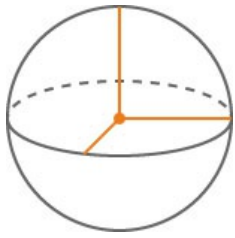


# The Planet

Mars is no place for the faint-hearted. Arid, rocky, cold and apparently lifeless, the Red Planet offers few hospitalities. Fans of extreme sports can rejoice, however, for the Red Planet will challenge even the hardest souls among us. Home to the largest volcano in the solar system, the deepest canyon and crazy weather and temperature patterns, Mars looms as the ultimate lonely planet destination.

## Size



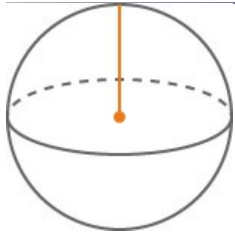
### Volumetric Mean Radius

Distance from the planet's center to its surface, if the planet's volume were contained in a symmetric sphere

About half (53.2%) that of Earth

**Mars:**  
3,389.5 kilometers  
*or*  
2,106.1 miles

**Earth:**  
6,371 kilometers  
*or*  
3,958.8 miles



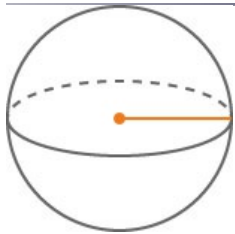
### Polar Radius

Half the diameter of the planet from pole to pole

About half (53.1%) that of Earth

**Mars:**  
3,376.2 kilometers  
*or*  
2,098 miles

**Earth:**  
6,356.8 kilometers  
*or*  
3,950 miles



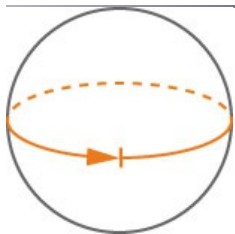
### Equatorial Radius

Half the diameter of the planet at its equator

About half (53.2%) that of Earth

**Mars:**  
3,396.2 kilometers  
*or*  
2,110 miles

**Earth:**  
6,378.1 kilometers  
*or*  
3,963 miles



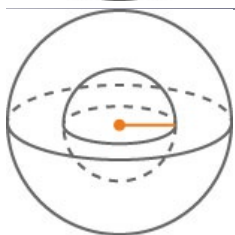
### Equatorial Circumference

A measurement of the distance around the equator of Mars

About half (53.2%) that of Earth

**Mars:**  
21,339 kilometers  
*or*  
13,259 miles

**Earth:**  
40,075 kilometers  
*or*  
24,901 miles



### Radius of the Core

The distance from the planet's center to the outer boundary of the core

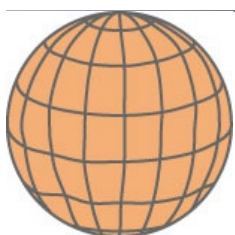
About half (50%) that of Earth

**Mars:**  
**Total core:**  
1,700 kilometers  
*or*  
1,056 miles

**Earth:**  
**Total core:**  
~3,400 kilometers  
*or*  
2,113 miles

**"Solid" inner core:**  
~1,220 kilometers  
*or*  
758 miles

**Liquid outer core:**  
~2,266 kilometers  
*or*  
1,408 miles



### Surface Area

The sum of the areas of all shapes that cover the surface of the planet

About 28% that of Earth

**Mars:**  
144,371,391 square kilometers  
(1.4437 x 10<sup>8</sup> km<sup>2</sup>)  
*or*  
55,742,106 square miles

**Earth:**  
510,064,472 square kilometers  
(5.1006 x 10<sup>8</sup> km<sup>2</sup>)  
*or*  
196,936,994 square miles

## Bulk

Volume

About 15.1% that of Earth



The quantity of three-dimensional space that a planet contains

**Mars:**  
163,115,609,799  
cubic kilometers

**Earth:**  
1,083,206,916,846  
cubic kilometers

(1.63116 x 10<sup>11</sup> km<sup>3</sup>)

(1.0832 x 10<sup>12</sup> km<sup>3</sup>)

**Mass**

**About 11% that of Earth**



A measurement of the amount of matter Mars contains

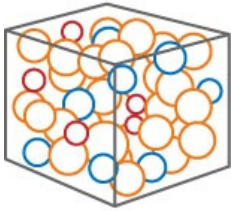
**Mars:**  
641,693,000,000,000,000,000  
kilograms  
(6.4169 x 10<sup>23</sup> kg)

**Earth:**  
5,972,190,000,000,000,000,000,000  
kilograms  
(5.9722 x 10<sup>24</sup> kg)



**Mean Density**

**About 71% as dense as Earth**



The planet's total mass divided by its total volume, which gives some clues about the planet's makeup (e.g., how much metal it has) and whether it is solid or gaseous

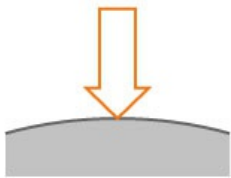
**Mars:**  
3,933 kilogram/meter<sup>3</sup>

**Earth:**  
5,514 kilogram/meter<sup>3</sup>

### Gravity and More

**Surface Gravity**

**About 38% that of Earth**



The gravitational acceleration experienced at a planet's surface

**Mars:**  
3.71 meters per second squared  
*or*  
12.2 feet per second squared

**Earth:**  
9.80665 meters per second squared  
*or*  
32.174 feet per second squared

**Escape Velocity**

**About 45% that of Earth**



The speed an object needs to break free from the gravitational attraction of a planet, moon, or other body without further propulsion

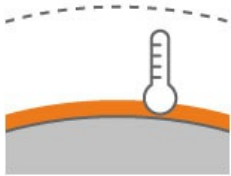
**Mars:**  
18,108 kilometers per hour  
(5.03 km/second)  
*or*  
11,252 miles per hour

**Earth:**  
40,284 kilometers per hour  
(11.19 km/second)  
*or*  
25,030 miles per hour

### Temperature

**Temperature of the Surface (Typical Minimum/Maximum)**

**Mars is colder than Earth because it is farther from the Sun.**



How hot or cold the surface varies between day and night and among seasons

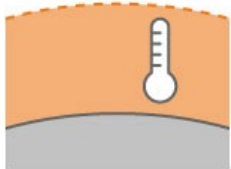
**Mars:**  
-190 to 86° Fahrenheit  
-120 to 30° Celsius  
150 to 303 Kelvin

**Earth:**  
-126 to 136° Fahrenheit  
-88 to 58° Celsius  
185 to 331 Kelvin

**Average Temperature of the Atmosphere**

**Mars:**  
-81° Fahrenheit  
-63° Celsius  
210 Kelvin

**Earth:**  
59° Fahrenheit  
15° Celsius  
288 Kelvin



Measurement of how hot or cool the atmosphere is at different altitudes (heights relative to the surface)

### Composition

**Composition of the Planet**

**Mars' composition is similar to Earth's**



The chemical materials that make up a planet

**Mars:**

**Crust and Surface** : mostly iron-rich basaltic rock similar to Earth's thin crust

**Mantle:** Silicate rock

**Core:** probably an iron, nickel, and sulfur core, but whether it is hot liquid or cooled metal is not known

**Earth:**

**Crust and Surface:** iron magnesium silicate igneous rocks, like basalt

**Mantle:** Silicate rock rich in magnesium and iron

**Core:** Iron-nickel alloy



### Composition of the Atmosphere

The chemical materials that make up the layers of gases surrounding a planet or moon, which are held in place by the object's gravity

### Mars' atmosphere is 100 times less dense than Earth's

**Mars:****Main Gases:**

96% Carbon Dioxide (CO<sub>2</sub>)\*  
1.93% Argon (Ar)\*\*  
1.89% Nitrogen (N<sub>2</sub>)  
0.145% Oxygen (O<sub>2</sub>)  
<0.01% Carbon Monoxide (CO)

**Earth:****Main Gases:**

78.09% Nitrogen (N<sub>2</sub>)  
20.95% Oxygen (O<sub>2</sub>)  
0.93% Argon (Ar)  
0.039% Carbon Dioxide (CO<sub>2</sub>)

Both planets also have other gases in very small amounts (trace gases).

**Did you know...?**

*\*Carbon dioxide is used for carbonation in beverages. Frozen carbon dioxide is "dry ice."*

*\*\*Argon is used to make blue "neon lights."*

## In Space

### Distance

#### Perihelion

#### 1.405 times that of Earth

**Mars:**

206,655,215 kilometers  
2.06655 x 10<sup>8</sup> km  
*or*  
128,409,598 miles  
*or*  
1.381 AU

**Earth:**

147,098,291 kilometers  
1.47098 x 10<sup>8</sup> km  
*or*  
91,402,640 miles  
*or*  
0.9833 AU\*

An AU is an astronomical unit. In simple terms, 1 AU is the average distance between the Sun and Earth.

**Did you know...?**

*\*The reason that the perihelion of Earth is less than 1 AU is that this is a measure of its closest distance from the Sun (its minimum distance). 1 AU is the average between the minimum and maximum distances.*

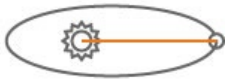


The closest distance between the Sun and Mars as the Red Planet travels in its orbit around the Sun

#### Aphelion

#### 1.639 times that of Earth

The farthest distance between the Sun and Mars as the Red Planet travels in its orbit around the Sun

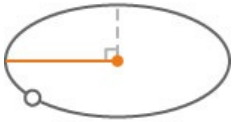


<b>Mars:</b> 249,232,432 kilometers $2.49232 \times 10^8$ km <i>or</i> 154,865,853 miles <i>or</i> 1.666 AU	<b>Earth:</b> 152,098,233 kilometers $1.52098 \times 10^8$ km <i>or</i> 94,509,460 miles <i>or</i> 1.017 AU
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An AU is an astronomical unit. In simple terms, 1 AU is the average distance between the Sun and Earth.

## Orbit

### Orbit Size Around Sun (semi-major axis)



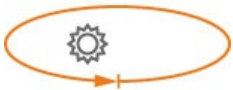
One half of the longest diameter of an orbital ellipse (radius of the orbit at the orbit's two most distant points)

### About 1.5 times that of Earth

<b>Mars:</b> 227,943,824 kilometers $2.2794382 \times 10^8$ km <i>or</i> 141,637,725 miles <i>or</i> 1.523662 AU	<b>Earth:</b> 149,598,262 kilometers $1.4959826 \times 10^8$ km <i>or</i> 92,956,050 miles <i>or</i> 1.000 AU
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An AU is an astronomical unit. In simple terms, 1 AU is the average distance between the Sun and Earth.

### Circumference of Orbit



The distance Mars travels in its orbit around the Sun.

### About 1.5 times that of Earth

<b>Mars:</b> 1,429,085,052 kilometers $(1.429 \times 10^9)$ km <i>or</i> 887,992,283 miles	<b>Earth:</b> 939,887,974 kilometers $(9.399 \times 10^8)$ km <i>or</i> 584,019,311 miles
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### Orbital Eccentricity

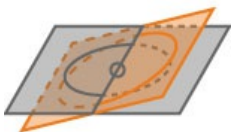


A measurement of how much Mars' orbit around the Sun differs from a perfect circle; 0 = a perfect circle, and values between 0 and 1 represent an elliptical (oval) orbit

### Mars' orbit is about 5.6 times more elliptical than that of Earth, which is nearly a perfect circle

<b>Mars:</b> 0.0933941	<b>Earth:</b> 0.01671123
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### Orbit Inclination



The angle an orbit is "tilted" relative to a reference plane

### Earth's orbital plane is almost flat, but Mars' has a slight tilt

<b>Mars:</b> 1.85 degrees	<b>Earth:</b> 0.00005 degrees
------------------------------	----------------------------------

0 degrees (reference plane for describing the position of bodies in the solar system)

The ecliptic is the plane of Earth's orbit around the Sun

## Speed

### Average Orbital Velocity



The rate of change in Mars' position: how fast it is moving in its orbit around the Sun (its speed)

### About 81% (0.808) that of Earth

<b>Mars:</b> 86,677 kilometers per hour $(2.4077 \times 10^4)$ meters per second <i>or</i> 53,858 miles per hour	<b>Earth:</b> 107,218 kilometers per hour $(2.9783 \times 10^4)$ meters per second <i>or</i> 66,622 miles per hour
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## Year

### About twice as long as an Earth year

### Length of Year (Sidereal Period or Revolution)

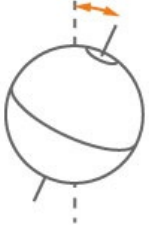


The time it takes for a planet or other body to make a full orbit of the Sun (or outside of our solar system, its primary star)

**Mars:**  
about 687 Earth days

**Earth:**  
365.25 Days

## Tilt / Seasons



### Axial Tilt (Obliquity)

The angle between Mars' orbital plane and its spin axis

**Very similar to Earth's - only a 2-degree difference**

**Mars:**  
25.2°

**Earth:**  
23.5°



### Change in Axial Tilt

Variations in the angle of tilt

**The tilt of Mars changes more dramatically over time**

Unlike Earth, substantial changes in the obliquity (or tilt) of Mars occur on timescales of hundreds of thousands to millions of years and result in long-term climate change

### Seasons



Changes in the amount of sunlight reaching different latitudes due to the varying orientation of the axial tilt as the planet orbits the Sun

**Mars' year is almost twice as long as Earth's so its seasons are longer too**

4 seasons, roughly twice as long as those on Earth, but with more variation given Mars' eccentric orbit and the fact its orbital speed varies more as result (fastest when at perihelion; slowest at aphelion)

Season (Northern Hemisphere)	Length of Season on Earth	Length of Season on Mars
Spring	93	194
Summer	93	178
Autumn	90	142
Winter	89	154

## Day



### Average Length of Day (Sidereal Rotation Period)

The time it takes for a planet or other body to make one rotation (one spin on its axis)

**About 37 minutes longer than an Earth day**

**Mars:**  
24 hours, 37 minutes  
(24.623 hours)  
1.029 Earth days

**Earth:**  
23 hours, 56 minutes  
(23.934 hours)

## In Our Night Sky

### Mars Opposition

The distance to Mars varies from about 56 million kilometers (about 35 million miles) to 400 million kilometers (about 249 million miles). Why the difference? And why so close now?

More About  
MARS OPPOSITION

## Solar Conjunction

When the Sun comes between Earth and Mars, communications with Mars spacecraft diminish drastically. Find out how the mission teams cope!

[More About  
SOLAR CONJUNCTION](#)

## Mars Retrograde

When Mars is close, it appears to move backwards from night to night! Find out why.

Find out where and when Mars will be in your neighborhood.

[More About  
MARS RETROGRADE](#)

## Mars Close Approaches

Close is a relative term. At its closest, Mars is still tens of millions of miles away from Earth. Still, the decreased distance during "closest approach" allows for fuel-conserving flights to Mars every 26 months and a good view of Mars once or twice every 15 to 17 years for Earth-bound sky watchers. For help viewing Mars, please contact your local [Night Sky Network](#) astronomy club.

[More About  
MARS CLOSE  
APPROACHES](#)

## Human Time

Humans from all cultures around the world have been curious about the "Red Planet" Mars since before recorded history.

[More About  
Mars In Human History](#)