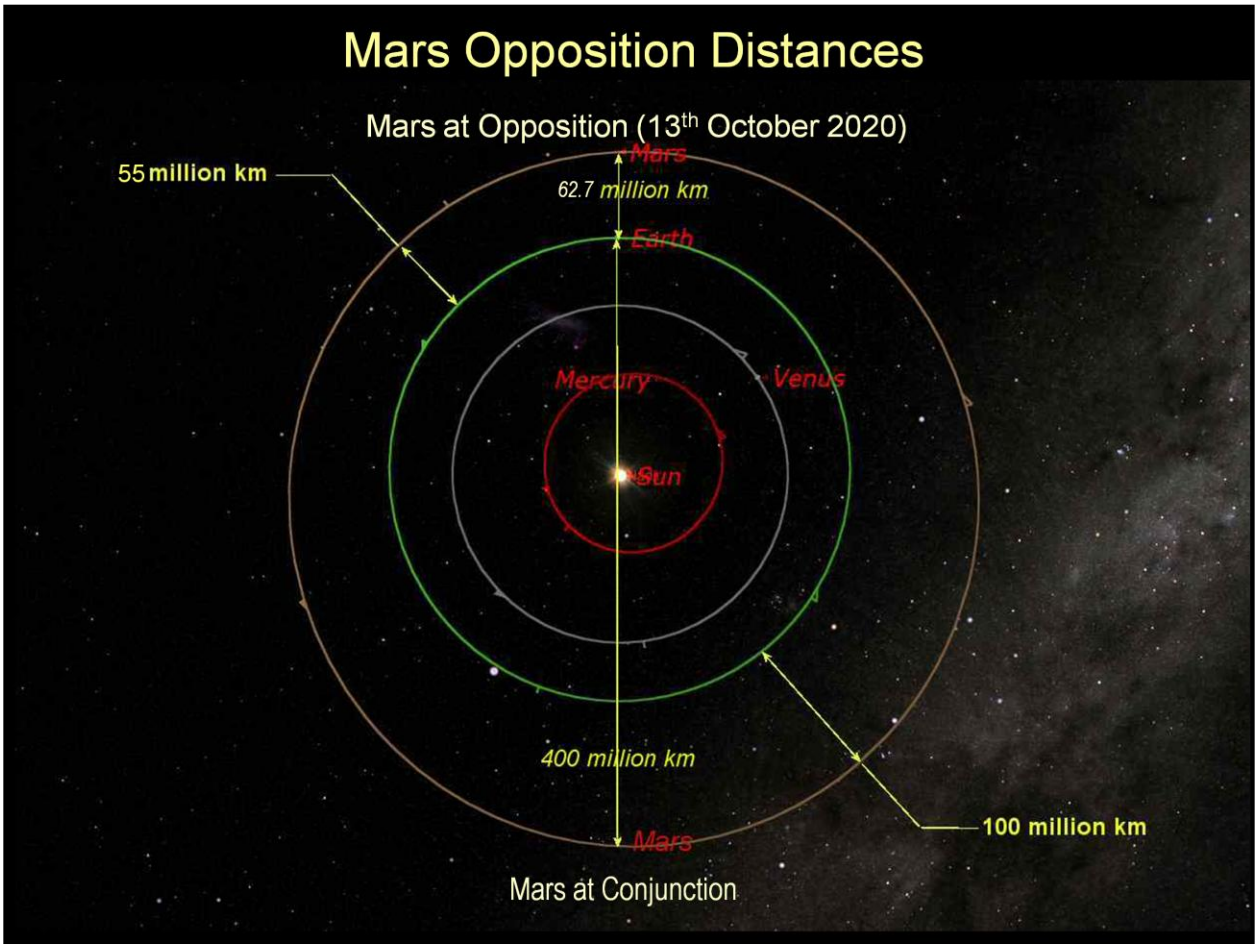
Astronomers using the 200-inch telescope at the Palomar Observatory in California took these two images of Mars around 1956.

They took the image on the left hand side through a blue filter, which allowed them to see the atmosphere and the clouds circling the planet.

The image on the right was taken through a red filter, which allowed them to see details of the planet, such as the dark areas and polar ice caps.

Today amateur astronomers have access to digital cameras and excellent quality telescopes.

The image above was taken by Damian Peach one of the best amateurs.



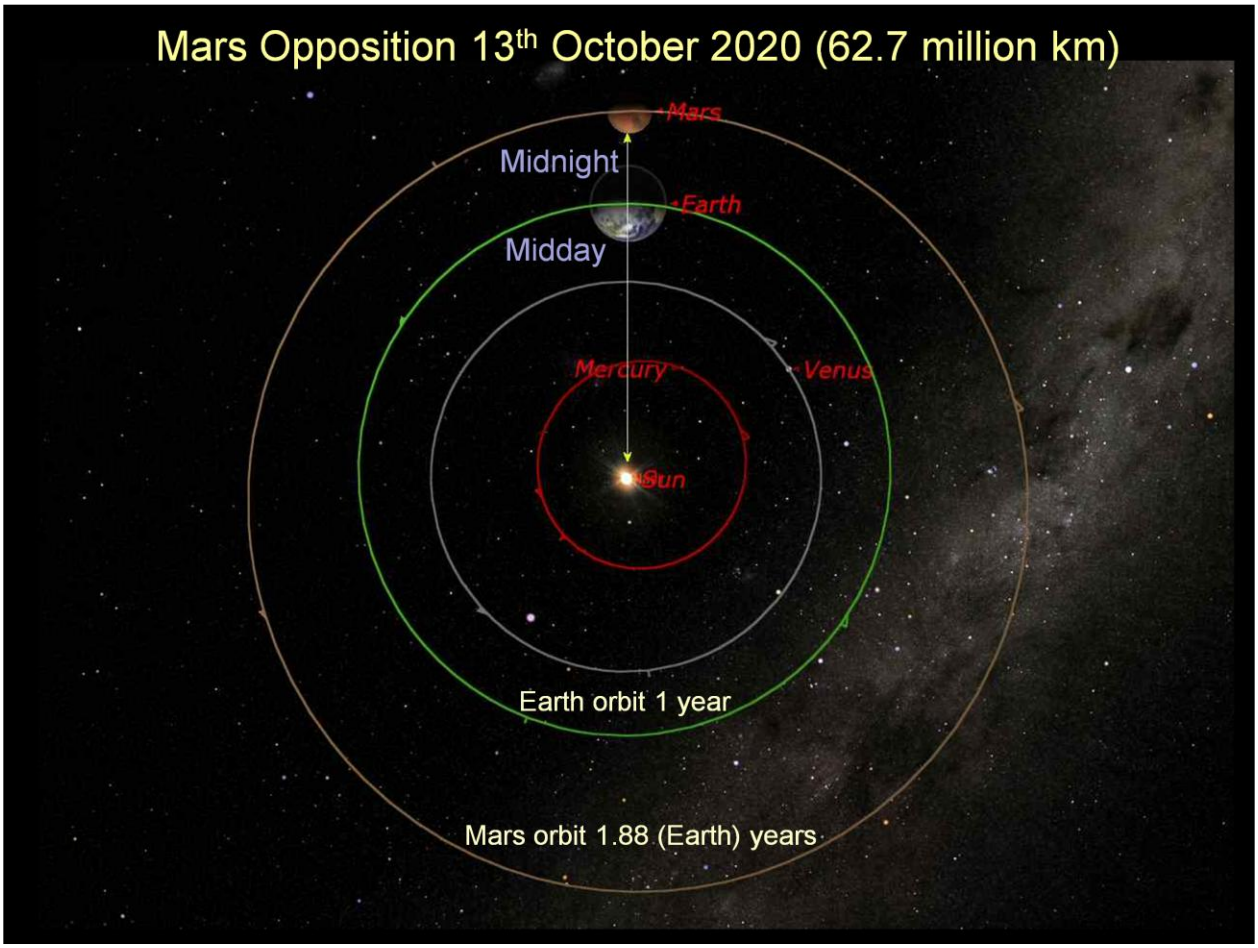
Mars has a noticeably eccentric orbit that varies between 206.66 million km and 249.23 million km a difference of 43 million km from the Sun.

Earth also has an elliptical orbit so at closest approach they can be as little as 55 million km and up to 100 million km.

So Mars can be as close as 55 million km but when Mars is on the opposite side of the Sun to Earth is can be up to ~400 million km away.

When Earth overtakes Mars on their orbits (called Opposition) they will be at their closest approach.

This year Opposition occurs on 13th October when the two planets will be 62.7 million km apart.



At Opposition Mars, Earth and the Sun will be aligned at the moment Earth passes (undertakes) Mars.

At midnight on 13th October 00:00 (12 o'clock GMT) 01:00 (1 o'clock BST) Mars will be due south.

These are not the exact times but those given above are close to make it easier to understand.

Opposition Periods of the Planets

Sidereal Period
(Time to orbit the Sun)

Planet	Dist. from Sun (Millions of km.)	Period of orbit (Earth years)
Mercury	57.9	0.24
Venus	108.2	0.62
Earth	149.6	1.00
Mars	227.9	1.88
Jupiter	778.3	11.86
Saturn	1429.4	29.46
Uranus	2875.0	84.01
Neptune	4504.3	164.79

Synodic Period
(Time between Oppositions)

Planet	Synodic Period (days)	Sidereal Period Earth times
Mercury	116 (3x y)	88 days
Venus	584 (1.5x y)	225 days
Earth	-	1.0 year
Mars	780 (2.137y)	1.9 years
Jupiter	399 (y +34d)	11.9 years
Saturn	378 (y +13d)	29.5 years
Uranus	370 (y +5d)	84.0 years
Neptune	368 (y +3d)	164.8 years

The chart above shows the time that each planet takes to orbit the Sun this is called the Sidereal Period.

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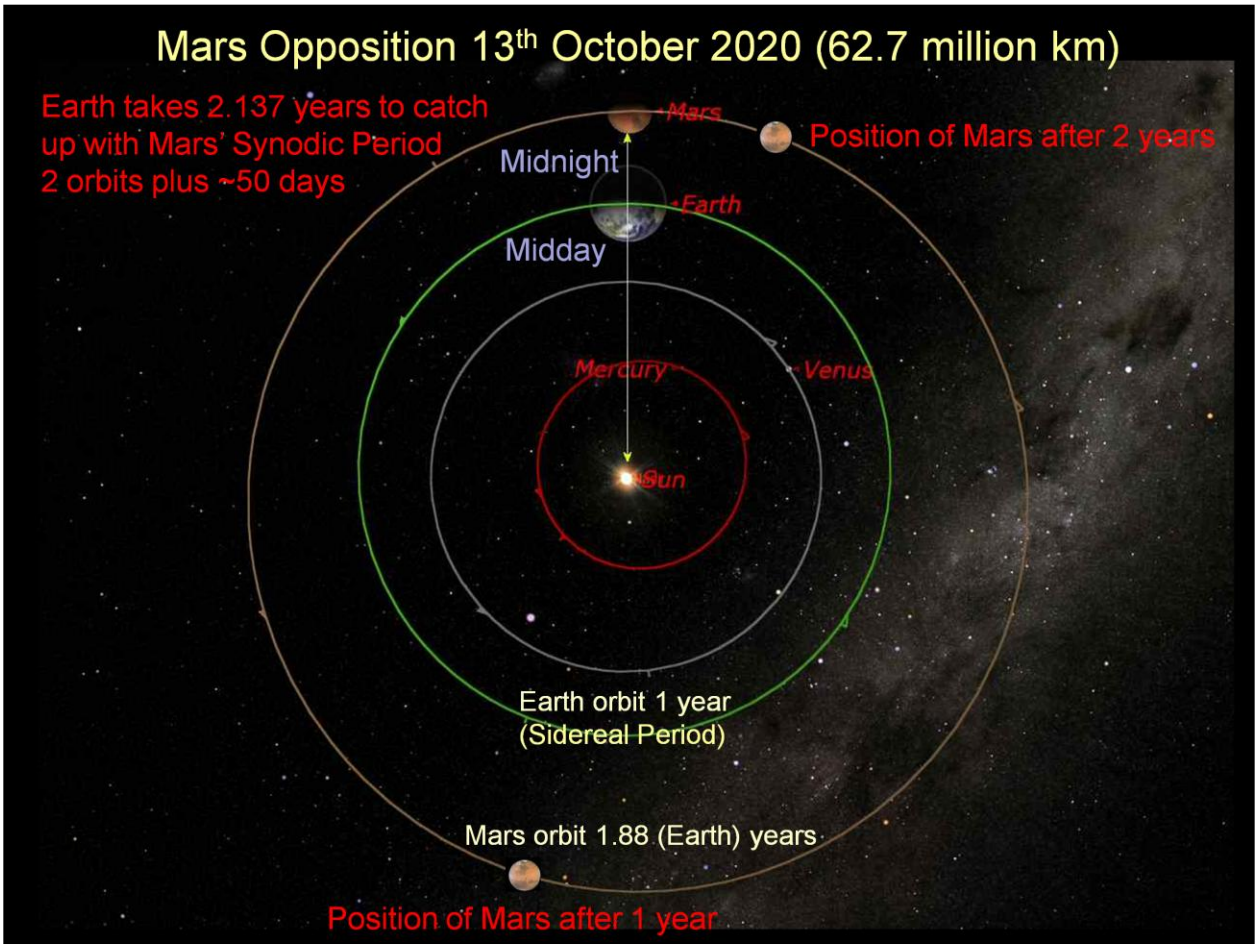
The chart on the right shows the time Earth takes to catch up and overtake or undertake the other planets.

So for Mars when Earth completes one Sidereal Period, Mars will have moved along its orbit and Earth must continue on to catch up with Mars.

Earth has to travel another Sidereal Period and 50 days (a total of 780 Earth days) to catch up with Mars.

The Earth / Mars Synodic Period is 780 Earth days or 2.137 Earth years.

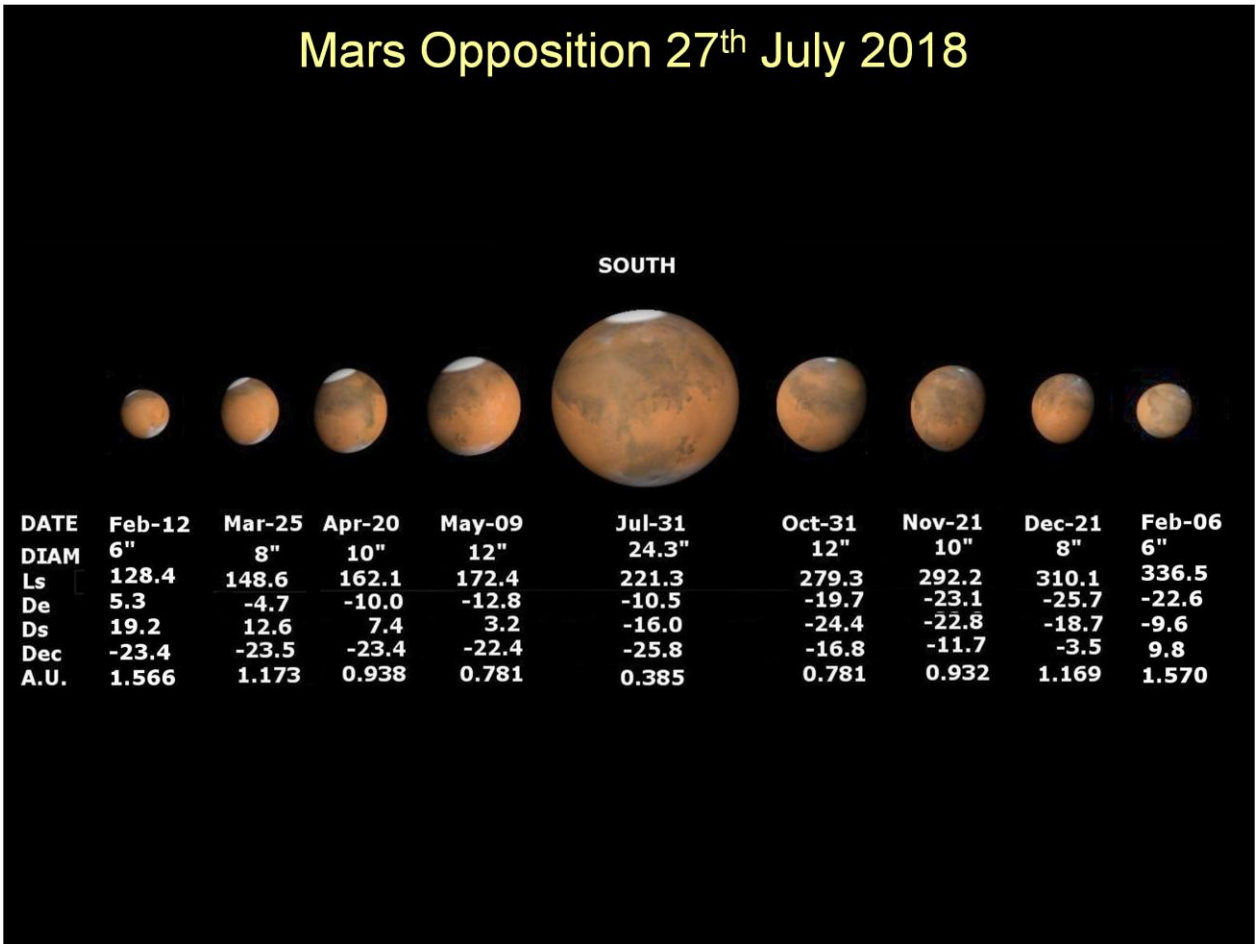


Earth / Mars Oppositions, occur every 2.137 Earth years.

Mars orbits the Sun every 1.88 Earth years so when Earth completes one orbit Mars will have moved around its orbit.

Earth needs to complete 2.137 orbits to catch up with Mars.

This is called its Synodic Period.

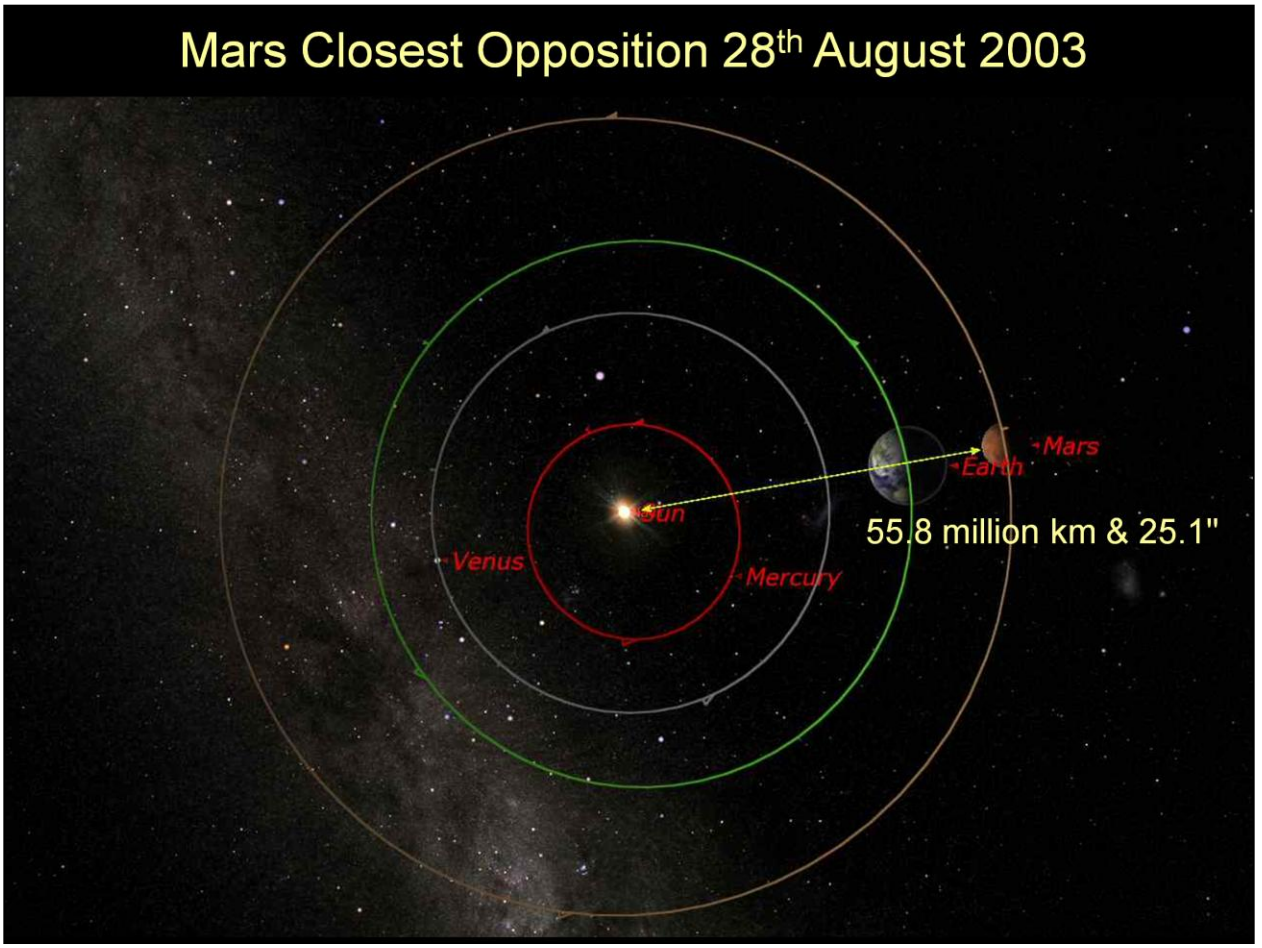


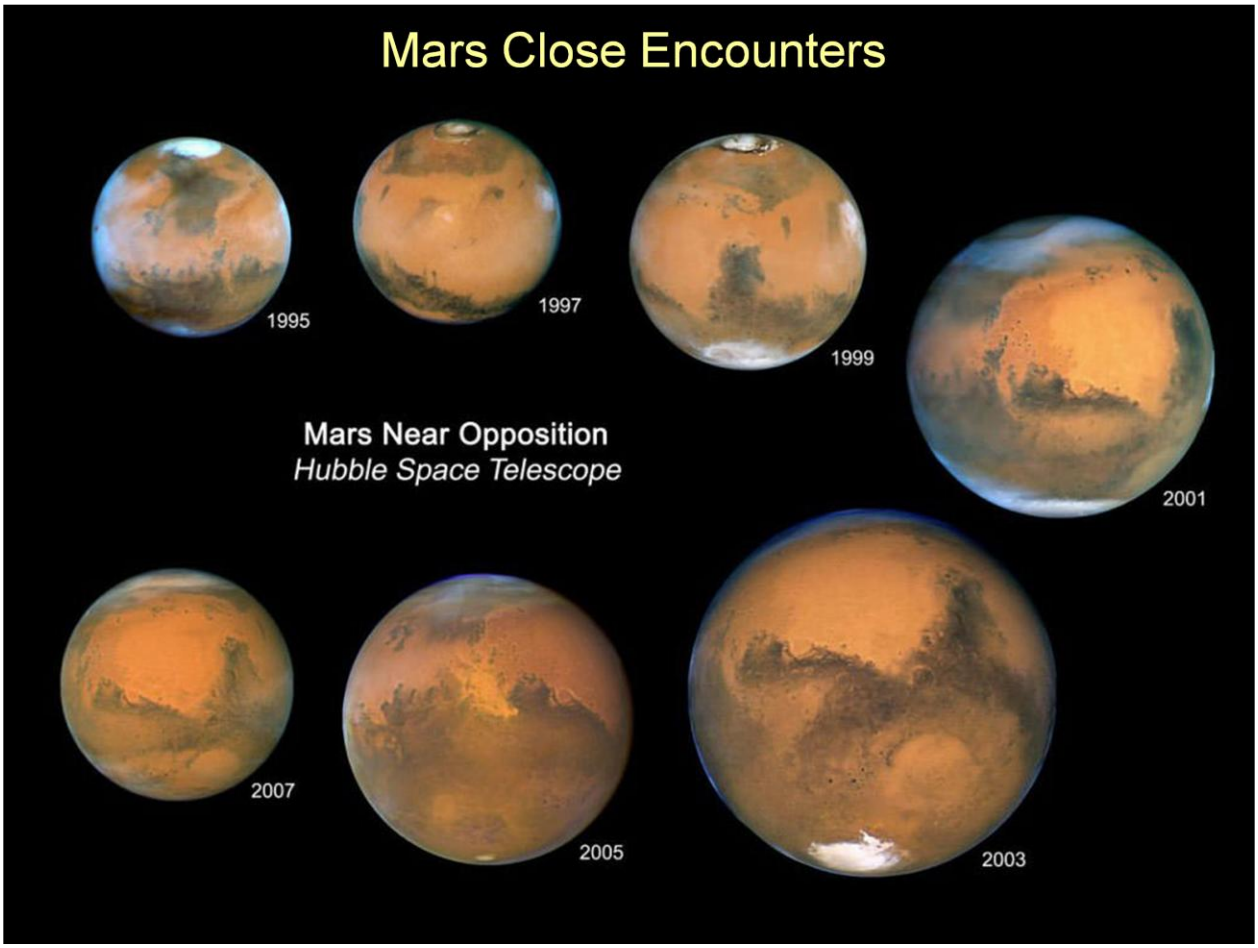
As Earth approaches Mars towards Opposition Mars appears to increase in size. The chart above shows how Mars appeared larger as it approached for the last Opposition in 2018. In February Mars was just 6 arcseconds (written 6") in diameter. On 31st July Mars appeared to be 24.3" in diameter and by February it had shrunk to just 6" again.

Mars / Earth close encounters

Martian oppositions between 1990 and 2020

Opposition date	Earth-Mars separation (10^6 km)	Angular diameter (")	Type
Nov 27 1990	78.2	18.0	perihelic
Jan 7 1993	93.9	14.8	aphelic
Feb 12 1995	101.1	13.8	aphelic
Mar 17 1997	98.9	14.0	aphelic
Apr 24 1999	87.2	16.2	aphelic
Jun 13 2001	68.2	20.5	perihelic
Aug 28 2003	55.8	25.1	perihelic
Nov 7 2005	70.3	19.8	perihelic
Dec 28 2007	89.8	15.5	aphelic
Jan 29 2010	99.3	14.0	aphelic
Mar 3 2012	100.8	14.0	aphelic
Apr 8 2014	92.9	15.1	aphelic
May 22 2016	76.1	18.4	perihelic
Jul 27 2018	57.7	24.1	perihelic
Oct 13 2020	62.7	22.3	perihelic

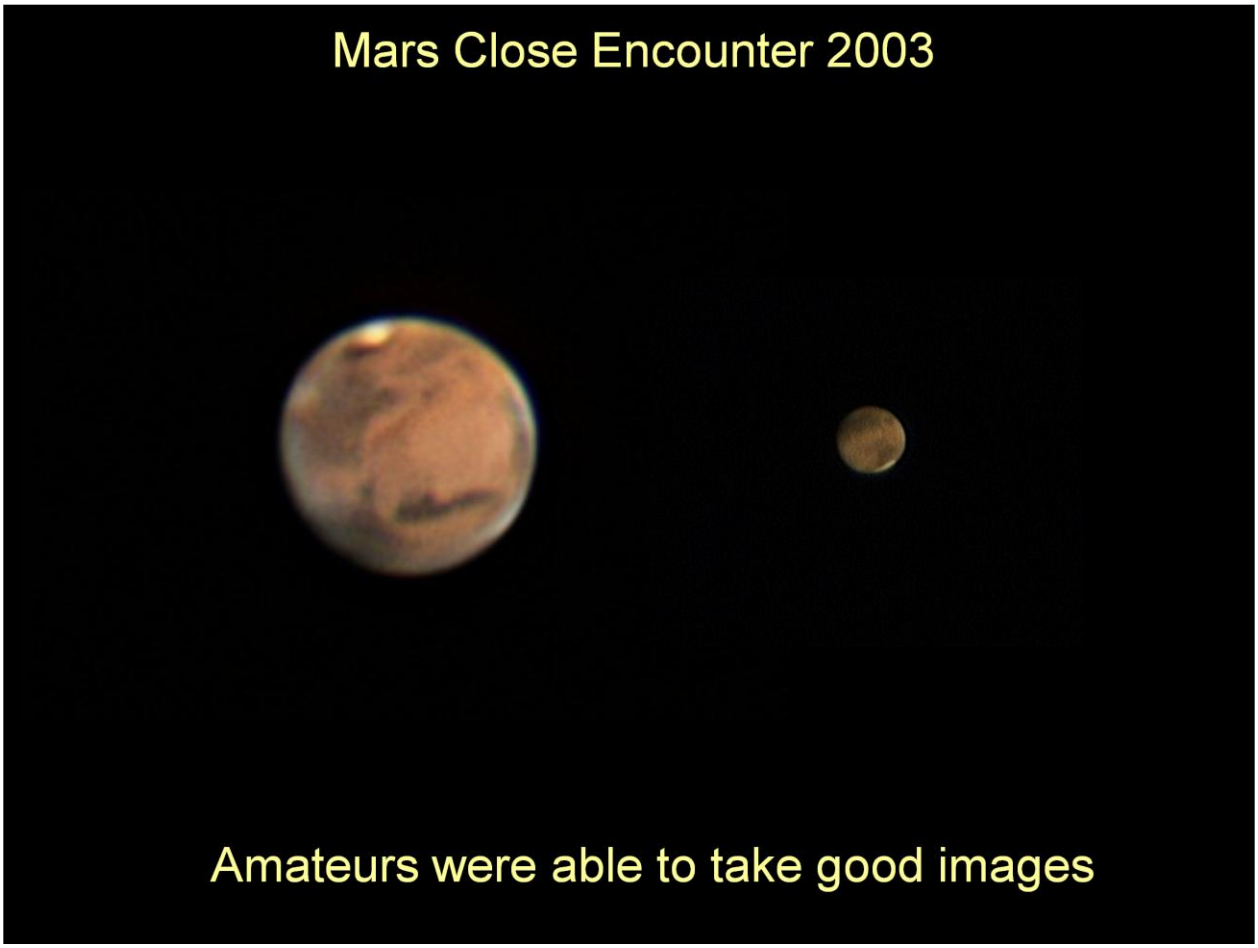

Mars Closest Opposition 28th August 2003
Mars
Earth
Sun
55.8 million km & 25.1"
Venus
Mercury



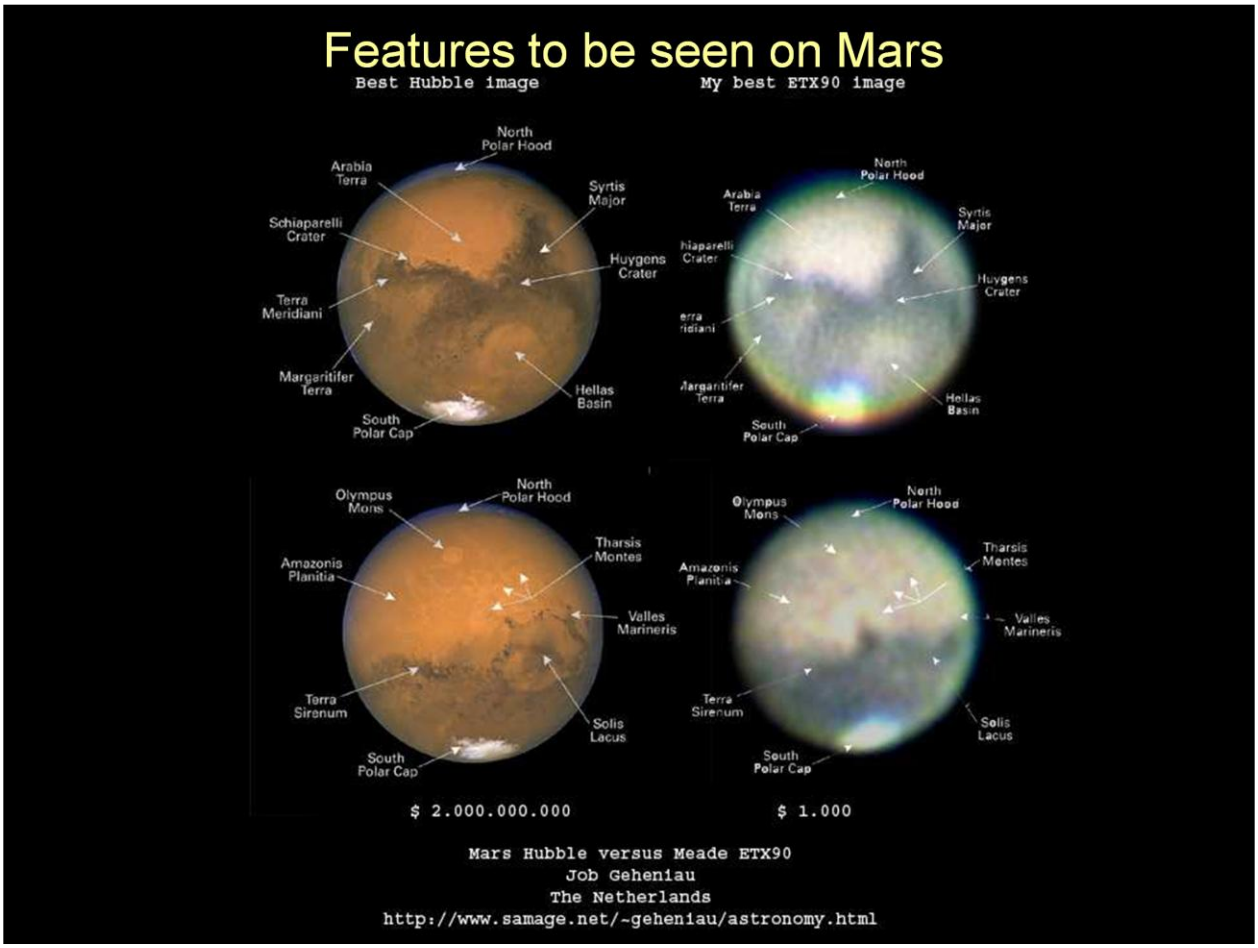
The closest approach at Mars / Earth Opposition was in 2003 when Mars was just 55.8 million kilometres from Earth.

This was said to be the closest that Mars had approached Earth for 61,000 years.

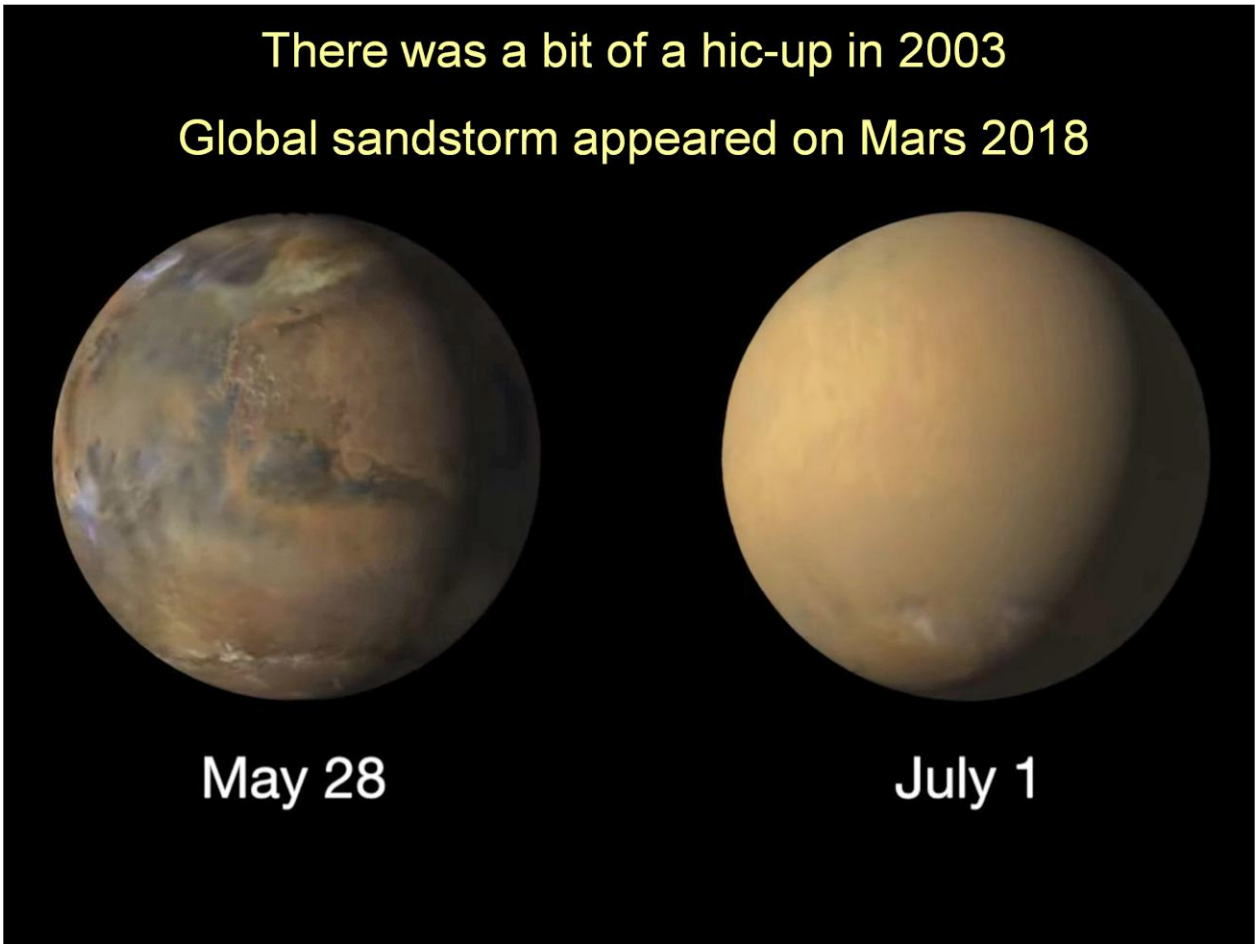
The picture above shows the comparative size of Mars in the previous and following years. The 2001 image give the closest approximation of how large will appear during the conjunction this year.



Two images taken in 2003 using different telescopes and cameras.

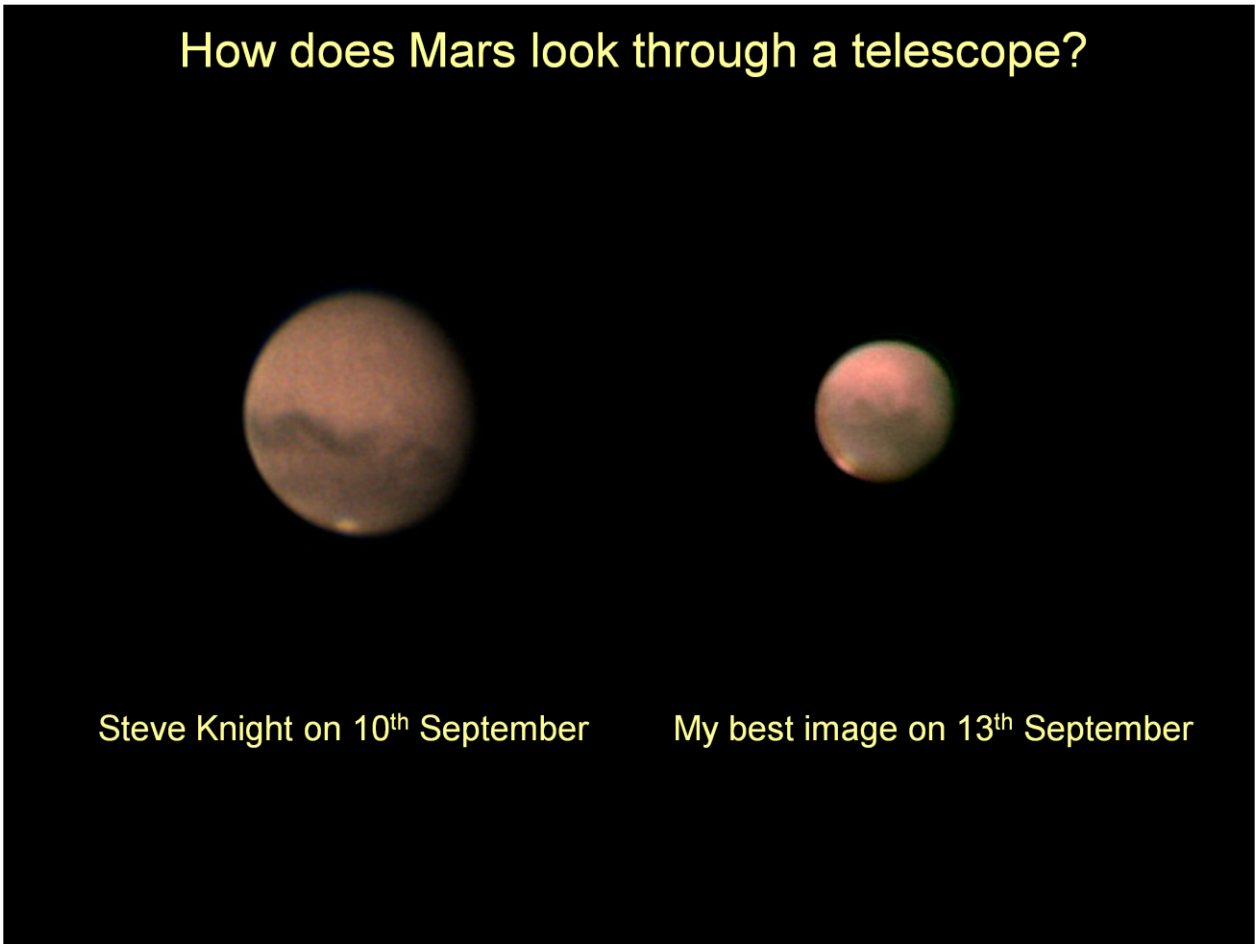


Obviously we cannot see Mars as clearly as the Hubble Space Telescope but is helpful to use Hubble images to identify features seen using are more modest telescopes. The images above show how we can use the Hubble images on the left to identify features seen through our telescope or on images we have produced.



Observers had a shock in 2018 when all the features on Mars disappeared.
This was due to a planet wide dust storm that covered everything.
Luckily the dust storm cleared for the end of the opposition.

The image above shows the front of the dust storm moving across the planet.

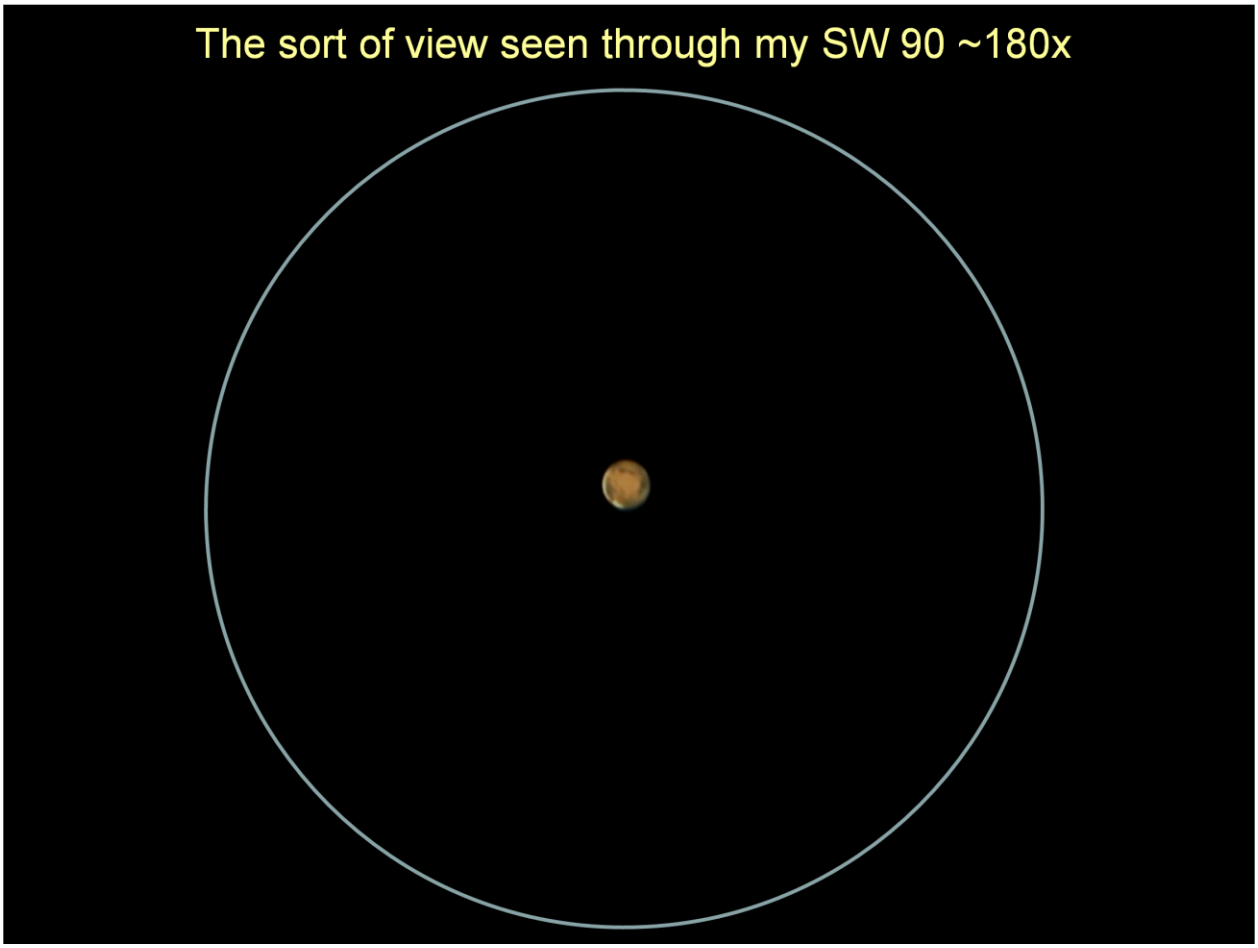


Here are two images of Mars taken this month (September 2020)

Observing Mars – My 90mm refractor

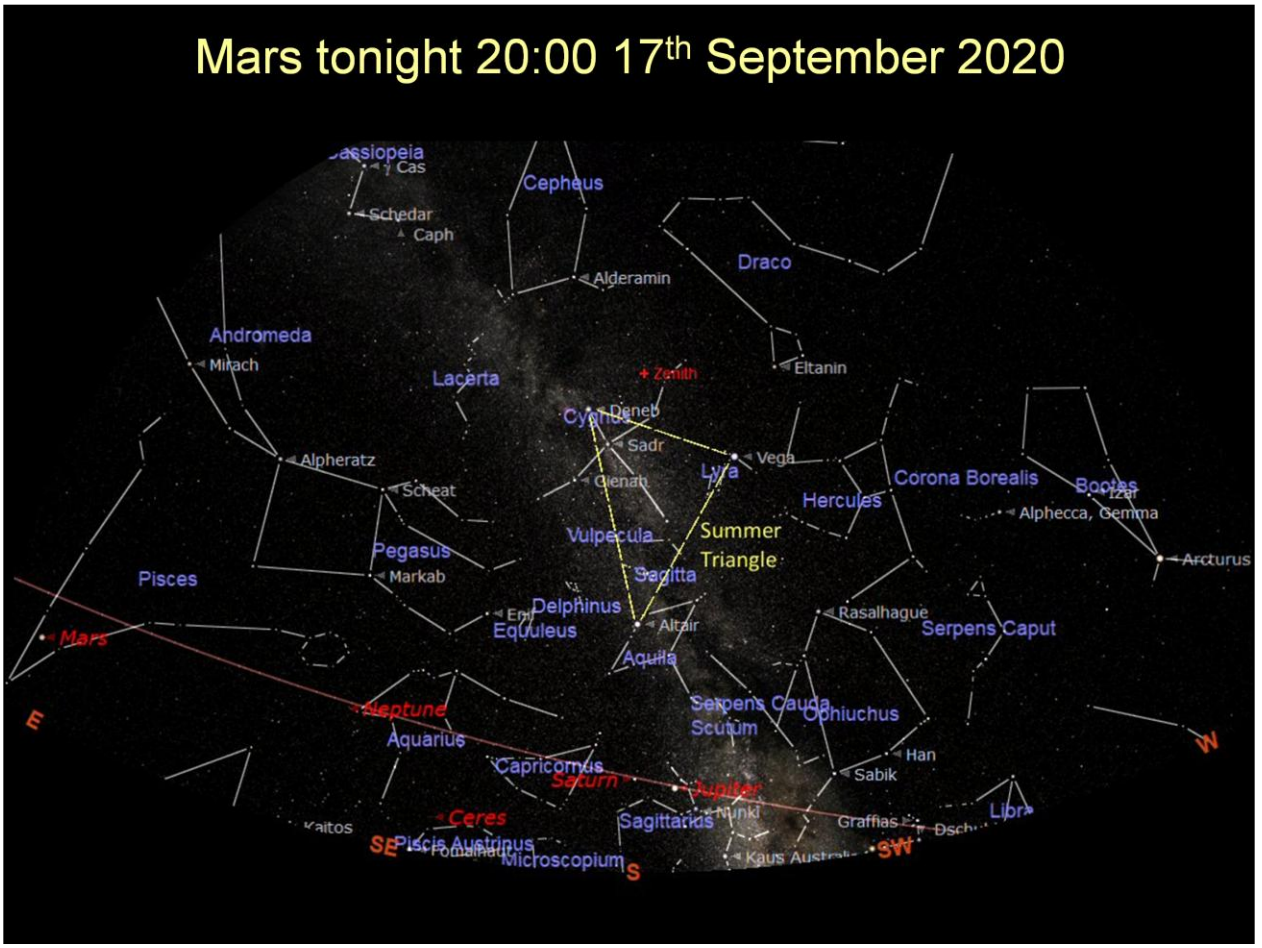
Mars can be seen quite well when it is at a close Opposition like on 13th October 2020.

Even a modest beginners first telescope will give a fairly good view of Mars.

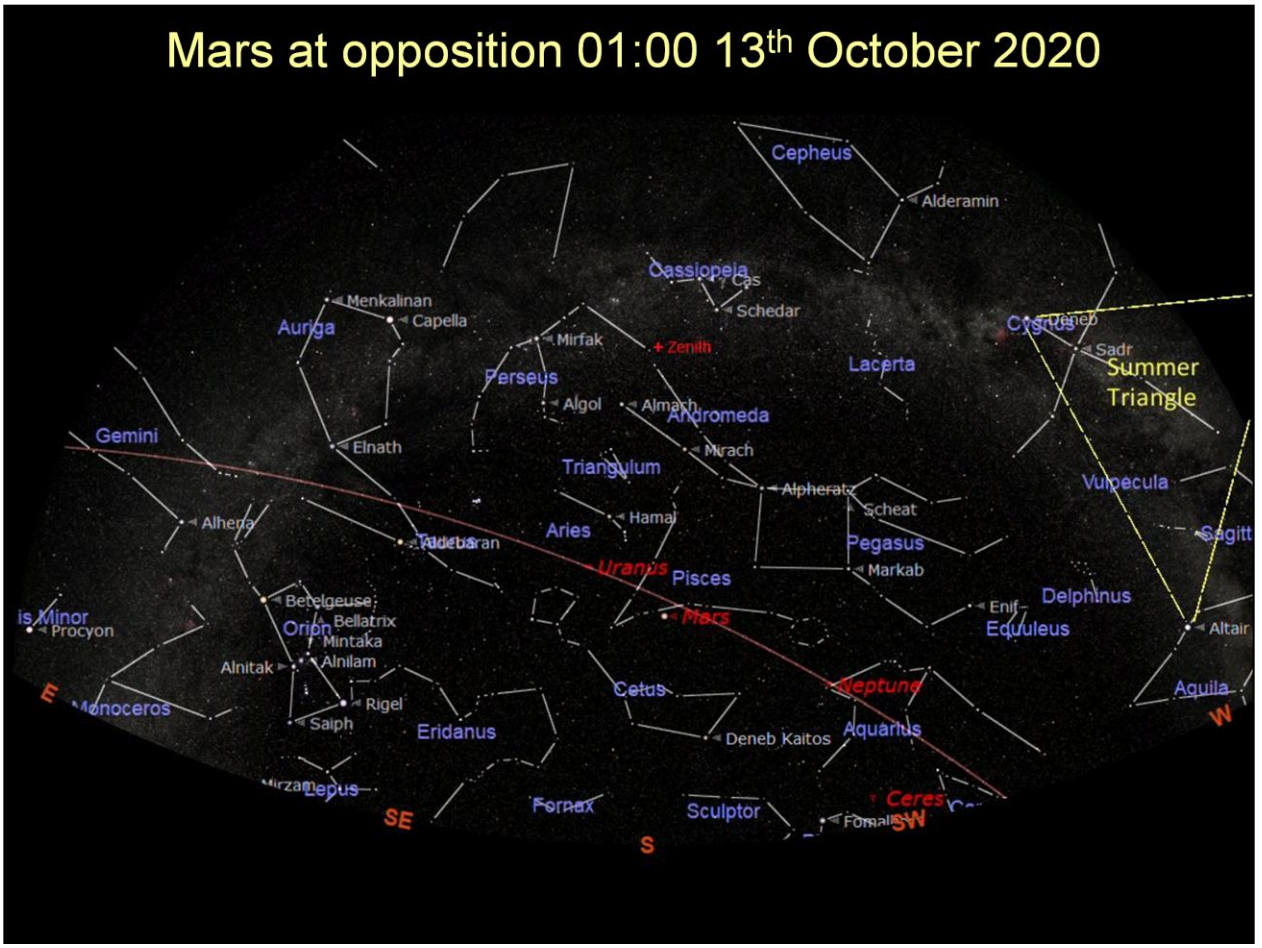


The view through a small telescope will not be as good as the view through a larger telescope.

However the view through your own telescope and from your own garden can take some beating.



Mars is in the east during the early evening but will be at its best after midnight.



Mars will be at opposition at midnight 01:00 BST (24:00 GMT / UT) on and around 13th October 2020.

At this time it will be at its closest to us, highest in the sky and at its largest apparent diameter.

The next opportunity like this will be 2031, 2033 or 2035.

Newbury Astronomical Society Website:

www.naasbeginners.co.uk