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What is PlanetWatch?

PlanetWatch is an easy-to-use atlas and simulation of our solar system. It uses a simple multiple-window interface to combine a photo viewer, an up-to-date planetary atlas, and animated maps into a powerful desktop reference.

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Set Time - use to set displayed date, time, and geographical time zone.



Star Map - displays equatorial map of the sky as seen from Earth.



Inner Map - displays heliocentric map of the inner planets of the solar system.



Outer Map - displays heliocentric map of the outer planets of the solar system.



Animate - use to set any/all maps into motion. Time can be set to run in increments from an hour to a year.



Info - displays atlas information of a planet displayed in the image window. If no image is displayed, the atlas index is displayed.



Ephemeris - displays astronomical (position) data for the planets for the date and time set.



Print Ephemeris - prints astronomical data to an installed printer.



Help - displays the Contents page of the online help.

Procedures

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Viewing Maps

PlanetWatch displays three maps which can, either singly or in combination, be displayed and animated. The map(s) displayed are plotted for the date displayed in the title bar of the main PlanetWatch window.

To view a map, click one of the map buttons in the PlanetWatch toolbar.



Displays an equatorial map of the sky as seen from Earth.



Displays a heliocentric map of the inner planets of the solar system.



Displays a heliocentric map of the outer planets of the solar system.

(To view a map using the PlanetWatch menu, select 'Show', then select either 'Star Map', 'Inner Orbit Map', or 'Outer Orbit Map' from the drop down menu.)

For information on how to display maps for specific dates, or to run map animations, see topics:

[Change Viewing Date and Time](#)

[Run Animations](#)

Changing Date and Time

When PlanetWatch starts, it uses the current system time of the computer. When desired, PlanetWatch will display maps and coordinates for any date and time between 1600 A.D. and 2400 A.D. Changing the viewing date or time does not affect the computer system time.



To change the viewing date/time, click the 'Set Time' button in the PlanetWatch toolbar (or select 'Time!' from the menu).

When the dialog box opens, type in the desired date and time (the mouse or the tab key can be used to move among the entry boxes and the buttons), then press the 'Enter' key or click the 'OK' button. ('Cancel' will close the dialog without making any changes.)

Set Time

Date

Day Month Year

12 MAY 1994

Time (local)

Time 00 : 47

Time Zone -6

OK Cancel Now Save Help

Later, if you wish to return to the current system time, click the 'Now' button in the dialog box, then click 'OK'.

For PlanetWatch to display maps using the correct time you should also change the 'Zone' field to match your local time zone. Click the 'Save' button to make the time zone setting permanent in PlanetWatch.

See also:

[Changing Time Zone](#)

This topic shows correct Time Zone settings for many major cities...

Changing the Time Zone setting

PlanetWatch uses "Mountain Standard Time" as its default time zone setting, which is ok for Denver, Colorado, but not of much use in most other parts of the world.

For PlanetWatch to more accurately display its maps, the correct time zone needs to be set for your location. (Note: an incorrect time zone setting is especially noticeable for the position of the moon plotted in the star map window.)



To set the time zone, click the 'Set Time' button in the PlanetWatch toolbar (or select 'Time!' from the menu).

When the dialog box opens, change the 'Time Zone' setting to match your local time zone. Click the 'Save' button to make the setting permanent.

List of Time Zone settings for some major cities

If you are uncertain of your correct time zone setting, check the following list for a major city near you, or check a world map marked with time zone boundaries. If your locale observes "daylight time" you will need to add one hour to the setting shown below when daylight savings time is in effect.

| Zone | City |
|------|-----------------------------------|
| -7 | Albuquerque, New Mexico, USA |
| -10 | Anchorage, Alaska, USA |
| 1 | Amsterdam, Netherlands |
| 2 | Athens, Greece |
| -5 | Atlanta, Georgia, USA |
| -5 | Baltimore, Maryland, USA |
| 7 | Bangkok, Thailand |
| 2 | Beirut, Lebanon |
| 1 | Berlin, Germany |
| 5 | Bombay, India, Asia |
| -5 | Boston, Massachusetts, USA |
| 1 | Brussels, Belgium |
| 2 | Bucharest, Romania |
| -3 | Buenos Aires, Argentina |
| 2 | Cairo, Egypt |
| -7 | Calgary, Alberta, Canada |
| 2 | Cape Town, South Africa |
| -6 | Chicago, Illinois, USA |
| -5 | Cincinnati, Ohio, USA |
| -6 | Dallas, Texas, USA |
| -7 | Denver, Colorado, USA |
| -6 | Des Moines, Iowa, USA |
| -5 | Detroit, Michigan, USA |
| -10 | Fairbanks, Alaska, USA |
| 8 | Hong Kong, China |
| -10 | Honolulu, Hawaii, USA |
| -6 | Houston, Texas, USA |
| 5 | Indianapolis, Indiana, USA |
| 3 | Istanbul, Turkey |
| 2 | Jerusalem, Israel |
| 6 | Kansas City, Kansas/Missouri, USA |
| -5 | Lima, Peru |

0 London, England
-8 Los Angeles, California, USA
1 Madrid, Spain
10 Melbourne, Victoria, Australia
-6 Mexico City, Mexico
-5 Miami, Florida, USA
- 6 Minneapolis, Minnesota, USA
- 5 Montreal, Quebec, Canada
3 Moscow, Russia
-5 New York, New York, USA
-6 Omaha, Nebraska, USA
1 Oslo, Norway
1 Paris, France
3 Saint Petersburg, Russia
-8 San Francisco, California, USA
-7 Phoenix, Arizona, USA
9 Tokyo, Japan
-5 Toronto, Ontario, Canada
2 Tripoli, Libya
-5 Vancouver, British Columbia, Canada
1 Warsaw, Poland
-5 Washington, DC, USA
12 Wellington, New Zealand
-6 Winnipeg, Manitoba, Canada
3 Zanzibar, Tanzania, Africa

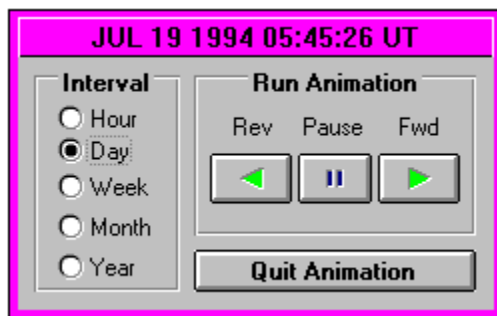
Running Animations

PlanetWatch can animate any of its displayed maps. Animations can be played in forward or reverse and at one of several time-lapse intervals. Animation of the maps can be instructive as well as entertaining. For example, you can watch retrograde movements (often a loop) of a planet in the star map window, and simultaneously watch the planet pass (or be passed) in the orbit maps.



To open the "Animation dialog", click the 'Animate' button in the PlanetWatch toolbar (or select 'Animate!' from the menu).

When the animation dialog box opens, select the time-lapse interval. For watching the motions and changing phases of the moon you may wish to use shorter intervals of an hour or day. For animations of the inner planets, a week works well. For the outer planets, longer intervals of a month or even a year may be needed.



After you select the interval, click one of the animation VCR buttons for the direction in time you wish to run the animation. Pressing the 'Pause' button pauses the animation, and 'Quit Animation' stops it and exits the animation dialog box.

See also:

[Changing Viewing Date and Time](#)

View or Print Ephemeris info

PlanetWatch can display or print the equatorial coordinates for all the planets for the date displayed in the PlanetWatch title bar. The coordinates are given in Right Ascension and Declination. Currently, perturbations in the planet's orbits are not accounted for by PlanetWatch. Therefore, the positions calculated may vary by as much as a couple degrees Declination, and 30 minutes Right Ascension. A future version of PlanetWatch may address these inaccuracies, for now PlanetWatch will get you in the neighborhood...



To view the ephemeris information, click the 'Ephem' button in the PlanetWatch toolbar (or select 'Show' in the PlanetWatch menu, then select 'Ephemeris').



To print the ephemeris, click the 'Print' button in the toolbar (or select 'File' in the PlanetWatch menu, then select 'Print Ephem'). Note: your printer must be on-line and properly installed in the Windows control panel!

Copying to the Windows Clipboard

Use the alt+printscreen keystroke combination to copy a PlanetWatch map to the Windows clipboard. You can then paste it into another Windows application. See the Help provided with the Windows Clipboard Viewer application for more information.

Adding Images to the database

PlanetWatch will handle a total of sixteen images in the “other images” database that you can use for your own images. The images must be in standard Windows .bmp format and be viewable by Windows Paintbrush.

To install your own images you need to copy them into the PlanetWatch directory. You also need to modify the plnwch.ini file by using the Windows Notepad application. Select 'File' then 'Open' from the Notepad drop-down menu. Enter the complete filename of the PlanetWatch ini file (if you used the default paths suggested during installation then this will be: c:\plnwch\plnwch.ini). After the file has loaded, your image can be entered after the "tag" line named [PlanetWatch]. The proper format for adding a picture is "ImageXX=picname". XX is a number that isn't already being used for another picture, picname is the filename of the image you want to add (but do not include the .bmp extension!). In the following example, Shuttle1 and MoonWalk have been added to an existing list.

```
[PlanetWatch]
Image0=Io
Image1=Europa
... other entries ...
Image7=Ida
Image8=Shuttle1           <== your 1st new entry
Image9=MoonWalk           <== your 2nd new entry
... and so on ...
```

When you have completed the list, select 'File' from the Notepad menu, then select 'Save'.

When you restart PlanetWatch, 'More Images' should be available in the 'Show' menu selection and should show your additional selections.

Setting PlanetWatch Options

The PlanetWatch 'Options' menu allows changes to the following option settings:

Show Toolbar

By default a checkmark appears next to this option indicating it is enabled. When 'Show Toolbar' is enabled, a toolbar is displayed at the top of the PlanetWatch window.

Show Status Help

By default this option is enabled. When 'Show Status Help' is enabled, a brief description of a button's function appears in the "status bar" at the bottom of the main PlanetWatch window.

"Quick Start" on Startup

By default, a checkmark appears next to the "'Quick Start' on Startup" option indicating it is enabled. After using PlanetWatch for awhile, you may find the "Quick Start" help window annoying when PlanetWatch loads. If you don't want the "Quick Start" help window to appear when PlanetWatch loads, select this option so no checkmark appears by it.

Save Settings on Exit

By default this option is disabled. When 'Save Settings on Exit' is enabled, PlanetWatch will remember your current option settings, window positions, sizes, and animation interval setting for use next time you use PlanetWatch.

How to Un-Install PlanetWatch

I'll address something you may wish to do, but few authors ever tell you how to do: how to un-install this application!

The only difference in un-installing PlanetWatch Shareware or PlanetWatch Pro is in the number of files to delete.

Un-installing PlanetWatch

- The simplest way to delete PlanetWatch is to use the Windows File Manager. Select the PlanetWatch directory (default is c:\plnwch for PlanetWatch Pro), then select "Delete" from the File Manager "File" menu. The File Manager may ask for confirmation of deletion of each file.

If you are more comfortable using DOS to remove files, you may do so. You will find a complete list of installed files in the readme.txt file provided with PlanetWatch...

- The last step is to delete the icon(s) for PlanetWatch. Select the PlanetWatch icon, select "File" from the Program Manager menu, then select "Delete".

NOTE: If a group was created for PlanetWatch, you may delete the entire group by selecting the group, select "File" from the Program Manager menu, then select "Delete".

Try This!

Watch the retrograde motion of Mars. Set the date to 1st of July, 1994. Open the starmap window and enlarge it to fill the PlanetWatch window. Use the scroll bars to center the 10th hour mark. Start the animation by pressing the 'Animate' button. When the animation dialog opens, select an interval step of '1 week' and press the 'Fwd' VCR button. As September 1994 approaches you will see Mars appear from the right. In October, it will slow its march across the sky, stop, then reverse its motion until early in 1995, when it will resume its normal course across the sky! (Note: you may need to move the starmap scroll bars to keep Mars visible within the window.)

Context Sensitive Help

If you are lost, besides selecting the 'Help' button or help menu, PlanetWatch offers two different methods of "Context Sensitive Help".



If you need help on a button in the toolbar or a dialog box; simply place the mouse cursor over it. A brief description of the button's function will appear in the "status bar" at the bottom of the main PlanetWatch window. (Note: this function can be turned on/off in the PlanetWatch Options menu.)



In the PlanetWatch menus, select an item and press F1 to get help.

Menu Commands

[File](#)

[Time!](#)

[Show](#)

[Info!](#)

[Animate!](#)

[Options](#)

[Window](#)

[Help](#)

[See also: Procedures](#)

File Menu

Print Ephemeris

Prints planetary ephemeris (position) data to an installed printer.

Exit

Quits PlanetWatch

Time Command

Opens a dialog to set displayed date, time, and geographical time zone.

[See: Changing Date and Time](#)

Show Menu

Star Map

Displays equatorial map of the sky as seen from Earth.

Inner Orbit Map

Displays heliocentric map of the inner planets of the solar system.

Outer Orbit Map

Displays heliocentric map of the outer planets of the solar system.

Ephemeris

Displays astronomical (position) data for the planets for the date and time set.

View Images

Selects a planet photograph to be displayed in the image window.

More Images

Selects a photograph from optional images (or user-added images) to be displayed in the image window.

Info Command

Displays the atlas information of a planet displayed in the image window. If no image is displayed, the atlas Contents page is displayed.

Animate Command

Opens a dialog used to set any/all maps into motion. Time can be incremented in steps from hours to years.

[See: Running Animations](#)

Options Menu

Show Toolbar

If this option is checked, the toolbar is displayed at the top of the PlanetWatch window.

Show Status Help

If this option is checked, the mouse cursor becomes "smart", displaying a brief description of a button's function in the "status bar" at the bottom of the main PlanetWatch window.

"Quick Start" on Startup

If this option is checked, a "Quick Start" help window is displayed when PlanetWatch is started.

Save Settings on Exit

If this option is checked, PlanetWatch "remembers" current option settings, window positions, sizes, and the animation interval setting for use next time PlanetWatch is loaded.

Window Menu

1... 4

Menu of open PlanetWatch map, image, and ephemeris windows. Selecting one brings it to the top if it is currently displayed under another window.

Close All

Closes all open PlanetWatch map, image, and ephemeris windows.

Help Menu

Quick Start

Displays a brief summary of major PlanetWatch functions.

Contents

Displays help Contents page of online help.

Search for Help on...

Opens a "search for keyword" dialog for the online help.

Diagnostic...

Displays what PlanetWatch knows about your computer configuration. This information is useful if you need technical help.

Order Info

Displays information on ordering additional copies of PlanetWatch from the author, obtaining technical help.

About

Displays version and registration information.

Common Questions and Answers

What is the dotted line in the star map window?

This line represents the ecliptic plane, which is the path the Sun traces in the sky throughout the year.

How can I tell when a planet rises or sets?

PlanetWatch currently doesn't give you this information. You can still tell roughly though if you know when the Sun sets or rises. Find the Sun in the star map and note where the planets are relative to it. Planets to the left of the Sun are visible after sunset. Count the number of hours on the R.A. grid the planet is away from the sun. This will be the approximate number of hours after sunset the planet will set. Planets to the right of the Sun are visible before sunrise. Likewise, you can count the number of hours before the Sun a planet will rise.

After I upgraded to PlanetWatch Pro, why do some images show "funny" colors?

You aren't using a 256 (or better) color display driver or perhaps it is incompatible. Select the 'Diagnose' item from the PlanetWatch 'Help' menu to determine how many colors are supported by the display driver installed in Windows.

For what location is the star map plotted?

The star map window is a "generic" map as the horizon is not plotted. The sky is plotted as if seen from the center of the Earth with a full 360° view along the equatorial axis. Therefore it can be used at most locations on Earth. It's quite similar to the "Solar System Almanac" maps published in the more popular astronomy magazines.

Why can I only enter dates between 1600AD and 2400AD?

Actually, the choice of dates is arbitrary. PlanetWatch doesn't currently calculate perturbation and precessional effects. Therefore; the further you get from 1990AD the less accurate the plots are. Also in 1582AD the calendar was "reformed" by Pope Gregory which further complicates things. It is possible to get around the built-in restriction in PlanetWatch by using the 'Animate' function to "scroll" past the date restrictions, but keep in mind that PlanetWatch plots may not accurately represent the sky for those dates.



The PlanetWatch 2.1 Atlas (shareware version)

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[Photo Credits](#)

The Sun

[The Sun](#)

The Planets

[Mercury](#)

[Venus](#)

[Earth](#)

[Mars](#)

[Jupiter](#)

[Saturn](#)

[Uranus](#)

[Neptune](#)

[Pluto](#)

The Planetary Moons

[Planetary Moons of the Solar System](#)

[Earth's Moon](#)

Other Objects

[Asteroids, Comets, and other objects](#)

Photo Credits

Many thanks to the organizations and people who have made the photographs possible (and readily available)...

Sun - Naval Research Laboratory, Skylab, Dec. 1973
Mercury - NASA, Mariner 10, Mar. 1974
Venus - NASA, Pioneer Venus, Feb. 1979
Earth - JPL/NASA, Galileo, Dec. 1990
Mars - NASA/? (source uncertain, Mariner 9 composite?)
Jupiter - NASA, Voyager 1, Feb. 1979
Saturn - NASA/?, Hubble, 1991
Uranus - JPL/NASA, Voyager 2, Jan. 1986
Neptune - JPL/NASA, Voyager 2, Aug. 1989
Pluto - NASA/ESO, Hubble, 1994
Moon - source unknown

The Sun (Sol)

Our star, the Sun, is the most prominent object that appears in our sky. It is one of several hundred billion stars in our galaxy. It is located in a spiral arm, 26,000 light years from the galactic center (our galaxy is almost 100,000 light years across). Containing 99.9% of the matter in our solar system, the Sun is by far the largest and most massive single object in the system.

The Sun is a sphere of hot gas. In its center the temperature and density reach values that are sufficient to maintain nuclear reactions. The fuel the Sun uses for energy is hydrogen, the nuclei of which are converted to helium by nuclear fusion.

The Sun's surface

The visible surface of the Sun is called the photosphere. The temperature at the surface is around 5500° Celsius (9900° Fahrenheit). The photosphere has a granular appearance with a typical "granule" being 1000 km (620 miles) across and consisting of a bright region surrounded by a darker border. Granules are produced by convective heat currents flowing outward from the Sun's interior. The surface of the Sun is constantly changing, a typical granule lasts only a few minutes.

The most prominent features of the photosphere are the sunspots. They are dark, roughly circular areas that appear on the surface. They can range in size from 1000 km (620 miles) to 150,000 km (93,000 miles), with 10,000 km (6200 miles) being an average size. The darkness of a sunspot is a contrast effect; each sunspot is a localized cooler area in the photosphere. Sunspots have intense magnetic fields associated with them. It is believed that the strong magnetic fields are responsible for the sunspots lower temperature. It is known that high-energy charged particles cannot readily enter areas where intense magnetic fields are present, thus convective currents tend to be suppressed.

A typical sunspot comes and goes within a week, although larger ones may last a month or more. The number of spots on the Sun at any time doesn't remain the same year to year but varies in roughly 11 year cycles (at a minimum, there may only be 3 or 4 spots seen, at a maximum, there may be 100 or more). The equatorial regions of the Sun rotate at a slightly faster rate than the polar regions and this differential rotation is believed to be responsible for the 11 year cycle. The differential rotation causes intense subsurface magnetic field which eventually build up and burst through the photosphere. These bursts appear as a sunspot. The formation of sunspots releases the magnetic energy in the interior, leaving the Sun free to begin another cycle.

The Solar Atmosphere

The chromosphere is a layer of gases just above the photosphere. The chromosphere is much hotter and highly ionized gas (composed primarily of protons and electrons), typically extending to an altitude of 5000 - 10,000 km. The temperature of the chromosphere rises with increasing altitude above the photosphere, and can get as hot as 50,000° Celsius (90,000° Fahrenheit).

The gaseous layer that extends a million km or more above the chromosphere is called the corona. Temperatures here are in the millions of degrees Celsius. Many particles (electrons, protons, some heavier ions) in the corona have enough energy to escape the Sun. This stream of particles is known as the solar wind. During sunspot maximum, the corona is larger than normal and the solar wind is more intense. Also during this period there is a larger number of intense discharges from the chromosphere known as a solar flare. Solar flares often disrupt the magnetic field of the Earth and if particularly intense can disrupt radio, television, and satellite communications.

Mercury

Mercury is the planet closest to the Sun. Because of this, it is difficult to observe as it's always in the glare of the Sun. It can be seen only during extremely favorable conditions at dusk or early dawn.

Orbit

Mercury's orbit has an average distance of 0.39 AU from the Sun. With the exception of Pluto, Mercury has the most elliptic orbit of any of the planets (with an eccentricity of 0.206) as well as the orbit with the highest inclination to the ecliptic (7°). Mercury's day is 58.7 days long, the Mercurian year is 88 days.

Geology

Almost everything known about the geology of Mercury was learned from a single spacecraft, Mariner 10, which made three flybys of the planet in 1974 and 1975. Mariner's cameras revealed a surface much like our moon's: a small airless world heavily scarred by impact craters. These craters range from 100's of km across to less than 100 meters across. Although the surface appearances are similar, Mercury shows very few indications of the past volcanic activity that helped shape our moon's surface. This is somewhat of a paradox as Mercury's interior is like Earth's, with a large metallic core and the presence of a small planetary magnetic field. More detailed study of Mercury is needed to determine whether the magnetic field is "frozen" in the rock or if it is truly generated in the interior.

Atmosphere

There is no significant atmosphere.

Moons

None

Venus

Venus is the second planet from the Sun. With the exception of the Sun and the Moon, Venus is the brightest object in our sky. In a telescope Venus appears to have a yellow-white color, but no markings of any kind can be seen. Because Venus's orbit lies between the Earth and Sun it goes through phases of illumination, just as the Moon does. Venus rotates in the retrograde direction; its day is 243 days long, and the Venusian year is 224.6 days.

Orbit

Venus has a nearly circular orbit (the least eccentric of any of the planets at 0.007) with an average distance from the Sun of 0.72 AU. The inclination of its orbit to the ecliptic is 3.4°.

Geology

Because of the thick cloud cover, not much was known about the surface of Venus until recently. The first pictures of the surface were transmitted by Veneras 9 and 10 in 1975. With the arrival of the Magellan spacecraft in May 1991, the complete surface of Venus was mapped at high resolution. The interior of Venus is very similar to that of Earth, though it has an extremely weak magnetic field. This may be due to its slow rotation rate (243 days), or a less fluid inner core.

Three distinct types of terrain have been found on Venus: lowlands, rolling plains, and highlands. Several large highland features have been identified: a mountain named Maxwell Montes rises 11 km (36,000 feet) above the surrounding plain, and large rift canyon known as Diana Chasma is much deeper than any on Earth.

The dominant force that shaped the surface of Venus seems to have been volcanic activity. Many areas of the rolling plains contain large numbers of complex linear features which could be faults possibly caused by plate tectonic (crust movement) activity.

Atmosphere

Carbon dioxide (96%) and nitrogen (3.4%) are the major components of the atmosphere with traces of water vapor, sulphur dioxide and other gases present. The surface pressure and temperature is very high. The clouds of Venus are so thick that only 1% of the Sun's light ever reaches the surface. The composition of the clouds is still uncertain, but is probably water vapor and sulfuric acid.

Moons

None

Earth

The third planet from the Sun is the Earth. Even from a distance, Earth appears to be unique in the Solar System. It is the only planet in the Solar System with a partially blue surface, sunlight glinting brightly off its oceans of water. Much of Earth is blanketed in an ever-shifting canopy of clouds. Glimpses of the land masses can be seen between the clouds.

Orbit

The Earth's orbit around the Sun is approximately circular (with an eccentricity of 0.017). The average Earth - Sun distance is 149 million km (93 million miles). This distance value defines the astronomical unit (or AU). Earth's elliptical orbit around the Sun defines a fixed plane in the sky, relative to the stars, which astronomers refer to as the ecliptic plane. The time it takes for the Earth to complete one orbit of the Sun with respect to the stars is called the sidereal year, which is 365.24 days long.

The most readily noticed periodic phenomenon on Earth is the coming and going of the seasons. The seasons are caused by the Earth's rotational axis being tilted 23.5° . When traveling about the Sun, the Earth's rotational axis remains fixed toward the same point in the sky (toward the star Polaris). Therefore the average amount of sunlight falling on any one location changes during the year, which affects the average temperature.

Geology

Oceans of water cover more than two thirds of the Earth, making water one of the most abundant compounds. Most of the land area is concentrated in six massive continents.

Geologically, the Earth is very active. The Earth has a strong magnetic field, generated by the solid metallic core and turbulent convection currents in the outer liquid core. The complex geology of the Earth is due to plate tectonics. The crust and mantle are divided into ten major continental plates that slowly move about and change. The plate boundaries are marked by long narrow regions where volcanoes and earthquakes are frequent. The force that drives the slow motion of the plates (a few centimeters per year) is the convective upward flow of molten lava that forces some adjacent plates apart. Once the lava has forced its way up it cools and accumulates, forming a range of high mountains deep in the ocean known as an oceanic ridge. The mid-Atlantic ridge is perhaps the best known of these submarine ridges.

Since plates are pushed apart in some regions, it means that in other regions they are being pushed together. In some locations new mountains are being pushed up by the collision. A well known example is the Himalayan mountain chain. In other locations, one continental plate is forced to slide over the other. The lower plate is pushed downward where it remelts. This creates deep oceanic trenches, such as the one near the Mariana islands in the Pacific Ocean. Intense volcanism is often found in these regions as well (such as the Mariana islands, the Aleutians, and Japan).

Atmosphere

A particularly significant factor, as far as life is concerned, is the Earth's dense atmosphere. It is comprised of 78% nitrogen, 21% oxygen, 1% argon, and traces of other gases. Water vapor is also present in the air, the amount varies 3% to 0.1% depending upon surface location and season of the year. There is a constant exchange of water between the oceans and the atmosphere via a cycle of evaporation, condensation, and precipitation. Unlike the other planets of the Solar System, Earth's atmosphere has been largely formed and shaped by biological activity. Carbon dioxide is converted into sugar by photosynthetic organisms. Oxygen is a by product of this process. Other creatures use this oxygen for respiration, releasing carbon dioxide back into the air. Apparently the Earth is the only planet in the Solar System with an oxygen-rich atmosphere.

Moons

Moon (Luna)

See *also*:

[Earth's Moon](#)

Earth's Moon (Luna)

The Moon is the only planetary body that can be distinguished with the naked eye as a sphere, and even without a telescope we can see its surface is not uniform. The Moon has been visited by numerous space probes and by six manned missions. The historic landing on July 20, 1969 of the Apollo 11 crew culminated thousands of years of human dreams and study of our closest neighbor in the Solar System.

Orbit

The Moon occupies an elliptical orbit around the Earth, averaging 384,400 km (239,000 miles) away. Its orbit takes approximately 27.3 days. Due to the gravitational influence of the Sun, the eccentricity of the lunar orbit also changes, varying from 0.04 to 0.06. The plane of the Moon's orbit is much more closely parallel to the ecliptic (5.6°) than to the Earth's equator. The Moon is tidally coupled to the Earth (the Moon always presents the same face to the Earth).

Geology

The Earth and the Moon are structurally very different. Samples returned from the Moon indicate that less differentiation of material has occurred inside the Moon. Seismic tests by instruments left behind on the Moon, indicate the Moon has a very small core 400 km (249 miles) or so in diameter. It may still be partially molten; its composition is uncertain. Surrounding the core is a 1000 km (622 miles) thick mantle, probably completely rigid to at least 600 km (373 miles) below the surface. At the surface is a crust 60 km (37 miles) or so thick. The Moon has no significant magnetic field.

The most conspicuous features on the Moon are craters. They range in size from 240 km (149 miles) across down to sizes less than a few meters. The density of the craters varies considerably over the surface. Some regions are relatively smooth and have few craters, other regions are saturated with large numbers of overlapping craters. The most densely cratered regions are known as the highlands. The highlands tend to be the brightest regions on the Moon, and contain ranges of mountains that average a couple km higher than surrounding terrain. Some lunar mountains tower nearly 5 km (16,000 feet), rivaling the highest mountain ranges on Earth.

To an observer on Earth, the Moon's surface appears partially covered by irregularly shaped, dark regions. These are known as maria, which are plains of solidified dark-colored lava. The floors of the maria are typically 2-3 km (1-2 miles) below the surrounding terrain. They are often surrounded by rings of mountains, and craters with dark colored floors are sometimes found at the edges. The maria are much less cratered than the highlands; apparently they formed after the meteoric bombardment that formed the highlands had ceased.

Atmosphere

The Moon has no significant atmosphere.

Mars

Mars is the fourth planet from the Sun. Mars looks like an inconspicuous red star, and even the best telescopes reveal little surface detail. Mariner 4 transmitted the first close-up pictures during its flyby in July 1965. Since then Mars has been visited several times by orbiters, and two landers (Viking 1 and Viking 2 - July, Sept 1976).

Orbit

The orbit of Mars is significantly elliptical, with an eccentricity of 0.09. Its orbit has a semi-major axis of 1.52 AU. The large orbital eccentricity may have long-term effects on the Martian climate. The Martian day is 24 hours 37 minutes long, the year is 686.7 days. Since the tilt of Mars' polar axis (25°) is nearly the same as Earth's, it experiences similar seasons.

Geology

The internal structure of Mars is probably quite similar to Earth. Mars has a smaller inner metal-rich core, surrounded by a rocky mantle. Mars has no significant magnetic field. Although Mars has a metallic core and spins on its axis nearly as rapidly as Earth, its core is much smaller and may have cooled enough to be partially or fully solidified.

Impact craters cover much of the surface but are far more numerous in the southern hemisphere of the planet. Nearly all of the larger craters are shallow and have flat floors. In general, Martian craters are softer in appearance than those on the Moon, perhaps from erosion by the wind and windblown dust.

In the southern hemisphere, the density of craters larger than 30 km (19 miles) across is about the same as the highlands on the Moon. However, there is an absence of small craters, suggesting they have been covered by lava flows. The southern hemisphere also has several large basin-like areas. These consist of flat lightly cratered lowlands surrounded by mountains. The three most prominent of these are named Hellas, Argyre and Isidis.

The northern hemisphere is much less cratered and the craters are well preserved, apparently much younger. The northern hemisphere is covered by a large number of extinct volcanoes, most much larger than any on Earth. The most spectacular of these is named Olympus Mons. Olympus Mons is nearly 700 km (435 miles) across and towers 23 km (75,000 feet) above the surrounding plain. In spite of the intense volcanism though, Mars seems on a whole to have been much less geologically active than Earth.

Mars also has some features that suggest, at one time Mars had running water. Runoff channels are found in the heavily cratered southern uplands. The shapes of the runoff channel networks, and the way they clearly drain from higher areas to lower areas point to past presence of liquid water. Apparently, Mars experienced rivers flowing across the upland regions at about the same time as the bombardment by meteors 4 billion years ago. It is important to note that running water requires a thicker, warmer atmosphere than Mars has at present.

Above 70° north and south latitude, the surface is strongly influenced by polar caps. The polar caps seen through a telescope are largely seasonal caps retreating and expanding during the Martian year. The southern polar cap is composed primarily of carbon dioxide frost and perhaps some water ice. Temperature measurements indicate the northern cap is primarily water ice as it is too warm for carbon dioxide ice to be stable.

Atmosphere

The atmosphere of Mars is very thin and consists primarily of carbon dioxide (95%), nitrogen (3%),

and argon (2%), and traces of other gases. The global circulation of the atmosphere is much simpler than on Earth. Seasonal change is affected mostly by the exchange of carbon dioxide between the atmosphere and the polar caps. Morning fogs can occur in low lying areas and extensive clouds are regularly seen around high volcanoes. This association of mountains and clouds is well known on Earth: as air rises over a volcano it cools and water vapor condenses to form the cloud.

Moons

Phobos, Deimos

See also:

[Planetary Moons](#)

The Planetary Moons

In the inner Solar System, moons are rare. Neither Mercury nor Venus has one; Earth's Moon is a peculiar object. Mars has two moons which are both tiny objects presumably "captured". However, moons are the norm for the giant planets of the outer Solar System. Each of these systems are virtually a miniature solar system themselves.

Earth

[Moon \(Luna\)](#)

Mars

Phobos, Deimos

Jupiter

Metis, Adrastea, Amalthea, Thebe, Io, Europa, Ganymede, Callisto, Leda, Himalia, Lysithea, Elara, Ananke, Carme, Pasiphae, Sinope (others suspected)

Saturn

Pan, Atlas, Prometheus, Pandora, Janus, Epimetheus, Mimas, Enceladus, Tethys, Telesto, Calypso, Dione, Helene, Rhea, Titan, Hyperion, Iapetus, Phoebe (one unnamed, others suspected).

Uranus

Cordelia, Ophelia, Bianca, Cressida, Desdemona, Juliet, Portia, Rosiland, Puck, Miranda, Ariel, Umbriel, Titania, Oberon

Neptune

Naiad, Thalassa, Despoina, Galetea, Larissa, Proteus, Triton, Nereid

Pluto

Charon

Jupiter

The fifth planet from the Sun, Jupiter, appears in a telescope as a slightly flattened disk, with light and dark bands running parallel to its equator. Jupiter was first visited by Pioneer 10 in December 1973. Since then it has been visited by three more probes, Pioneer 11 in 1974, and the far more sophisticated Voyager's 1 and 2 in 1979. An orbiter and atmospheric penetrator probe, Galileo, is enroute to Jupiter and due to arrive in December 1995.

Orbit

Jupiter lies in a nearly circular orbit with an eccentricity of 0.049. Its orbit averages 5.2 AU from the Sun. Jupiter is the fastest spinning of any of the planets, its day being 9.8 hours long at the equator. Different parts of the planet are spinning at slightly different rates, with polar regions turning slightly slower than the equatorial regions. It takes 11.9 years for Jupiter to orbit the Sun once.

Morphology

Jupiter's internal structure is quite different from that of the four inner planets. Jupiter is not a solid body; it is composed primarily of liquid and gaseous hydrogen and helium. Its elemental composition is similar to the Sun, but Jupiter is not massive enough to produce temperatures high enough to initiate fusion. Both temperature and pressure increase with depth into the planet and is high enough to maintain all but the outermost layers of the planet in a liquid state. The outer 30,000 km (19,000 miles) of Jupiter consists of liquid hydrogen and liquid helium. At a depth of more than 30,000 km it is believed the pressure is high enough that hydrogen may be a liquid metal. Jupiter may also have a large rock-ice core.

Jupiter has a tremendous magnetic field, that forms intense radiation belts which are fed by particles trapped from the solar wind.

Atmosphere

Jupiter's atmosphere is 81% hydrogen and 10% helium, approximately the same ratios found in the outer layers of the Sun. Slight traces of methane, ammonia, water vapor, phosphine, germane, ethane, and acetylene have also been detected.

Jupiter emits more energy than it receives from the Sun, so temperatures at a given altitude would vary little whether measured at the poles or the equator. The Pioneer and Voyager flyby probes were unable to provide much information about the chemical composition of the complex layer of thick clouds seen in the upper atmosphere. The Jovian upper-atmosphere clouds exhibit a rich pattern of colors: red, brown, blue, and white can be seen.

The Jovian atmosphere shows violent weather patterns. The best known disturbance is the Great Red Spot, which is 50,000 km (31,000 miles) across and has been observed over 300 years! Violent lightning storms have also been observed by spacecraft.

Moons

Metis, Amalthea, Thebe, Io, Europa, Ganymede, Callisto, Leda, Himalia, Lysithea, Elara, Ananke, Carme, Pasiphae, Sinope (others suspected)

See also:

[Planetary Moons](#)

Saturn

Saturn is the sixth planet from the Sun. In a telescope, except for its complex system of rings, Saturn appears overall to be similar to Jupiter: it has a slightly flattened disk. Saturn was first visited by Pioneer 11 in September 1979. Since then it has been visited by Voyager's 1 and 2 in 1980 and 1981.

Orbit

Saturn lies in a nearly circular orbit with an eccentricity of 0.054. Its orbit averages 10 AU from the Sun. Saturn spins on its axis very rapidly, its day being 10.2 hours long at the equator. It takes 29.5 years for Saturn to orbit the Sun once. The axis is inclined 27 degrees, therefore some seasonal effects of importance may be present.

Morphology

Like Jupiter, Saturn is composed of lighter elements such as hydrogen and helium. But Saturn is only 30% as massive as Jupiter. Like Jupiter, temperature and pressure increase with depth into the planet and they are high enough to maintain all but the outermost layers of the planet in a liquid state. The outer 30,000 km (19,000 miles) of Saturn consists of liquid hydrogen and liquid helium. Saturn may have a 17,000 km layer of liquid metallic hydrogen surrounding a dense metal/rock/ice central core.

Saturn has a magnetic field, but it is not nearly as strong as Jupiter. Saturn's ring system absorbs a large portion of any charged particles, so radiation intensity is much less than at Jupiter.

Atmosphere

Saturn's atmosphere is much like Jupiter's, composed primarily of hydrogen and helium. Like Jupiter, there are alternating light and dark bands parallel to the equator, but they don't have as much fine structure and contrasting color differences. It is believed that the temperature of Saturn is low enough that hydrogen and helium can separate; the helium sinks down into Saturn's interior.

The clouds of Saturn lie much deeper than Jupiter's, and there is nothing as dramatic as the Jovian Red Spot. The winds in Saturn's atmosphere are much more intense than those of Jupiter's.

Rings

Saturn's rings are composed primarily of particles of water ice. Voyager photos of the rings show a reddish tinge, indicating that iron oxide or a carbon-rich material may also be present. The ring system has three primary sets of rings, but on closer examination by Voyager, these are made up of hundreds of smaller rings. Voyager's camera was limited to a resolution of a few hundred meters. It is likely the number of individual ringlets may number in the hundreds of thousands.

Another phenomenon revealed by Voyager is a transient "spoke" effect. When backlit, the spokes appear to be dark, but when observed in forward-scattered light the spokes have a bright appearance. Because of this it is believed the particles that cause the spokes are very small, no larger than a micron. The spoke effect appears to be a coupling of static electric charges on the particles with Saturn's magnetic field.

Moons

Pan, Atlas, Prometheus, Pandora, Janus, Epimetheus, Mimas, Enceladus, Tethys, Telesto, Calypso, Dione, Helene, Rhea, Titan, Hyperion, Iapetus, Phoebe (one unnamed, others suspected).

See also:

[Planetary Moons](#)

Uranus

Uranus, being the seventh planet from the Sun, appears in the sky as an insignificant blue-green star. Because of its great distance, Earth-based measurements are extremely difficult. In January 1986 Voyager 2 passed through the Uranus system.

Orbit

Uranus occupies a slightly elliptic orbit with an eccentricity of 0.047. Because its orbit averages 19.2 AU from the Sun, it takes 84.1 years to complete one orbit. Uranus is unique by the fact it's tipped on its side; its axis inclined 98°.

Morphology

The outermost part of Uranus consists of an atmosphere of hydrogen and helium gases. The temperature and pressure of the atmosphere increase with depth. The outer gas layer merges with a denser and hotter layer of liquid hydrogen which may extend 11,000 km below the visible surface. Uranus may have a "mantle" of water beneath the hydrogen layer. There is probably a small dense core of metals and rock.

The magnetic field of Uranus is 55° off-axis with respect to the spin axis. There is a magnetic tail that twists into a long corkscrew behind the planet. This effect is probably due to the unusual orientation of the planet.

Atmosphere

The atmosphere of Uranus is primarily hydrogen and helium, appreciable amounts of methane gives Uranus its green color. Ethane, acetylene, and some heavier hydrocarbons have also been detected. There is a layer of hydrocarbon "smog" in the upper atmosphere that obscures everything below, giving Uranus a featureless appearance when viewed from space.

Rings

Uranus has a faint ring system. Which is nearly parallel with the equator of the planet. The rings consist of small particles, but no micron size particles as are observed at Saturn. The rings are very dark, indicating a carbon-rich material may be present.

Moons

Cordelia, Ophelia, Bianca, Cressida, Desdemona, Juliet, Portia, Rosilind, Puck, Miranda, Ariel, Umbriel, Titania, Oberon

See also:

[Planetary Moons](#)

Neptune

Neptune is the eighth planet from the Sun. It appears in a telescope as a small greenish disk with no markings. Because of its greater distance, Earth-based study is even more difficult than for Uranus. In August 1989 Voyager 2 passed through the Neptune system.

Orbit

Neptune lies in a nearly circular orbit averaging 30.1 AU from the Sun. The orbit makes an angle of 1.8° to the ecliptic. Neptune orbits the Sun once in 164.8 years.

Morphology

Like Uranus, Neptune probably has a small, dense core of rock and metals. The core seems to be wrapped in a layer of water and liquid methane.

The magnetic field of Neptune is highly tilted like the field at Uranus. It is tilted about 47° from the planet's spin axis.

Atmosphere

The atmosphere of Neptune is primarily hydrogen and helium. Small amounts of methane, and ethane have also been detected. The atmosphere of Neptune seems to be quite dynamic like that of Jupiter's. In the southern hemisphere of the planet a large, dark, hurricane-like storm similar to the Jovian Red Spot was observed. It was named the Great Dark Spot. Several bright cirrus clouds of frozen methane are also visible. Pushed around by Neptune's strong winds, these clouds may be pushed up from deeper in Neptune's atmosphere.

Rings

Neptune has a very faint, diffuse system of rings. The existence of partial rings had been suspected since 1984. It wasn't known until Voyager 2 visited the planet that the rings are actually complete.

Moons

Naiad, Thalassa, Despoina, Galetea, Larissa, Proteus, Triton, Nereid

See also:

[Planetary Moons](#)

Pluto

The outermost of the known planets, Pluto is nothing more than a tiny star in the best of telescopes.

Orbit

Pluto has the most eccentric orbit (0.248) which averages 39.7 AU from the Sun. The orbit of Pluto is so eccentric that it comes closer to the Sun than Neptune during part of its year. It passed the closest point in 1989. The orbit of Pluto is also unique because it's the most highly inclined to the ecliptic (17°). Pluto orbits the Sun once in 250.3 years. Pluto can actually be considered a double world; its moon, Charon, is believed to be almost 40% as large as Pluto.

Charon occupies a circular orbit almost 20,000 km from Pluto. The orbital period of Charon is 6.4 days, which is the same as the length of the day on Pluto (hence both worlds are probably tidally locked into synchronous rotation).

Geology

Little is known of Pluto's geology or makeup, since no probes have gone to this distant world. Telescopic measurements are exceedingly difficult due to the great distance. Pluto is very small, smaller than the Earth's Moon. The surfaces of Pluto and Charon are fairly bright, reflecting between 35% to 50% of the feeble sunlight that falls on them. The distribution of light and dark material is not uniform, Pluto appears to be darker at its equator than the poles. Pluto also shows evidence of having a dark spot on one side, near the equator. Spectroscopic studies indicate a surface of frozen methane. Charon, on the other hand, seems to be composed of water ice.

Atmosphere

The presence of a thin atmosphere of methane, nitrogen, and carbon dioxide has been detected. Because of Pluto's small mass, it shouldn't be able to maintain an atmosphere at all. One theory suggests the atmosphere may be temporary. Since Pluto's orbit is quite eccentric, the surface temperature may rise at perihelion (closest approach to the Sun), vaporizing some of the surface frost creating a temporary atmosphere. When Pluto moves away from the Sun, the atmosphere freezes back to the surface.

Moons

Charon

See also:

[Planetary Moons](#)

Asteroids, Comets, and other objects

Asteroids

Through a telescope, asteroids look like tiny, slowly moving stars. Asteroids are made up of rocky and metallic materials. The orbits of most asteroids are stable and roughly similar to those of the planets, most are between the orbits of Mars and Jupiter at an average distance of 2.8 AU from the Sun. Some small asteroids depart greatly from the norm, their orbits being very eccentric. A few asteroids even cross Earth's orbit.

Comets

Comets, on the other hand, often develop a head and tail that are easily visible to the unaided eye. They are made up primarily of volatile ices and dust particles. They can best be understood in terms of a dirty snowball. The nucleus is primarily composed of water ice, with traces of carbon dioxide, carbon monoxide, and ammonia ices and substantial quantities of silicates and carbonaceous dust particles. Rapid evaporation of the ice under influence of solar heating produces a head and a plasma tail, with dust carried along in a dust tail. Comets generally have highly eccentric and unstable orbits which can range from within the orbit of Earth to far beyond Jupiter.

Other objects

As of this writing, ten objects (believed to be asteroids) have been discovered in the outer solar system. These are all suspected to be members of the "Kuiper disk" (a donut-shaped zone of cometary debris outside the Solar System but within the "Oort cloud" cometary debris shell) from which many short-period (< 20 year orbit period) comets are believed to originate. The first objects discovered were 1992 QB1 and 1993 FW. 1992 QB1 is in a significantly elliptical orbit (eccentricity is about 0.1) at an average distance of 41 AU's from the Sun. 1993 FW is in a circular orbit (eccentricity of 0.04) at an average distance of 43.9 AU's from the Sun. The most recent objects discovered, 1994 ES2 and 1994 EV3, are at an average distance of 45 AU's from the Sun. Little else is known at this time.

Ordering Information

PlanetWatch Shareware has not been limited in any manner, and there are NO "trial-period" limitations or nasty "begware" requests. You may continue to use PlanetWatch "as-is" as long as you like. All I ask is if you like PlanetWatch, consider registering. Your registration tells me that writing this program hasn't been a waste of my time and expense, and that you'd like to see it developed further.

What you get...

Upon registering you will receive the latest version of PlanetWatch Pro, a user manual, good karma, and substantial discounts on future upgrades!

So what are the differences between the Shareware version and the Pro version? PlanetWatch Shareware has "just the basics". It uses a 16-color image set to make it as small as possible to save downloading time. The retail Pro version is enhanced with an expanded atlas and 256-color image set which not only includes the Sun, Moon, and the planets, but also some of the major planetary moons, and asteroids Gaspra and Ida.

Registering/Ordering PlanetWatch

I am asking \$20 U.S. for registration/purchase of PlanetWatch, this includes shipping and handling.

[Registration by Mail](#)

[Registration through CompuServe](#)

[Registration by phone "Credit Card Orders"](#)

See also:

[Product Support \(getting technical help\)](#)

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By mail:

Raben Software & Graphics
3915 B Street
Greeley, CO 80634 USA



CompuServe e-mail: 73717,510

Product Support

Formal technical support doesn't exist, but I will try to help resolve any difficulties you experience in running PlanetWatch. Every effort has been made to be sure the program is as bug-free as possible, however I can't anticipate everything. If you experience difficulties running PlanetWatch, please write or send e-mail; it is the only way that I can become aware of problems!

In order to try to fix any problem, I'll need as much information about your computer configuration as possible. If PlanetWatch runs well enough to get to its menus, select 'Help' and then select 'Diagnose'. Write down all the diagnostic info displayed. It will be useful to me!

By mail

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PlanetWatch Credits

This release of PlanetWatch is the result of your suggestions, many sleepless hours, and considerable effort. It includes a number of major enhancements to the original and some re-thinking of the direction of any future versions of PlanetWatch.

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Photograph Credits:

Photographs used in PlanetWatch came from / were contributed by various public resources. We all owe our thanks for these photographs to the various organizations and people who made them possible. JPL, NASA, NRL, ESA, ESO. Click the topic below for more specific information.

[Photo Credits](#)

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PlanetWatch was developed using Microsoft Visual Basic 2.0 Professional for Windows.

The PlanetWatch planetary and lunar ephemeris algorithms are based upon methods presented in "Practical Astronomy With Your Calculator" by Peter Duffet-Smith ISBN 0-521-28411-2.

The PlanetWatch Help and Atlas were developed using Visual Help 2.1. For information on Visual Help, contact WinWare, PO Box 2923, Mission Viejo, CA. 92690.

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Other Programs

PlanetWatch covers but a small corner in the universe. You might find PlanetWatch an excellent companion to a broader "desktop planetarium" program. A number of excellent commercial, shareware, and freeware programs exist in both DOS and Windows versions. Most I haven't seen so I can't really tell you very much.

SkyView

I will tell you about a great FREE program called SkyView written by Stephen Michael Schimpf. Stephen was one of my beta testers and also is a friend of mine (even after shredding PlanetWatch to bits). But more important to you is that SkyView makes a great companion program to PlanetWatch! SkyView does a number of things beyond what is needed for PlanetWatch. SkyView accurately shows you everything you could see with the naked eye from any location on Earth, in the past, present, or distant future. Another neat thing you can do is point at a star and an informational window pops up with the star's name, magnitude, spectral type, proper motions, and more!

SkyView 3.00 is available at a number of ftp sites, bbs's, and on CompuServe. If you are interested in taking a look at it and are having trouble finding it, please contact Stephen at one of the following addresses:



Internet: stephen@eggneb.astro.ucla.edu



CompuServe (to his Internet address): >INTERNET:stephen@eggneb.astro.ucla.edu

Apollo 11

U.S. Launched 16th July, 1969. First manned landing on Moon 20th July, 1969, landed in Mare Tranquillatis (Sea of Tranquillity). Safely returned to Earth 24th July, 1969.

AU

Astronomical Unit - the distance value of 1 AU is defined as the average Earth - Sun distance (149 million km or 93 million miles).

Callisto

Callisto has a very old, cratered crust, which shows large impact basins identifiable by their light color and surrounding concentric rings.

carbonaceous

Made up of mostly carbon, a non-metallic organic compound.

crater

A circular depression in the surface of a planet or moon, generally of impact origin.

Diana Chasma

Located at 5°S, 158° on Venus.

eccentric
Non-circular

eccentricity

The degree to which an orbit is non-circular.

ecliptic

The apparent annual path of the Sun in the sky; the plane defined by the Earth's orbit around the Sun, relative to the stars.

Europa

This Jovian moon displays a large number of intersecting linear features. Europa is thought to have a thin crust of water ice floating on a 50km (30 mile) deep ocean.

Galileo

US Launched 18th of October, 1989. Enroute as of this writing to Jupiter. Flybys of Venus, Earth, asteroid Gaspra, and asteroid Ida have been completed.

Ganymede

This is the largest moon in the Solar System. It shows two distinct types of terrain; cratered and grooved. This suggests tectonic (crustal movement) activity in Ganymede's icy crust.

heliocentric

Position with respect to the sun as the center. The inner and outer solar system maps in PlanetWatch are shown as would be viewed from space above the Sun's north pole.

highlands

On the Moon; the older heavily cratered areas.

Io

Considerable volcanism was discovered on Io. Plumes from Io's volcanoes extend more than 300 km (190 miles) above the surface. The volcanism on Io affects the entire Jovian system, and matter from Io is found throughout Jupiter's magnetosphere.

light years

A light year is defined as the distance light can travel in one year and is equal to 9.46×10^{12} kilometers (9.46 trillion km or 5.8×10^{12} miles).

Mariner 10

US Launched 3rd November 1993, first flyby of Mercury.

Maxwell Montes

Located at 66°N, 5° on Venus.

Olympus Mons

Located at 20°N, 130° on Mars.

Pioneer 10

US Launched 2nd March 1972, first Jupiter flyby.

Pioneer 11

US Launched 5th April 1973, second Jupiter flyby, first Saturn flyby.

R.A.

Abbreviation for "Right Ascension".

silicates

Made up of any of a large range of rocks composed in part of silica (silicon and oxygen), a hard glassy mineral.

tectonic

A process where heat from the interior of a planet or moon causes currents in the mantle which in turn exerts forces on the crust.

Titan

Titan is the only moon in the Solar System with a major atmosphere. Because of the dense haze in the nitrogen atmosphere, no features can be seen.

Triton

Triton shows evidence of a remarkable geologic history. In some areas, volcanoes spew nitrogen gas and dust particles several km high into the very thin atmosphere. Other areas have rough terrain, and yet others have bright frozen lakes.

Veneras 9 and 10

USSR Launched on the 8th (Venera 9) and 14th (Venera 10) of June 1975.

Viking 1 and Viking 2

US Launched 20th August (Viking 1) and 9th September (Viking 2) 1975. First and second landings on Mars.

Voyager 2

US Launched 20th August 1977, flybys of Jupiter, Saturn. First flybys of Uranus, and Neptune.

Voyager's 1 and 2

US Launched Sept 5th 1977 (Voyager 1) and 20th August (Voyager 2) 1977. Voyager 1 - flybys of Jupiter and Saturn. Voyager 2 - flybys of Jupiter, Saturn, Uranus, and Neptune.

