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Starry Night
Backyard

User's Guide

FOR MACINTOSH AND WINDOWS

WRITTEN BY

MIKE PARKES & MARK DYKSTRA

Cover Photo composite © Terence Dickinson
Terence Dickinson is the author of the stargazing
guidebook NightWatch and the editor of the Canadian
astronomy magazine SkyNews.

Printed in Canada.

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Chapter 1
Getting Started

Welcome

Welcome to Starry Night Backyard, the perfect tool for discovering the wonders of astronomy for the first time, or enhancing your observing pleasure and knowledge if you are already a convert to this wonderful pastime. With this book as your guide, you have at your fingertips the power to manipulate your view of the sky in almost any way you can imagine, and instant access to large amounts of data previously available only to the professional astronomer.

You can see how the sky will look tonight, tomorrow, or far into the past or future. You can view the stars as they appear from your own backyard, from a country on the other side of the world, or from another planet. You can witness a total eclipse from the Moon, watch the Sun set from the surface of Mars, or even ride a comet. You are limited only by your curiosity.

Thank you for purchasing Starry Night Backyard. Enjoy the program!

Before You Start

This manual assumes that you possess basic computer skills such as clicking, dragging, and selecting with a mouse, the use of the File menu for opening and closing documents, and familiarity with the Cut, Copy, and Paste

commands. You should also know how to move windows, use scroll bars, and resize windows. If you do not feel comfortable with these commands, please refer to the documentation that came with your computer.

Tip: When discussing Starry Night Backyard functions which use the mouse, this text refers to the 2-button mouse found on a PC. Macintosh users should mentally substitute "click" for "left-click" and "click and hold" for "right-click" wherever it appears in the text.

Installing Starry Night Backyard

After starting up your computer, follow the installation instructions below.

Note: Before you begin the installation, refer to the ReadMe file on the Starry Night Backyard CD for the latest installation information, including system requirements.

Windows 95/98/NT: On Windows, you must install both QuickTime and Starry Night Backyard (if you already have version 3 or later of QuickTime on your computer, you do not have to install QuickTime again). This requires running two separate installation programs.

1 To begin, insert the compact disk into the CD-ROM drive.

2 To install QuickTime, choose Start | Run and click Browse.

3 Navigate down to the CD-ROM drive, select the QuickTime installation file named QuickTimeInstaller.exe, and

click OK.

4 Follow the instructions that appear on the screen.

5 To install Starry Night Backyard, repeat steps 2 - 4, except this time select the Starry Night installation file, Setup.exe.

Macintosh: To install Starry Night Backyard for the Macintosh, follow these steps.

1 Insert the compact disk into the CD-ROM drive.

2 Open the "Read Me First" file for instructions and late-breaking product and compatibility information.

3 Drag the Starry Night Backyard folder from the CD to your hard disk.

Starting Starry Night Backyard

Once you have installed Starry Night Backyard, you can start it by double-clicking on the Starry Night Backyard icon, which is on the desktop (Windows) or in the Starry Night Backyard folder (Macintosh).

Setting Your Home Location

The first time Starry Night Backyard opens, the Set Home Location window asks you to set your home location. Once you have done this, you do not need to change your home location unless you move.
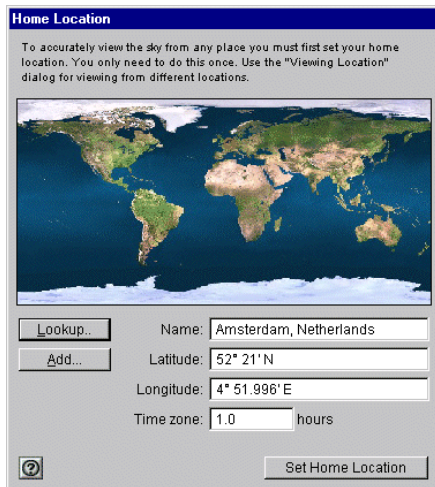
1 Click Lookup.
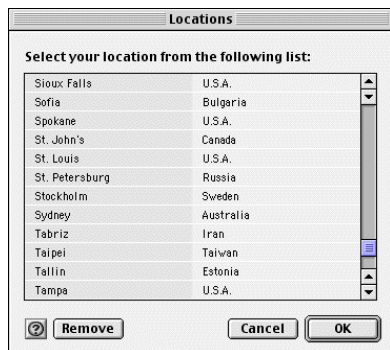
2 Select your location from the list of world locations.

3 If your location is not listed, click Add. Enter your latitude and longitude. You must also enter the correct time zone. Time zones are calculated according to the time difference with London, England. For example, all communities on Eastern Standard Time are 5 hours behind London, so you would enter -5 h if you are on Eastern Standard Time.

4 Click Set Home Location.

Tip: If you ever move and need to change your location, click on the Go menu and select Set Home Location.

Registering

After you have entered your home location, the program will ask you to enter your name and registration number. This unique number is printed on a special registration form at the back of this manual. If you have Internet access, please click the "Register Online" button to register with Sienna Software. Otherwise, you can complete and return the registration form to us.
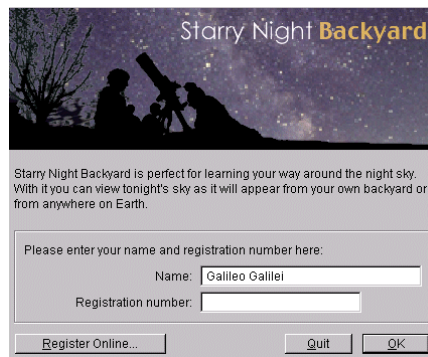
Registering makes it possible for us to notify you of any upgrades, bug fixes, or plug-ins as they become available. You are also eligible for reduced upgrade prices to other astronomy programs written by Sienna Software. You can update your

registration information at
www.siennasoft.com/register

Starry Night For the First Time

After you have entered your registration
information, the main screen of Starry
Night Backyard appears. This window
shows what you would see if you stepped
outside at the current time, and looked
south from your home location. Direction
arrows along the horizon help you orient
yourself. If you open the program at night,
you see a star-filled night sky. If you open
the program during the day, you see a
daytime scene with blue sky and sunshine.
A horizon and trees are shown to give you
some perspective. If it is daytime, shadows
from the trees indicate the position of the
Sun. Your viewing location and the time
are shown across the top of the window in
the Control Panel. All of the buttons and
dropboxes in the Control Panel are
described in "Control Panel" on page 17

*Note: If your computer's clock is
incorrect, Starry Night Backyard may
show night when it is day outside, or vice
versa. The next section explains how to set
the time.*

Setting the Time

Starry Night Backyard uses your
computer's clock to determine the current
time. The current date and time, along
with your viewing location, are shown
across the top of the main Starry Night
Backyard window. If the time or date is
incorrect, make the appropriate
adjustments to your computer. On
Windows, click on the "Start" button on

the Desktop and then select Settings |
Control Panel, and double-click on "Date/
Time" in the list which appears. On the
Macintosh, click on the Apple menu, then
select Control Panels | Date & Time. Make
sure that you have the Daylight Savings
Time setting which is appropriate for your
home location.

*Tip: If you are using the UK version of
Windows, Starry Night Backyard will not
automatically show the date in the
European format (dd-mm-yyyy). To
change this, open your computer's control
panel and double-click on "Regional
Settings". From the "Date" menu, change
the setting for "Short Date Style" to
something other than its current value and
click "OK". Now double-click on
"Regional Settings" again and change the
"Short Date Style" to the proper format.
The next time you run Starry Night
Backyard, it will display the date in your
chosen format.*

Getting Help

In Windows, tool tips give brief
descriptions of toolbar icons and floating
palettes. Tool tips appear when you hold
the mouse pointer over the icon.

On both Windows and the Macintosh,
dialog windows display a Help icon. Click
the icon to open your Web browser and
link to the corresponding page of the latest
version of the online manual.

The Help menu also has a link to the full
online manual. Just select Help | On-Line
Starry Night Backyard Manual to connect.
The on-line manual may have more

detailed information than the print manual on some topics, or additional exercises.

Updates

To make sure you have the latest version of Starry Night Backyard, you can select one of two options from the Help menu. Help | Auto Update from the Internet will ask you if you want to download the latest version of Starry 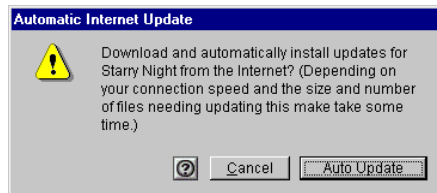Night Backyard and then begin downloading the file from our website. If you have the latest version, the program will tell you this and will not attempt to download any files.

Selecting Help | Check for Starry Night Backyard Updates will take you to a page on our website which describes the latest version. It will display the size of the file you need to download, and may have additional information mentioning the new features or bug fixes in this release. If you have a slow Internet connection, it is a good idea to select this option to find out if it is worth taking the time to download the latest update.

Technical Support

If you have technical questions which are not answered in the print or online versions of the manual, please check our

Starry Night Backyard technical support webpage: www.siennasoft.com/english/support_backyard.shtml If you still have questions, e-mail us at support@siennasoft.com.

Sienna Website

More information about Starry Night Backyard and other astronomy products made by Sienna Software is available at our website, www.siennasoft.com You can get there directly from inside Starry Night Backyard by selecting Help | Starry Night Backyard Website.

Starry Night Pro

If you enjoy Starry Night Backyard and become more interested in astronomy, you will want to purchase Starry Night Pro, our top-of the line program for dedicated hobbyists and professionals. Find out more about Starry Night Pro at www.siennasoft.com/english/pro.shtml
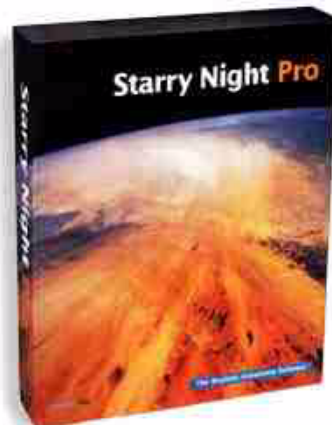
Chapter 2
The Hand Tool

The Hand Tool

The feature you will probably use most often in Starry Night Backyard is the hand tool. When Starry Night Backyard is open, a small picture of a hand shows you where your mouse cursor is located. If you move the mouse, the hand moves as well. You can perform 3 separate tasks with the hand tool:

1 **Change the direction in which you are looking.** If you hold down the left mouse button and move the mouse, your view shifts in the same direction that you moved the mouse. When you hold the mouse button down, you will see the hand close, as if it is "grabbing" part of the sky and moving it. If you are located on Earth or another planet, you are limited in how much you can adjust your view. You are able to look only as far up as the zenith (the point directly above your head), and only as far down as the horizon. As in real life, to look beyond these points you must first turn around by shifting your view sideways, and then look up or down.

Tip: You can configure Starry Night Backyard to display scroll bars along the edges of the window by selecting Window | Scroll Bars. You can then use thse scroll bars in place of the hand tool to look around.

2 **Identify and select objects in the sky.** If you let the hand hover over an object for a few seconds, information about it will automatically appear. Displayed are the object's name, the constellation it is currently in, and its distance (if known) from Earth. You can choose which information you want displayed. See "Cursor Tracking (HUD)" on page 57 for more details. To find out more about an object, point at it with the mouse, and click the left mouse button. This "selects" the object, and its name will appear in a different font, along with an arrow pointing to the object. This name remains even after you move the cursor away from the object.When an object is selected, you can display an Information Window for it by selecting Edit | Get Info from the main menu or search the LiveSky astronomy database on the Internet for more information on the object by selecting Edit | LiveSky.com Info. See "Info Window" on page 30 to learn about the Information Window, and "LiveSky.com" on page 34 for information on LiveSky.

3 **Find the separation between two objects.** If you point at an object and click and hold the left mouse button and then move the mouse, a line appears which connects this object to the current location of your cursor. The angular separation between the two points is displayed, along with the direction of the line and the actual distance between the two points (if known). The angular separation between objects is measured in degrees and measures how far apart in the sky two celestial bodies appear. The entire

sky is divided into 360 degrees, so an object which is directly in front of you and an object directly behind you in the sky have an angular separation of 180 degrees. A good rule of thumb is that your closed fist held at arm's length has an angular width of about 10 degrees.Note that the angular separation of two objects has no connection to how far apart these objects really are: two bodies which appear side by side in the sky may be hundreds of light years apart!

Tip: If you have the mouse pointed directly at an object, the picture of a hand will change to an arrow. The angular separation tool and information window will only work if the arrow is displayed.

Chapter 3
Control Panel

Much of the functionality of Starry Night Backyard is built into the control panel, which runs across the top of the main window. The controls can be subdivided into 3 categories: those that control time, those that control your viewing location, and those that control your field of view.

Manipulating Time

The time of observation is significant in determining what you can see in the night sky. If you compare the view at the beginning of the evening to the one at midnight, you will see that the stars have shifted their position. This is the effect of the Earth rotating on its axis. The movement of the stars is the most obvious effect of the passage of time, but there are many more subtle and interesting effects that can only be seen over longer periods of time.

The ability to control time offers you great power and potential for learning. Events in astronomy occur over a wide range of time scales. The total darkness of a solar eclipse lasts but a few brief minutes, while the appearance of the constellations changes only slightly over many thousands of years.

Changing the Date and Time: Starry Night Backyard shows the date and time at which you are viewing the sky in the Control Panel.

```
☼ 2:30:44 PM 10/ 7/1999 AD
```

By default, all new windows are opened with the current date and time, as determined from your computer's operating system. To change the date or time, just click on the part of the date or time which you want to change. It will light up, and you can either type in a new value or use the arrow keys to change the value up or down. Starry Night Backyard allows you to set the date from anywhere between 4713 BC and 10000 AD.

Tip: A picture of the Sun appears beside the time in the Control Panel. If Daylight Savings Time is turned on, this picture is lit up. Click on this picture to turn on or off Daylight Saving Time.

Note: To record the time of astronomical events, astronomers often use the "Julian day". The Julian day is simply the number of days since January 1, 4713 BC. For example, January 1, 2000 is Julian day number 2 451 545.

To return to the present time, just click the button labelled "Now"

Note: If your current viewing location is in a different time zone than your home location, Starry Night Backyard automatically adjusts the time to your new location's local time. If your current location is in space or on another planet,

the time is set to Universal Time, the astronomical "time zone". Universal Time is equal to the time in Greenwich, England, without the effects of Daylight Savings Time.

Time Flow

Your view of the sky in Starry Night Backyard updates as time passes. In realtime, the view is updated every 5 seconds. You can adjust the rate at which the view is updated by choosing File | Preferences | Time.

One of the nice things about Starry Night Backyard is that you can change the rate at which time flows. Just like nature programs use time-lapse photography to show processes which take place too slow to see in realtime, you can speed up or slow down time to get the best possible views of an astronomical event. To do this, use the VCR-like controls in the Control Panel.

⏮ **Single Step Backward:** Moves the time backwards by one step, as set in the Time Step field (described below).

◀ **Backward:** Runs time backwards continuously. Each time the screen is updated, time has moved back one step.

■ **Stop:** Freezes time at the current point.

⏩ **Realtime :** Synchronizes the current window with the real flow of time.

▶ **Forward:** Runs time forward continuously. Each time the screen is updated, time has moved forward one step.

⏭ **Single Step Forward:** Moves the time forward by one step.

Time Step: This box adjusts the time step, which determines how fast time moves when not in realtime mode. The default setting is three minues. You can increase or decrease the time step by entering a new number and clicking on the arrow to the right of the time unit to select a new unit (if necessary). A few of the units displayed may be unfamiliar to you:

Sidereal day: This is the time it takes for the Earth to rotate once on its axis. It is four minutes shorter than the day we are familiar with, which is called the solar day. The days are not exactly the same length due to the revolution of the Earth around the Sun.

Lunar month: This is the time interval between two full moons, as seen on Earth. It is about 29 1/2 days.

Tip: If you are running the time using the Forward or Backward controls, the speed at which time flows will depend on the speed of your computer. If you upgrade to a faster machine, you may need to adjust your time step to a smaller value to make the sky change at the same rate as on your old computer.

Changing Your Viewing Location

For every different location on earth, the night sky reveals a unique face. Australians never lay eyes on the North Star, while stargazers in the northern latitudes find the nearby galaxies known as the Magellanic Clouds forever hidden from view. Our place on Earth determines when the sun rises and sets, where and when the planets sweep across the sky, and what constellations we can see. Or at least it used to. With Starry Night Backyard, you can travel around the Earth, the solar system, and even out to the stars!
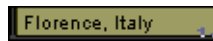
The Control Panel displays your current viewing location. To change this location, click on your current location in the Control Panel. This opens the Viewing Location window, which looks the same as the window where you entered your home location. Again, you can select a new city from the locations or enter a new latitude and longitude. Press Set Location when you are done.

If you don't know the exact co-ordinates, but just want to view from an approximate location somewhere on earth, click anywhere on the world map. A small red circle appears at your new choice. Press Set Location and you are viewing from your new location.

Adding Locations: Click Add in the Viewing Location window to save your current viewing location in Starry Night Backyard's permanent list.

Elevation: To view from above the named location, enter a value into the elevation field. For example, to view the Earth from 5000 km above Toronto, enter 5000 km in the elevation field.

Note: Elevation is the distance above the earth's surface, not the distance above sea level. So if you want to view from the ground in Denver or another city at high altitude, don't change this value from its default value of 3 metres.

Viewing From Other Planets: You can also view from the surface of another planet, the moon of another planet, or even from the Sun.

To change your viewing location:

1 Click on your current location in the Control Panel.

2 The Viewing Location window opens. The body you are currently on is shown near the top of the Viewing Location window beside the words "View From". Click the arrow to the right of this. A list of planets and their moons appear. Click on the body you wish to go to.

3 A surface map of the new moon or planet replaces the map of Earth. Initially you are placed at the same latitude and longitude on the new planet which you were at on Earth. You can change this latitude and longitude in exactly the same way as you did for locations on Earth.

4 Click Set Location when you are finished.

Tip: Each planet has a list from which you can lookup locations, just like Earth. Initially these lists are blank, but you can add your own landmark sites, such as the Apollo landing site, Mount Olympus on Mars, and others!

Viewing From the Stars: You can also view the sky from nearby stars with Starry Night Backyard, but you can't do this from the Viewing Location window. See "Object Menu" on page 27 for information on how to do this.

Returning to your Home Location: Click on the Home button in the Control Panel to return to your home location at any time.

Go Menu

Selecting the Go menu along the top of Starry Night Backyard offers another way to change your viewing location, and has many interesting locations already set up for you. The options in the Go menu are described below. The choices shown on your version of Starry Night Backyard may be slightly different, as Sienna Software may update this menu to add interesting locations.
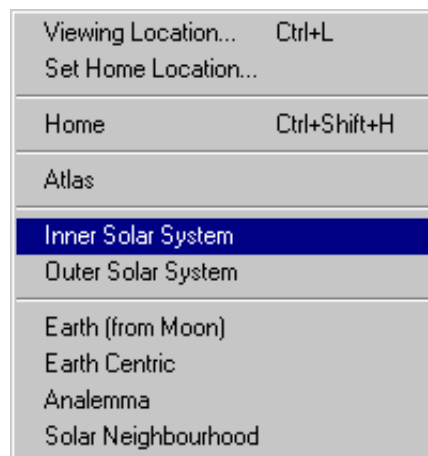
Viewing Location: This brings up the Viewing Location window.

Set Home Location: This also brings up the Vewing Location window, but the location you enter here will be saved as your home location, and will be your default viewing location every time you open Starry Night Backyard.

Home: This returns you to your home location.

Atlas: This setting shows the celestial sphere, the imaginary sphere which surrounds the Earth. You can imagine that the stars are "painted" on the inside of this sphere. Your viewing location is the same as it was before you chose Atlas mode, but the horizon is turned off, so you can see the entire celestial sphere. The celestial grid is shown to help you orient yourself. See "Celestial Grid:" on page 52 for more information.

Inner Solar System: This places you just outside the orbit of Mars. The orbital path of each planet is shown.

Outer Solar System: This places you at the edge of our solar system, looking back towards the Sun.

Tip: If you go to the inner solar system or outer solar system using the Go menu, the time step is changed to the appropriate time scale for watching the planets revolve. If you then hit the Play button in the Control Panel, you can watch them move around the Sun.

Earth (from Moon): This places you on the Moon's surface, looking back at Earth, The Moon's position relative to the Earth and Sun determine whether you see the Earth in light, in shadow, or somewhere in between.

Earthcentric: Before Copernicus advanced the theory that the Sun is at the center of the solar system in 1530, it was a universal belief that the planets revolved around the Earth. This view shows you how the orbits of the inner planets would have to look to match the observational evidence, if the

Earth were really at the centre of the solar system.

Satellites: This shows the three different satellite layers. The outermost layer is made up of geosynchronous satellites. The middle layer is composed of GPS (Global Positioning System) satellites. The satellites which are closest to Earth are Low Earth Orbit satellites. Because they are so close to Earth, Low Earth Orbit satellites can take the most detailed pictures. Most Low Earth Orbit satellites have a polar orbit. The rotation of the Earth allows satellites in a polar orbit to eventually fly over every location on Earth.

Analemma: This traces the Sun's position in the sky at 12:00 noon every day (ignoring adjustments for Daylight Savings Time). Over the course of a year, the Sun traces out a figure 8 path known as the analemma. This is caused by the axial tilt of the Earth and its revolution around the Sun and the slightly elliptical nature of the Earth's orbit.

Solar Neighbourhood: This puts you 200 light years above the Earth, and allows you to see the 3-dimensional grouping of the nearby stars. You still rotate along with the Earth in this view, allowing you to see the sky in every direction.

Elevation

You can change your elevation above a planet's surface in Starry Night Backyard with the elevation buttons. These buttons have icons which resemble rocket ships. The icon which shows a rocket ship blasting off increases your
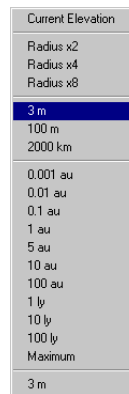
elevation, while the one which shows a rocket landing decreases your elevation. Your current elevation is shown to the right of these two buttons. The standard setting is 3 metres.

Use the hand tool to shift your gaze down and then use the elevation button to rise off the Earth. You will see the trees drop away beneath you and the planet's outline will begin to appear as you get high enough above the planet's surface.

Note that you are still at your original location but at some distance over it, as if attached by a long, invisible pole. As the Earth rotates, you also rotate in space. You can tell you are rotating due to the apparent motion of the sky and stars. To return to and "land" at your original location, press the 🖉 Elevation Down button.

You can use the Elevation tools while located on any object (the Sun, planets, moons, or comets), thereby achieving some extraordinary views of the solar system.

If you click on the arrow beside the current elevation, a list of other possible elevations appears. Selecting any of these options places you at the new elevation.

Current Elevation
Radius x2
Radius x4
Radius x8
3 m
100 m
2000 km
0.001 au
0.01 au
0.1 au
1 au
5 au
10 au
100 au
1 ly
10 ly
100 ly
Maximum
3 m

While clicking on an elevation from this list places you immediately at the new elevation, using the elevation buttons mimics the effect of taking off or landing a spaceship. Some of the abbreviations in the list may be unfamiliar to you:

AU: This stands for Astronomical Unit, which is the average distance from the Earth to the Sun. 1 AU is about 150 000 000 km. Astronomical units are commonly used to describe distances to objects within our solar system.

LY: This stands for light year, which represents the distance which light travels in one year. The speed of light is about 300 000 km per second, so 1 light year is about 9 460 800 000 000 kilometres! While this seems like an enormous value, the closest stars are about 4 light years away, and galaxies can be millions or even billions of light years away. To describe the distance to any object outside the solar system, the light year is the most convenient choice.
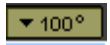
Field of View

Starry Night Backyard opens with a 100° field of view. This means you are viewing a 100° slice of the 360° panorama of the sky. We call this the normal field of view, since it approximates a view of the sky that you see with your own eyes, including some peripheral vision. If you look through binoculars, the area you see is a much smaller piece of the sky, which means

binoculars have a correspondingly smaller field of view. Telescopes have an even smaller field of view than binoculars.

The easiest way to change your field of view is to use the Zoom buttons on the Control Panel. The left button zooms out to a larger field of view, while the right button zooms in to a smaller field of view, thereby magnifying the image you see on screen. As you zoom in, Starry Night Backyard automatically shows dimmer stars. The button to the right of the Zoom button always returns you to the default field of view of 100 degrees.

Your current field of view is always displayed to the right of the zoom buttons.

Note: When you zoom in to a small enough field of view, the field of view will no longer be shown in degrees, but in arcminutes ('), and, if you keep zooming in further, in arcseconds ("). An arcminute is 1/60 of a degree, and an arcsecond is 1/60 of an arcminute.The smallest field of view which Starry Night Backyard can display is 2.5 arcseconds.

It is important to remember that when you zoom in on objects, you are not in fact changing your location. Think of zooming as looking through a more and more powerful telescope, while your feet remain firmly planted. Unless you've locked onto an object, Starry Night Backyard displays the effects of the Earth's rotation, so at a high magnification, stars and planets quickly rotate out of view. For information on locking onto an object, refer to "Locking On an Object" on page 35.
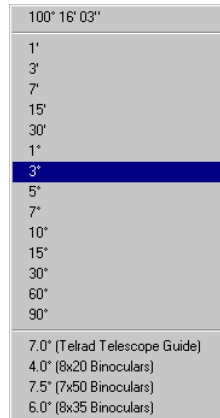
Field of View Menu: Another way to change your zoom setting is to use the popup menu that appears if you click on the arrow which appears to the left of the Current Field of View. Select from any of the preset fields of view.

Chapter 4
Astronomical Data

Once you are familiar with how the controls on Starry Night Backyard work, your next goal will likely be to locate astronomical objects in the sky and get more information about them.Starry Night Backyard has methods for doing this, as well as several commands which give you more information about the sky in general.

Note: Some of the features in this section make use of Sienna's astronomy website, www.livesky.com If you are not connected to the Internet when you try to access these features, Starry Night Backyard will try to connect you. If you do not have Internet access, you will not be able to make use of these features.

What's Up Tonight?

If you select Sky | What's Up Tonight, you will be connected to a page on the LiveSky website which is updated daily and has lots of topical information on what interesting events can be observed on the current night. Included are daily writeups from Astronomy magazine and Sky & Telescope magazine, as well as an astronomy picture of the day and much more. For more on LiveSky, see "LiveSky.com" on page 34.

Interesting Events

One of the things you will probably want to do with Starry Night Backyard is watch astronomical events from the past. If you select Sky | Interesting Events, a list of astronomical events from the past and future is shown. Most of the events are solar and lunar eclipses, but there are also a few planetary conjunctions and transits.
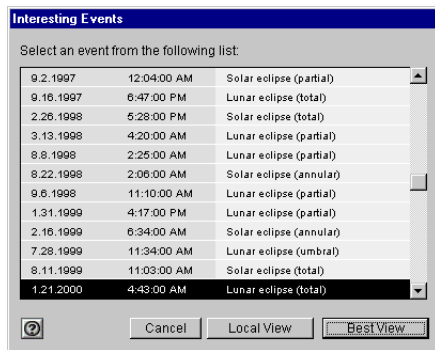
For most events, you have two choices. Selecting Local View leaves you at your current location but places you at the event time looking in the proper direction. If the event is not visible at all from your location at ths time, this option is greyed out.

Selecting Best View places you at the best time and place to watch the event. For example, selecting Best View for a solar eclipse places you on the surface of the Moon.

Tip: If an eclipse is not visible from your location, select Best View to view from the Moon. Zoom in to see which areas of Earth are seeing a partial eclipse (anywhere inside the large shadow) and

which areas are seeing a total eclipse (anywhere inside the tiny circle in the middle of the shadowed area). Then set yourself at a location in one of these areas and reset the time to watch the eclipse from Earth.

Finding Objects in the Sky

Starry Night Backyard provides you with a number of ways to quickly locate celestial objects.

Find: Choose Edit | Find.
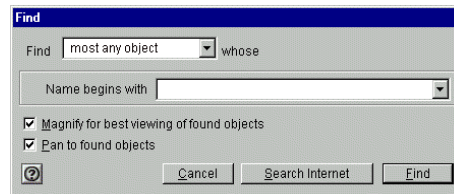
If you're performing a general search, select Most Any Object. You can narrow down your search results by specifying the type of object you're looking for, such as Star. Type in the name or first few letters or numbers of the object and click Find. Starry Night Backyard immediately centers the first match it finds.

Select Pan to Found Object if you want Starry Night Backyard to pan to your selection. This feature is handy if you want to see where the new object is relative to your current view.

Tip: If you hit the space bar during a pan, the program immediately takes you directly to the object. If something catches your eye and you want to stop the pan, press Esc.

To zoom in on the object for which you are searching, make sure the box Magnify For Best Viewing Of Found Objects is checked.

Find Again: You can search for additional matches to your Find inquiry without re-opening the Find dialog. Choose Edit | Find Again. This will automatically find the next object which matches the name criteria you entered the last time that you used the Find feature.

Example: The Messier Marathon Tour

1 Choose Selection | Find.

2 Select Find: Messier.

3 Enter "M" and press Find. The first object you will find is M1.

4 Choose Selection | Find Again. Starry Night Backyard takes you to the next Messier object, M2.

5 Repeat as often as desired to view all of Messier objects in succession.

Printing Star Charts

After you have located a target object, and used the magnifying glass in the Control Panel to select a good field of view, you may wish to print out a star chart for observing purposes (you may also want to add a Field of View Indicator for your binoculars on the screen.See "Field of View Indicators" on page 53 to learn how to do this.

Starry Night Backyard has a special set of Print settings which make printing informative, legible charts a snap. Just select File | Print. You will get a full-page chart view of the area on the screen, with lots of helpful information, such as the time and place you are viewing from, an outline of the celestial grid, and much more.

Tip: If you are interested in viewing a dim object, and it is not labelled on the printed chart you make, select it on the screen by clicking the mouse button on it. Its name should then appear on screen with an arrow pointing to the object. If you print a new chart, it will now have your object labelled.

Object Menu
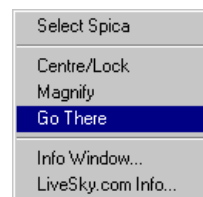
You already know that hovering over an object in Starry Night Backyard causes the screen to display some basic information about an object. To get more information, click the right mouse button (click and hold on the Macintosh) while the cursor is pointing at the object. When you do this, a menu will appear. All of the items in the menu relate to the object which the cursor was pointing at. If you were not pointing at a specific object, the menu gives you options related to the appearance of the sky as a whole and the constellation which you are pointing at.

The various choices are described below.

Select/Deselect: This selects or deselects the object. If an object is selected, its name and an arrow pointing to the object will appear on screen.

Centre/Lock: This changes your view so that the object is at the center of the screen and remains in the center of the screen as time passes. This is handy if you want to watch a planet's motion against the background stars, for example.

Note: If you are locked on an object and it falls beneath your horizon, your view of it will be obscured by the horizon.

Magnify: This zooms in on the object so that you get the best possible view. Stars other than our Sun are just shown as points of light, but most planets have detailed images.

Go There: This changes your location to the surface of the object in question (if the object is a star, you will be placed nearby). First your orientation will change, then you will begin to lift off your current planet and move in the direction of the celestial body you have chosen. Your current distance from the original body will appear in the right-hand corner of the screen as you fly to the new location. This is the only way to view the sky from another star.

Labels: This option (displayed only for bodies in the solar system) allows you to change the way the object and others of the same kind are labelled.

Show Orbit: Also only available for objects in the solar system, this option draws the orbit of the body.

Info Window: This opens a new window with much more information on the object. All the fields in the info window are explained in "Info Window" on page 30.

LiveSky.Com Info: LiveSky is an astronomy directiory and search engine on the Internet. Selecting this option searches LiveSky for all pages related to the object in question.

Custom Bookmarks

If you have your web browser open when running Starry Night Backyard, the context menu which comes up when you right-click on an object will have another option which says Add Bookmark to "..." where the part in quotations is the title of the web page which your browser is looking at. You can add your own Web page and e-mail bookmarks to any object in Starry Night Backyard. On the Macintosh you can also add local files such as pictures and text notes.

Example: Add your own Web page bookmark to the Moon.

In this example, you will add a bookmark from the moon to the website Moon-watch.com:

1 Open your web browser to the page www.moon-watch.com/

2 Switch back to Starry Night Backyard and right-click to bring up the context menu for the Moon.

3 Choose the option Add Bookmark to "Moon-Watch.com".

Once you have created a bookmark for an object, you will notice that its context menu is different the next time you right-click on the object. Two new items appear in the menu. One is the name of the bookmark, and one is an option called Edit Bookmarks.

Selecting the bookmark name links your web browser to the bookmarked site, if it is not there already. Selecting Edit Bookmarks brings up a window which lists the bookmarks for the object. Clicking on a bookmark then allows you to edit the name or URL of the bookmark, or delete it from the list of bookmarks.
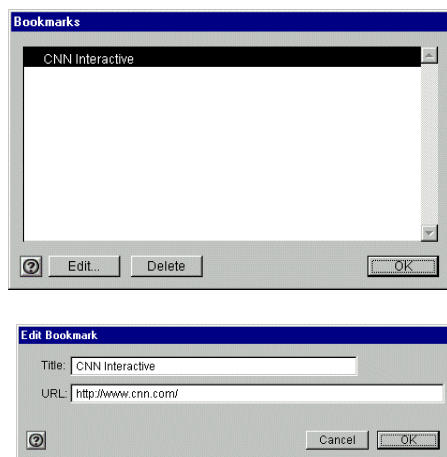
Cool effect: *You can use LiveSky as a way of bookmarking any of your favorite Internet sites. For example you could bookmark the Sun with a weather information Web page.*

On a Macintosh you can drag and drop text from any text editor to Starry Night Backyard. For example, select an email address and drag it into the Starry Night Backyard window. You will notice constellations and stars "lighting up" as you drag the address towards the object you want to bookmark. When you get there, the object itself will light up. Let go of the mouse button to add the e-mail address.

Finding Your Custom Bookmarks: After you have made several bookmarks you may lose track of where they all are. Use this feature to quickly find them.

Choose Edit | Find and search for the name or the first few letters of the name of the bookmark you want. Starry Night Backyard centers the object that contains the bookmark. For example if you have put Maury's email address on the Moon, choose Edit | Find and enter Maury. Starry Night Backyard centers your view on the Moon.

Bookmark Files: Whenever you create a new bookmark by dragging or using menu commands with LiveSky, you are adding to the file "Personal Bookmarks" in Starry Night Backyard\Starry Night Backyard\User Bookmarks (Windows) or in System Folder\Preferences\Sienna (Macintosh).

This file is saved automatically when you quit the application. When Starry Night Backyard quits, the previous bookmarks file is renamed "Personal Bookmarks.bak", so there is a backup of your bookmarks. The backup only lasts until the next time you run Starry Night Backyard.

***Tip:*** *If you like your bookmarks, then please back them up — as you would any important document!*

Protecting Your Bookmarks: In the Starry Night Backyard Data folder there is a folder called "Bookmark Libraries", where you can store bookmarks that you want to prevent from being edited or deleted. For example, you could rename your Personal Bookmarks file "My Nice Links" and

move it to the Bookmark Libraries folder. Any bookmark file found in this folder is considered unchangeable.

The Bookmark Libraries folder allows you to send and receive bookmark files, or to distribute a common set of bookmarks to many individuals.

Info Window

If you select the option Info Window from an object's contextual menu, a window with all kinds of astronomical information appears (you can also double-click the left mouse button on an object to bring up its Info Window).
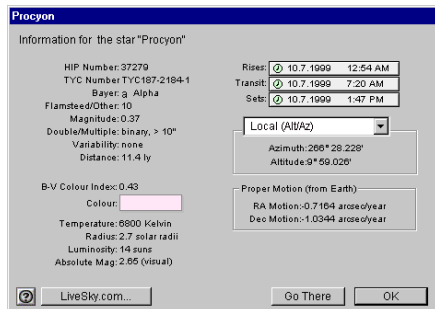
The information that appears depends on the type of object. If you click on a star, the following fields are present:

Note: Most of the star data in Starry Night Backyard comes from the HIPPARCOS and Tycho catalogs. Find out more about these catalogs on their official web page: http://astro.estec.esa.nl/SA-general/ Projects/Hipparcos/hipparcos.html

HIP Number and TYC Number: The HIPPARCOS and Tycho project was a study done by the European Space Agency to determine the distances to nearby stars. The Tycho catalog included about a million stars and the HIPPARCOS catalog about 100 000. These fields give the catalog numbers of the star in question. Not every star has a HIPPARCOS catalog number.

Bayer: This gives the star's Bayer catalog letter, if any. The Bayer letter is from the Greek alphabet. The brightest star in a given constellation is usually named Alpha (the first letter in the Greek alphabet), the second brightest is named Beta, and so on.

Flamsteed/Other: This gives the star's Flamsteed number, if any. The Flamsteed system orders stars not by brightness, but by their position relative to the western boundary of the constellation they are in. The star closest to the western edge is labelled 1.

Magnitude: This shows a star's apparent magnitude, a value which measures its brightness in the sky. The idea for assigning magnitudes originated with Greek astronomer Hipparchus (190-120 BC). He catalogued all the visible stars he could see and assigned them magnitudes from 1 to 6, the brightest stars having a value of 1.

Contemporary astronomers have refined Hipparchus' system, so that the system now includes larger numbers for dimmer stars, and negative numbers for very bright objects. The faintest stars that can be seen by the Hubble Space Telescope are in the 26 to 28th magnitude range — very dim stars indeed!

*Note: Many newcomers to astronomy get confused by the fact that the greater an object's magnitude, the **dimmer** it is. An object with magnitude -5 is much brighter than an object with magnitude 0, which in turn is much brighter than an object with magnitude 5.*

The sun has a magnitude of about -28, while the brightest star in the night sky is the dog star Sirius, which has a magnitude of -1.47. The magnitudes of the planets change, depending on how close they are to Earth, but Venus, Mars and Jupiter can all have lower magnitudes than Sirius. At the other extreme, Pluto has a magnitude of about 14, far too dim to be seen with the naked eye, and even most small telescopes.

Double/Multiple: This field indicates whether a star is part of a multiple star system. About half the stars in the sky are part of a multiple star system.

Variability: This indicates whether a star's apparent magnitude (and, therefore, its brightness) varies with time, and by how much.

Distance: This gives the star's distance from your current viewing location.

Note: the distances to stars are only given for those stars in the HIPPARCOS catalog. The distances to stars are known only approximately and should be treated with some caution. The closer a star is, the more accurate its distance measurement is likely to be. The distances to stars within a few hundred light years are relatively accurate, but are much less accurate for stars farther away than this.

B-V: This is a way of measuring a star's color. An average star has a B-V value of around 0. If a star has a negative B-V value it is on the bluish side of the spectrum. If it has a positive B-V value it is on the reddish side of the spectrum. The more negative or positive a star's B-V, the more blue or red it will appear. A star's color is directly related to its temperature: blue stars are hotter and red stars are cooler.

Color: This shows graphically what color the star would appear if we could view it through a very powerful telescope.

Temperature: This the star's surface temperature, given in degrees Kelvin (to get a star's temperature in Celsius, just subtract 273 from its temperature in Kelvins). The Sun has a temperature of about 5700 K.

Radius: This measures the star's radius, in terms of the Sun's radius. Red giant stars can be hundreds of times larger than the Sun.

Luminosity: Luminosity measures the light output of a star.

Absolute Magnitude: The magnitude we normally use when talking about objects is the apparent magnitude, which compares how bright they are as seen from Earth. But this doesn't tell us much about the intrinsic brightness of an object, because the bodies we see in the sky are spread out over a wide range of distances. The Sun produces only the same amount of light as the average star in the sky, but it is far, far brighter than anything else simply because it is so close to us. Absolute magnitude tells us how bright objects would be if they were all at the same distance (the distance

we use is arbitrary, but has been chosen to be 10 parsecs). As with apparent magnitude, a lower apparent magnitude means a brighter body.

Rise Time: This is the time that the object comes above the horizon at your current location.

Transit Time: This is the time at which the object is highest in the sky. This is useful because objects are harder to observe when they are close to the horizon, because air currents can distort the image.

Set Time: This is the time at which the object sets below the horizon at your current location.

Note: If you are near the poles, certain objects are circumpolar, meaning they never rise or set. In this case, the rise, set, and transit times do not apply.

Co-ordinate Systems: Looking up into the night sky, you can imagine that the stars are fixed to an imaginary sphere surrounding our planet. To specify locations on this celestial sphere, astronomers use a system of co-ordinates similar to the latitude and longitude measurements used to map Earth.

The info window can display the objects in several co-ordinate systems. All spherical co-ordinate systems require two independent co-ordinates, which are determined by an object's distance from two "great circles" which are perpendicular to each other. For example, the great circles in Earth's latitude/longitude co-ordinate system are the Equator and the Prime Meridian.

Local: The two co-ordinates in this system are the altitude and the azimuth. The altitude measures how high above the horizon an object is, and is usually measured in degrees. An altitude of 0 degrees means the object is right on the horizon, and an altitude of 90 degrees means the object is directly overhead. Azimuth measures the compass direction of an object. An object which is due north in the sky has an azimuth of 0 degrees, one that is due east has an azimuth of 90 degrees, and one that is due south has an azimuth of 180 degrees.

Equatorial: The equatorial system is the most common system for describing the position of celestial objects. Its two co-ordinates are declination and right ascension.

Declination is the astronomical equivalent of latitude. It measures an object's angular distance north or south of the celestial equator, which is simply a projection of the Earth's equator into space (an object of 0° declination is directly on the celestial equator). Because of this, objects with positive declination can be seen more easily in the Northern Hemisphere, and objects with negative declination can be seen more easily from the Southern Hemisphere. Declination is usually measured in degrees, minutes, and seconds (°, ', "). Polaris, the North Star, has a declination of almost 90 degrees.

The east-west measurement is called the right ascension (RA), and is most often measured in hours, minutes, and seconds (h, m, s), from 0 to 24 hours. Because the earth rotates, it is not possible to equate longitude on earth with right ascension.

Think of lines of right ascension as longitude lines which are fixed in space, not rotating with the Earth like lines of longitude. The zero-point of right ascension (RA) is defined to be the right ascension of the sun at the Vernal Equinox, which is the first day of spring in the Northern Hemisphere.

The Earth is precessing on its axis of rotation (picture a spinning top which does not point straight up but instead moves in an arc around the vertical) with a period of 26000 years. Because of this, the Vernal Equinox slowly changes over time and so do the equatorial co-ordinates of an object. These changes are quite small and often unimportant for the amateur astronomer. To standardize astronomical positions, astronomers often refer to an object's position using the co-ordinate system of a particular date. For example you will often see positions given in J2000 co-ordinates, using the equatorial co-ordinate system of Jan 1, 2000. The info window lets you display equatorial co-ordinates for the current time or the year 2000.

Ecliptic: This reference system uses ecliptic latitude and longitude. Ecliptic latitude is similar to declination, except the plane of 0 degrees latitude is the ecliptic plane (the plane of the earth's revolution around the sun), instead of the plane of the earth's equator. The plane of ecliptic longitude also has the vernal equinox as its zero point.For a definition of the ecliptic, see "The Ecliptic" on page 52.

Galactic: These co-ordinates use the center of the Milky Way as a reference point. Galactic latitude describes how far an object is from the plane of the Milky Way

(an object with galactic latitude of 0 degrees is in the plane of the Milky Way). The 0 point of galactic longitude points directly toward the galaxy's center.

Proper Motion: Stars are not fixed in space, and most are in fact moving quite rapidly. Because of their great distance from us, however, their positions appear constant. Only on a timescale of hundreds or even thousands of years can we actually see the shifting positions. This field in the Info Window describes how much the star's equatorial co-ordinates (described in "Equatorial**" on page 32**) are shifting each year due to the star's movement.

Planet Info

The information window for planets and other bodies in our solar system has some different categories than those shown for stars.

Angular Size: This measures the angular width of the object at its widest point.

Disc Illumination: This shows how much of a planet's face is illuminated by sunlight (the rest is in shadow). For example, when the moon is half full, the disc illumination is about 50%.

Length of Year: A year is the length of time which a body takes to revolve around its parent body. For example, the length of a year on the moon is the time it takes it to revolve once around the Earth.

Sidereal Day and Solar Day: These were described in "Sidereal day**" on page 19**. These two lengths differ by a large amount only when the length of a planet's solar

day is a significant fraction of the length of the planet's year.

LiveSky.com

Sienna Software maintains an astronomy database and search page at www.livesky.com This page has listings and brief descriptions of astronomy-related websites, sorted into different categories, much like the site Yahoo!, but devoted exclusively to astronomy. It includes pages with recent news about astronomy and space science, pages giving observing tips for the current night, and much more.

You can link directly to LiveSky by selecting LiveSky.com Info from the Object Menu. This will bring up a page on LiveSky which has more information about the object, and a listing of links which have more information about the object. It will also give you the option of searching other sites on the Internet, both general-purpose search engines and astronomy-specific pages, for information on your object. To begin at the main LiveSky page, type the Internet address www.livesky.com in your browser.

The Planet List

The Planet List provides an easy way to locate bodies in the solar system, and also has several special tools you can use to follow their path. To open or close the Planet List window, select Sky | Planet List or Window | Planet List.
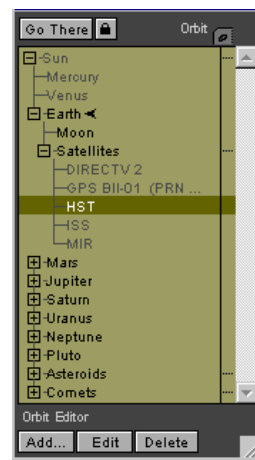
The window opens with a list of the planets. Starry Night Backyard dims the names of any planets that are not currently above the horizon, letting you know which planets are visible at the current time.

You can also choose to focus on a planet's moons or satellites. Click the symbol to the left of a planet's name to expand the list of available objects. For Earth, the Moon is shown, as well as a handful of satellites. Clicking again collapses the display to show you only the parent object.

Centering an Object: The simplest way to find a planet, satellite, comet, or asteroid is to double-click its name in the Planets List. Starry Night Backyard centers the object in the current field of view. If you click on an object which is currently beneath the horizon, you will not be able to see it. If the object has a rise and set time, Starry Night Backyard will offer you the option of resetting the time to 15 minutes after the object has come above

the horizon. If the object has no rise time (for example, if you are on the dark side of the Moon and you try to lock on Earth), Starry Night Backyard will give you the option of centering on that part of the horizon which is directly above the object.

Go There: To view from another planet, satellite, comet, or asteroid, select it on the Planets Palette and click Go There. Your viewing location changes to that of the selected planet, at the same planetary latitude and longitude that you had on Earth.

🔒 **Locking On an Object:** To keep a planet or satellite centered in your view as time passes, select the planet from the Planet Palette and press the lock button. Starry Night Backyard centers the object in your view and locks it there. Locking is useful for tracking an object's movement over time.

Example: Using the Planets List to do a flyby of the Sun from Halley's Comet.

1. If it is not already open, select Window | Planet List to open the planet list.

2. Scroll down to the bottom of the Planet List and click on the addition sign beside "Comets". This should bring up a list of comets.

3. Click on Halley's Comet, and click Go There.

4. Use the rocketship button to blast off from the surface of Halley's until your elevation reads about 40 km in the Control Panel. This step is necessary because we want to track the Sun, but because the comet is slowly rotating, it will eventually fall beneath the horizon.

Blasting off to this height ensures that the Sun stays in view at all times.

5. Click on the Sun in the Planet List and then click the Lock icon. This should center the Sun in the middle of the screen. A little Lock symbol should appear beside the Sun's name in the Planet List.

6. Change the date to June 30, 1985. By moving the cursor around the screen, you should be able to identify Mercury, Venus, Earth and Jupiter.

7. Position the mouse cursor above the Sun. The heads-up display will tell you your distance from the Sun. It will be about 3.5 AU away.

8. Change your timestep to 1 day. Now press the Forward button to set time in motion.

9. Move the cursor back over the Sun to watch how its distance changes. You will see the planets moving rapidly around the Sun, and the Sun getting closer. You will move inside the orbits of Earth, then Venus.

10. In about February 1986, Halley's comes closest to the Sun, at a minimum distance of about 0.6 AU. After this, it starts to move away again, heading back to the fringes of our solar system for another 75 years.
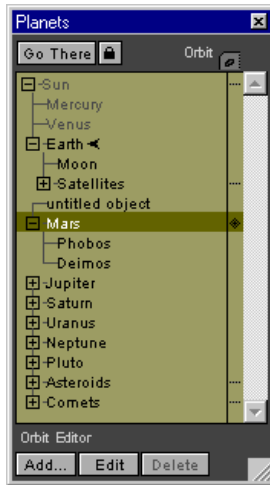
Orbits: To display the orbit of any object, click the Orbit column, the first column to the right of the object. A mark in this column reminds you that you have the Orbit displayed for this object.

This example shows the orbit of Jupiter. Viewing from the limits of our solar system (this shot was taken from Pluto) allows you to see its entire orbit, including the indicator markers.
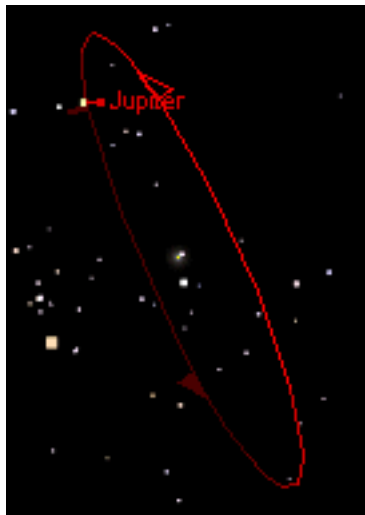
The ascending node of the orbit — the point at which the planet crosses through the plane of the ecliptic into the northern hemisphere — is marked with a solid wedge. The descending node of the orbit — the point at which the planet crosses down through the ecliptic plane — is marked with a hollow wedge. The point at which the orbit comes closest to the parent body — the pericenter — is marked with a bar.

To turn off a planet's orbit, click its marker in the orbit column. You can get a good view of the solar system by turning on every planet's orbit, then blasting off from the north pole of the Sun and looking back down towards the Sun.

Note: Because the planets orbit the Sun in slightly different planes, their orbits can appear distorted if you are too close. For example, if you blast off from the north pole of the Sun until the orbits of all planets are visible, the orbit of Pluto appears to be completely outside Neptune's orbit, when in reality they overlap. To rectify this, keep blasting off farther above the solar system, and then use the magnifying glass tool to magnify your view again so that you can see the correct orbits.

Orbit Editor

You can use the Orbit Editor to create new celestial objects. For instance, if a comet or moon has been recently discovered, you can use the Orbit Editor to add it to Starry Night Backyard, simply by entering its orbital elements. The Orbit Editor also allows you to add surface and atmosphere maps to your new objects.

Adding your own objects to the solar system is a great way to learn about celestial mechanics. The Orbit Editor lets you view the shapes, sizes, and positions of a new orbit, as well as use sliders to adjust these aspects in realtime. This feature makes it clear what each particular orbital element means, and how the orbit is affected when adjustments are made.

To use the Orbit Editor:

1 Open the Planet List.

2 Press the Add button along the bottom of the Planet List.

A window opens which asks you to enter the name of the object, its type and the body which it is orbiting. Once you click OK, a full-size Orbit Editor window opens with a default view of your new orbit. A series of tabs allow you to adjust orbit options and settings.

Starry Night Backyard calculates a preferred field of view for each tab folder, one that reflects the function of the tab. For example, the view of your new object from the Surface tab is closer than that of the view from the Orbital Elements tab.

Info Tab: On this tab, you can adjust the orbit colour, and the Absolute Magnitude of the object. Absolute Magnitude is described in "Absolute Magnitude" on page 31.

Orbital Elements Tab: This tab contains popup menus, sliders, and data input boxes which control the attributes of the new orbit.
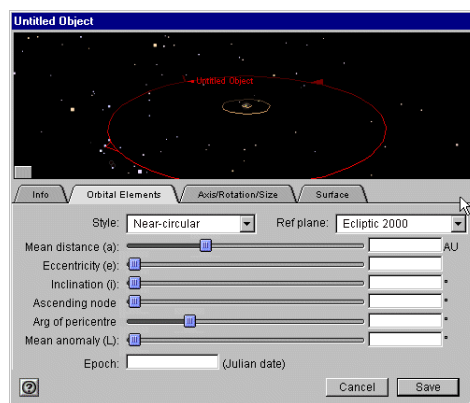
In order to specify orbits, or for that matter, the position of any astronomical object, it is necessary to have a reference system. There are two standard reference planes, the equatorial plane of the Earth and the ecliptic plane (the plane of Earth's orbit around the Sun). However, as mentioned earlier, the equatorial and the ecliptic planes are slowly changing their positions relative to the background stars due to precession. Consequently, an astronomical reference plane is dependent upon the time of the observations.

• *Reference Plane*: The Ref Plane popup menu allows you to select from ecliptic and equatorial standards by which all of the orbital element data are measured.

  — *Ecliptic*: An ecliptic reference plane based on the time of your current Starry Night Backyard window.

— *Ecliptic 1950*: An ecliptic reference plane based on the J1950.0 standards.

— *Ecliptic 2000*: An ecliptic reference plane based on the J2000.0 standards, established by the International Astronomical Union (IAU) in 1976.

— *Equatorial*: An equatorial reference plane based on the time of your current Starry Night Backyard window.

— *Equatorial 1950*: An equatorial reference plane based on the J1950.0 standards.

— *Equatorial 2000*: An equatorial reference plane based on the J2000.0 co-ordinates, established by the IAU in 1976.

Adjusting sliders and entering orbital elements into data boxes is relatively easy. Understanding what these numbers represent is a little more difficult. Orbital elements remain a mystery to most people, due in part to the complex names these numbers have acquired, and secondly to the trouble many people have in thinking three-dimensionally. To make matters even more complicated, often an orbital element will have several different names.

Several numbers are required to establish an object's orbit. These orbital elements, first defined by Johannes Kepler at the turn of the 17th century, place an object on an elliptical path at a particular time, and orient it about a parent body.

Note: The real world is more complex than the Keplerian model, since there are other factors that can influence an orbit,

including the gravitational influence of other planets, gravity anomalies of the parent, and atmospheric drag on an object if it is in a low orbit. Starry Night Backyard calculates orbits based only on the gravitational influence of the parent body.

• *Mean Distance*: Kepler's third law of orbital motion gives us a precise relationship between the speed of a satellite and its distance from the parent. Objects that are close to the parent orbit quickly, while objects farther away orbit more slowly. The implication is that if we specify either the speed at which the object is moving or its distance from the parent, we've measured similar values. In effect, Mean Distance and Mean Motion are two ways of describing the same thing.

The convention with planets is to call this number the Mean Distance. Planets in circular orbits would travel at a constant distance from their parent body, but since most planetary orbits are elliptical, this distance is constantly changing. The common practice is to average this distance, and record it as Mean Distance. It is usually measured in AUs.

The convention with satellites is to call this number the Mean Motion. Satellites in circular orbits travel at a constant speed, but since most orbits are elliptical, their speed is constantly changing as they orbit. The common practice is to average the speed, call it the Mean Motion, and record it in units of revolutions per day.

Comet orbits are extremely elliptical, so the distance between comet and

parent body is usually measured at pericenter, the point in their orbit where they are closest to the parent. This distance is called the Pericenter distance, and is given in units of AU.

For objects in orbit about the Sun, such as comets, pericenter distance is called Perihelion distance.

- *Eccentricity*: Eccentricity describes the shape of the orbit, based on a ratio of the distance of the focus from the center of the orbit's ellipse to the length of its semi-major axis. A circular orbit has an eccentricity of 0, while an extremely elliptical orbit, such as a that of a comet, has a value close to 1. The eccenctricity of hyperbolic orbits is greater than 1.

- *Inclination*: The orbit's elliptical shape lies in a plane known as the orbital plane. The orbital plane always goes through the center of the parent object, but may be tilted at any angle relative to the parent's equator. Inclination is the angle between the orbital plane and the equatorial plane, measured between 0° and 180°. If the orbit lies in the ecliptic plane, the inclination is 0°. At 90°, the orbit is perpendicular to the ecliptic, while an inclination of greater than 90° describes a retrograde orbit.

Satellites with an inclination near 0° are said to have equatorial orbits, because the satellite orbits around the equator. Those whose orbits are inclined near 90° are called polar, because the satellite crosses over the north and south poles.

Cool fact*: Spy satellites are often polar orbiting. From this inclination, they can examine all parts of the Earth as it rotates underneath them.*

- *Ascending Node*: This angular measurement specifies the point at which the orbit crosses northward through the ecliptic plane.

The ascending node is also sometimes called the Longitude of the Ascending Node, and is measured from the Prime Meridian of the parent body.

- *Argument of Pericenter*: The pericenter is the point on the orbit which is closest to the parent body. The Argument of Pericenter specifies the angular location of the pericenter, and is measured in degrees.

The value is determined by measuring the angle (measured at the center of the parent) from the ascending node to pericenter. For example, when the Argument of Pericenter is 0°, the pericenter occurs at the same place as the ascending node. That means that the planet would be closest to the Sun just as it rises up through the ecliptic plane. Likewise, when the Argument of Pericenter is 180°, the planet, as it rises up through the ecliptic plane, is at its farthest from Sun.

- *Mean Anomaly*: Mean Anomaly describes exactly where on the orbit the new object is located at the specified time. It is measured as an angle over one revolution, starting from 0° at the pericenter.

- *Epoch*: A set of orbital elements is a portrait of an orbit, at a specific time. The Epoch specifies this time. In most cases, this time is expressed as a Julian date. However, NASA has its own

epoch system that is commonly used for describing satellite orbits. Its format lists the year, the number of days, then the percentage of the day. For example 1997045.5 would translate as February 14th, 1997, at 12 hours UT.

Satellite Orbital Elements: If, on the Info tab, for Type Of Object, you chose Artificial Satellite, the Orbital Elements tab appears quite differently.
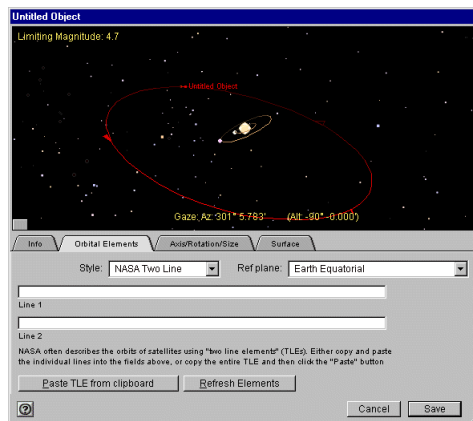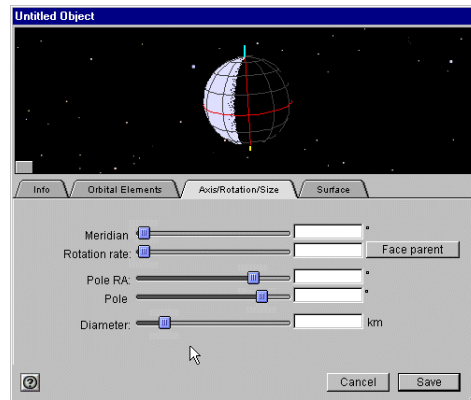

For style, you have four options:

• Pericentric

• Near-Circular

• NASA Two Line

• AMSAT

Each of these options presents sliders and dialog boxes that give you different ways of calculating the orbit of your satellite.

Axis/Rotation/Size Tab: Using these sliders and data boxes, you can enter information about your new planet's rotation rate, pole positions, and diameter.

• *Meridian*: Sets the position of the object's prime meridian, in J2000 equatorial co-ordinates.

• *Rotation Rate*: Sets the rate at which the new object spins on its axis.

• *Face Parent*: Over time, many objects in the solar system become gravitationally locked, that is, they keep the same face towards their parent at all times. Our Moon is a good example of this phenomenon. Clicking this button automatically locks your object by setting its rotation to match its orbital period.

• *Pole RA*: Sets the Right Ascension of the object, in this case meaning the horizontal angle of the poles.

• *Pole Dec*: Sets the Declination of the object, in this case meaning the vertical angle of the poles.

• *Diameter*: Sets the size of your new object, measured in kilometers.

__Note:__ Comet tail lengths are determined as a result of both absolute magnitude and size of the comet nucleus (diameter).

Surface Tab: On this tab, you can create a surface for your new object by importing an image file or pasting in information.
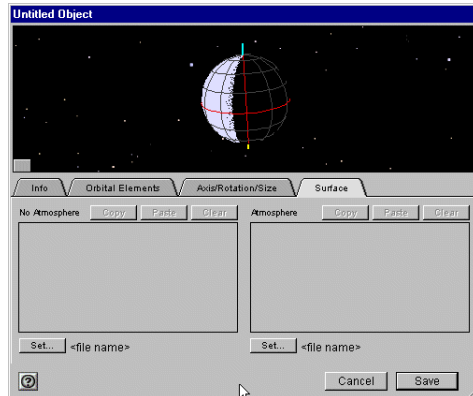
- *Atmosphere*: Controls the appearance of your planet's surface when its atmosphere is turned on in Planet/Sun settings. Click Set to select an image file or Paste to paste in information from your favourite imaging application.

- *No Atmosphere*: Controls the appearance of your planet's surface when its atmosphere is turned off in Planet/Sun settings. Click Set to select an image file or Paste to paste in information from your favourite imaging application.

  Note: The orbits of the major moons and planets that ship with Starry Night Backyard cannot be edited using the Orbit Editor. However, you can change their surface maps if you find a more detailed image.

Adding images to your new objects can be a lot of fun. Besides using the latest photos from space probes, you can add any picture you like: your pets, your family, Elvis, you name it! Just copy any image to your clipboard, then use the orbit editor to paste it onto your new object.

- *Copy*: This copies the contents of the map window to your computer's clipboard. You can use this feature to copy the maps of other planets if you want to add them to your new object. Select a planet on the Planet Palette and push the Edit button that appears at the bottom of the palette. Go to that planet's Surface tab, and click Copy. You can now paste that information into the Surface tab of the new orbital object.

- *Paste*: This pastes the contents of the computer's clipboard into the map window.

- *Clear*: This clears the map window, without copying to the clipboard.

  Note: The Orbit Editor can use almost any image as a surface map, as long as you can copy it to the clipboard.

- *Image size and appearance*: There is some restriction on image size. The maximum size is 4000 by 4000 pixels, while the minimum is 25 by 25 pixels. If the picture is too big or too small, your computer will beep twice and not allow the paste. We recommend using images that are about 600 pixels long by 300 pixels high.

  Whatever picture you do use, its width is wrapped around the planet, and the height of it will go from pole to pole. Because Starry Night Backyard maps the image on a sphere, your image will be distorted in the northern and southern latitudes. Keep the important parts of your image near the "equator". For examples, use the Orbit Editor or

Location window to look at the images of the planets or the comets. Their images can give you an idea how an object's map relates to the appearance of the planet.

• *Seams on objects*: If you have an image-editing program, such as Adobe Photoshop, you can adjust your images so that the seam (where the end of the pictures meet when wrapped on a planet) is minimized or invisible. Select one end of the picture (for example, the right third of the image), and Cut it. Then slide the remaining two-thirds of the image all the way over to the right. Paste in the first piece, and position it so that it is now the left side of the image. You should now have an obvious seam where the two pieces are joined. At this point, you can use the image-editing program to clean up the seam, blending the two sides together so that the join is less obvious. Now select the entire picture and copy it. Then, using the Orbit Editor, paste it into your Starry Night Backyard object. The place on the object where the two sides of the image meet should now be seamless.

Example: Adding a new planet between the orbits of Mars and Jupiter

1 Open a new window.

2 Open the Planet List..

3 Press the Add button at the bottom of the Planet List.

4 Enter the name of your object, and select "Asteroid" for type of object.

5 The Orbit Editor Window opens, giving you a default view of your new object's orbit. Since you selected the Sun, the default orbit is just past Earth's.

6 On the Info tab, for Type Of Object, select Planet.

7 Name your new planet.

8 Adjust the Orbit colour and Absolute Magnitude if desired.

9 Click the Orbital Elements tab.

10 Using the Planet List, turn on Mars' orbit. By default, Jupiter's orbit is already on.

11 Use the Elevation up button on the Tool palette to rocket out just past Jupiter's orbit (about 10 AUs). Here, you'll have a better view by which to adjust your new planet's orbit.

12 Using the Mean Distance slider, adjust your planet's orbit so that it lies between that of Mars and Jupiter.

13 Close the Orbit Editor window.

14 Select your new planet on the Planet List, and click Go There.

Orbit Editor Hints: Orbital elements for comets, asteroids, or satellites can be found in magazines such as "Sky & Telescope" and "Astronomy", or on the World Wide Web. For links to sites which contain recent orbital element data, check www.siennasoft.com or www.livesky.com

Julian Day: The Orbit Editor requires you to input dates as a Julian day value. The current Julian day is shown in the Orbit Editor window.

Orbit Editor Calculations: You may notice that some numbers you enter may change when switching between different styles.

For instance, if you've entered 485° in an Ascending Node box, move to another style, then return, the number will have changed to 125°. Starry Night Backyard has recalculated the number, but in effect, the value of the orbital element remains the same. The new number displayed is mathematically equivalent to the original number that you entered.

You also may notice that sliders may change when adjusting certain elements. This is because Starry Night Backyard is recalculating the position of the sliders.

For instance, if you adjust the Rotation rate of an object using the sliders, the Meridian slider will jump to a new position. Note that the Meridian drawn on the object has not moved. Starry Night Backyard has recalculated the Meridian position to keep it synchronized with J2000 standards.

Note: Data box entries are not recalculated in such a fashion.

Chapter 5
Appearance of the Sky

Unlike your real backyard, Starry Night Backyard allows you to modify the sky's appearance to best suit your needs. You can display illustrations of the classical constellations, show only the artificial satellites circling overhead, or customize your view in dozens of other ways. Most of the tools you will be using in this section are in the Sky menu and the Guides menu.

What Do You Want to See?

The celestial bodies in Starry Night Backyard can be divided into seven categories. The options for customizing the sky generally treat each category separately.

1   **Planets/Sun:** This category includes not only the nine major planets of our solar system and the Sun, but also the major moons of these nine planets. In the normal field of view, planets and moons are displayed like stars, which is how they appear to us from the Earth's surface. As you get closer to a planet (by changing either your field of view or your location) you begin to see the disc image and any phase information. Starry Night Backyard depicts the planets using the latest images from NASA and other space agencies. However, because many planets are constantly evolving, these images can quickly

become out of date. For instance, the appearance of the gas giants is continuously changing. The Great Red Spot of Jupiter drifts in unpredictable ways, making precise synchronization between Starry Night Backyard and observation from Earth difficult. In addition, surface features of some objects, such as Io, the volcanically active moon of Jupiter, change rapidly. Unfortunately, we have not yet been able to fully image all of the objects in our solar system. Where little or no data is available, Starry Night Backyard uses the time-honored tradition of deploying space artists to create the surfaces of distant worlds, such as Pluto, Charon, and Saturn's moon Phoebe. For information on locating planets in the night sky and turning on their orbits, refer to "The Planet List" on page 34.

2 **Artificial Satellites**: This refers to any man-made body orbiting our Earth.Most satellites fall into two distinct types of orbits: near-earth orbits and geosynchronous orbits. Satellites in near-earth orbit move much more rapidly than the Earth rotates, so they move over a large slice of the Earth's surface. Geosynchronous satellites are much farther from Earth. They move at exactly the same speed as the Earth rotates, so they stay directly above the same point on the Earth's surface at all times. Starry Night Backyard includes several satellites, including the Hubble Space Telescope and the International Space Station.

3 **Comets:** These are the small balls of rock and ice which revolve around the sun. Comets have very elliptical orbits, meaning their distance from the sun varies greatly with time. Comets are usually far away from the Sun, out beyond the orbit of Pluto, too dim to see. Once in a long while, they come close to the Earth and Sun, picking up speed and getting brighter. The "tail" which we see from a comet is the ice and rock being blown off of the comet by the solar wind. The tail of a comet always points away from the sun. Every time a comet comes close to the sun, it loses much of its material to the solar wind. This means that it will be much fainter the next time it comes around. Starry Night Backyard includes some great comets from yesteryear, such as Hale-Bopp and Halley's. It is impossible to predict very far in advance what will be the brightest comets of the future, because most of them are unknown before they come near the Sun. When a bright new comet is discovered, you will want to add it into Starry Night Backyard using the Orbit editor. Check www.livesky.com for information on the latest comets.

4 **Asteroids:** These are also rocky bodies which orbit the Sun, but almost all asteroids reside in the "Asteroid Belt", a region of space between the orbits of Mars and Jupiter. It used to be believed that asteroids were fragments of a planet which collided with Jupiter and broke up into many pieces, but most scientists no longer think this is true. Five major asteroids in the asteroid belt are included in Starry Night Backyard.

5 **The Milky Way:** This is the plane of our own galaxy. Because we are inside the Milky Way, it does not look like the photographs we see of other galaxies. It appears us to us as a broad band cutting across the sky, somewhat brighter than the surrounding area. The brightness is the composite light from billions of stars, each too faint to identify individually. The Milky Way is roughly 100 000 light years in diameter and about 13 000 light years thick. It is home to over 200 billion stars. Our solar system is located about two-thirds of the way out from the galaxy's center.

6 **Messier Objects:** These are 110 deep-sky objects catalogued by the astronomer Charles Messier. Some are nebulae or star clusters in our own galaxy, while others are distant galaxies. Many of these objects make fantastic photographic images. Some of the most famous Messier objects are M1, the Crab Nebula; M31, the Andromeda galaxy; M42, the Orion Nebula; and M51, the Whirlpool Galaxy. Starry Night Backyard includes pictures of all 110 Messier objects. You will have to zoom in using the magnifying glass tool to see these images.

7 **Stars:** A star is any body which burned or once burned hydrogen fuel. The energy and light produced in stars comes from the fusion of hydrogen atoms. This is the same process which takes place in the explosion of a hydrogen bomb, multiplied in power many times over. Stars which are burning hydrogen are said to be on the main sequence. As stars grow older,

they use up their supply of hydrogen and have to find other sources of energy. When they reach this point, they become either red giants or supergiants, depending on their size. As they continue to use up energy, stars eventually become either white dwarfs or, in the case of very massive stars, neutron stars or black holes.

Tip: Our sun is an ordinary star on the main sequence. However, to control its appearance in Starry Night Backyard, use the menu choices named "Planets/Sun", not those labelled "Stars".

With Starry Night Backyard, each of these 7 classes of objects is treated separately. This allows you to set the viewing settings to focus on your area of interest.
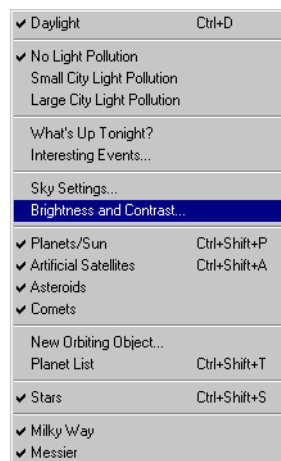
You can turn on or off any class of object by clicking on the Sky menu along the top of the main window, and clicking the mouse on the class you are interested in. If the objects are currently being displayed,

there will be a checkmark beside the name. Clicking on the name turns the display of these objects off. If they were already turned off, clicking on their name turns them back on.

Note: If you turn off the display of the planets by clicking Sky | Planets/Sun, the horizon of the planet which you are located on will not disappear.

Daylight

Many celestial objects are only visible during certain times of the year, because they are above the horizon only during the day at other times of year. With Starry Night Backyard, you can get around this problem by selecting Sky | Daylight. This feature turns on or off the effects of a planet's atmosphere, including the scattering of light which makes our sky appear blue. If it is daytime and you turn daylight off, you will be able to see the stars which are normally hidden.

Tip: This feature works on any planet which has an atmosphere. On Mars, the atmosphere scatters sunlight and makes the sky look pink. Turning off daylight eliminates this effect. Our moon has no atmosphere, so turning Daylight off has no effect.

Light Pollution

Even on a perfectly cloudless and moonless night, an observer in a big city will not see anywhere near the number of stars which his or her counterpart in the country will see. The default setting for Starry Night Backyard assumes the observer is far from bright lights. As a result, many stars are visible, perhaps too many for the urban stargazer. Starry Night Backyard allows you to mimic the effects of light pollution, showing only the brighter stars and making the sky more closely resemble what you see from home. You can choose two levels of light pollution, which mimic the light pollution effects of a large city and a small city. To turn light pollution on or off, select Sky | No Light Pollution, Sky | Small City Light Pollution, or Sky | Large City Light Pollution.

Sky Settings

Selecting Sky | Sky Settings brings up the Sky Settings window, which allows you to change several aspects of the sky's appearance. In addition to modifying how many stars Starry Night Backyard shows by selecting the light pollution option, you can have more control over exactly how many stars are drawn by moving the slider under "Number of Stars to Draw". Moving this slider far to the right displays many stars, far more than you could see with the naked eye even under perfect conditions. The default position of the slider is also marked. This slider can only be moved if you have selected No Light Pollution.

Tip: If you have a slower computer, don't move the slider too far to the right. Whenever the time is updated, Starry Night Backyard recalculates the positions of every star which is visible and redraws each star. If you are displaying a large number of stars, this can take a while.

Two other options in the Sky Settings window let you choose whether to display the compass points shown along the horizon and whether to enlarge the moon size. Most people perceive the moon to be larger than it actually is, so it appears too small when drawn at its correct size in Starry Night Backyard. For eclipse purposes, the moon's shadow is always calculated from the moon's actual size, so you do not have to worry about turning off the enlarged moon option during an eclipse.

You also have the option to turn off the scenery and draw a plain flat horizon. This can be useful if you are trying to observe something just above the horizon.

Finally, the Sky Settings menu allows you to change the colour of the Milky Way, and the colour of the orbits of comets, satellites, and asteroids. For information on showing these orbits, see "The Planet List" on page 34. By default, these are all different colours to allow you to easily differentiate between the different types of objects.

Brightness & Contrast

Starry Night Backyard gives you complete control over the brightness, contrast, and colour of star display.
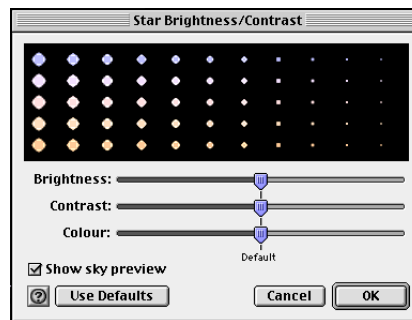
The Brightness slider allows you to adjust how brightly the stars are drawn on the computer screen. If you are running Starry Night Backyard on a portable computer, or if the room in which you are in is brightly illuminated, raising the brightness of the stars can be helpful.

The Contrast slider increases and decreases the distinction between the brightest and dimmest objects in the sky. If you're viewing from an urban location, you may want to decrease the contrast so that Starry Night Backyard's display is closer to your physical view. If you're viewing from a rural location, you can increase the contrast to view a more diverse and complete night sky.

A star's colour is determined by its surface temperature, ranging from blue (hottest) to red (coolest). The Colour slider increases and decreases the extent to which Starry Night Backyard displays star colour. Pulling the Colour slider to the right shows more and more of the full spectrum of star colours, to an extent you would never see

from Earth. Pulling the Colour slider to the left strips away colour distinctions until all stars appear white.

Labels
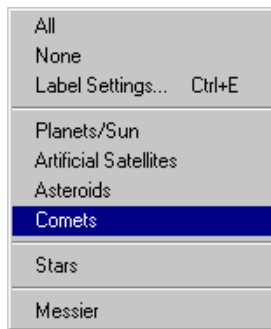
By using the Labels menu, you can control which celestial objects are labelled. This is especially useful if you are printing star charts.

The first two labelling options are choosing either All or None from the Labels menu. This does not label every object on screen, but instead labels the most prominent objects in six of the seven categories (the Milky Way is not labelled). Selecting None removes all labels.

You can selectively choose which categories of objects to label by clicking on the category name in the labels menu. If the labels are currently turned on, there will be a checkmark beside the name. Clicking on the name will turn the labels off. If the labels for that category are turned off, clicking the name will turn them back on.

Label Settings: Selecting this option from the labels menu brings up the Labels window, which has options for altering the appearance of labels.On the left side of the window is list of the different categories of objects, and a checkbox indicating whether the labels are currently turned on.

If you click on the category name, the right side of the Labels window brings up the settings options for each category. Some options are unique to the particular category, while others apply to all object types.

For all categories, you have the option of changing the appearance of the label. You can change the colour, font, and size of the label, and choose whether you want the labels to be in bold or italics. Many users choose different colour labels for each of the different types of objects, making it easier to quickly distinguish between planets, stars, and other objects.

Label Even When Very Dim: This is an option for planets, comets, asteroids, and artificial satellites. By default, Starry Night will not label an object if it is too dim to appear on screen. You can change this option. For example, you may wish to know the position of all the planets. Pluto and Neptune are generally too dim to be seen, but by selecting this option, you will still know where they are in the sky.

Planetary Symbols: You can choose to label the planets by their names, their symbols or both. The symbols represent the symbols for the mythological gods which the planets are named after. For example, Neptune was the god of the sea and is represented by the symbol of the trident.

Messier Label Options: You can label Messier objects by their Messier catalogue number, their common name (if there is one), their symbol, or any combination of these. The symbol indicates whether the Messier object is a galaxy, a nebula, or a star cluster. For example, M31 is also

known as the Andromeda Galaxy, and is labelled with a backwards 'S' to indicate that it is a galaxy. You can also use the scroller to decide how many Messier objects to label.

Star Label Options: You can label a star by its common name, its Bayer letter, or its Flamsteed number. Most common names are thousands of years old and have an Arabic origin. The classification scheme for Bayer letters and Flamsteed numbers is discussed in "Info Window" on page 30. If you check the box marked "Include Constellation", the constellation abbreviation is shown after the star name or number.

You can also choose whether to show the star's magnitude, and use the scroller to determine how many stars to label.

Constellations

People have always joined together patterns of stars to create images in the night sky. The most well known of these are those that have been handed down to us from the Arabians, Greeks, and Romans. Astronomers use these ancient constellations as a guide to map the stars into various regions. Today the International Astronomical Union recognizes 88 unique constellations, which together cover the entire sky. Many of the best-known figures in the sky, such as the Big Dipper and the Summer Triangle, are not formal constellations, but are known as asterisms. Starry Night Backyard has many options for drawing the constellations in its Constellations menu.
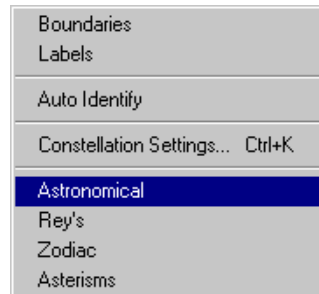
Boundaries: This displays the boundaries of the 88 official constellations.

Labels: This turns on or off constellation labels. For more control in displaying constellation labels, select Constellation Settings and then click the button marked Labels in the dialog box which opens up. In addition to the usual options, you can choose whether to display the constellation's astronomical name, its common translation, or both.

Auto Identify: Turning this feature on will identify the constellation which is at the centre of the screen. If you scroll around the screen using the hand tool, the constellations will gradually fade in and out. You can control whether to draw the name, boundary, stick figure or classical illustration using the auto identify feature by clicking on Constellations | Constellation Settings.

Constellation Settings: This dialog box allows you to turn on or off the stick figures and constellation boundaries, and also choose the colour with which they are drawn. If you have the autoidentify feature turned on, you can check which options are drawn using this feature. You can also

use the slider to control how bright the images drawn using auto identify appear.

Figures: You have four options for drawing the constellations themselves. You can draw stick figures using either the standard astronomical figures, or those popularized by H.A. Rey in his book *The Stars, a New Way to See Them.* These figures closely resemble the names of the constellations. For example, Ursa Major, the Great Bear, is depicted as a stylized bear. To get the figures to match the names, Rey had to take some liberties, so it may be difficult to match these figures to what you actually see in the sky. You can also choose to draw only the constellations of the Zodiac. Finally, you can draw stick figures of the asterisms, which are familiar star groupings which are not official constellations. A checkmark beside the name indicates that an option for constellation drawing is turned on. To turn it off, click on the name again.

Note: These four options are mutually exclusive, so you can only view one drawing method at a time.
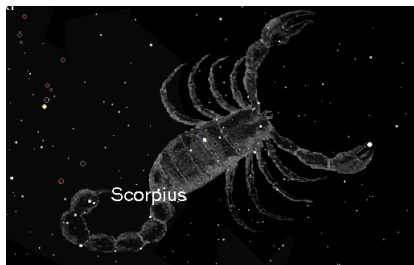
Guides

The Guides menu allows you to display various astronomical reference points and grids which will help you identify where objects in the sky are.

Celestial Grid: The celestial grid shows the gridlines of the Equatorial co-ordinate system mapped onto the sky. See "Equatorial" on page 32 for a description of this system. To turn on or off the celestial grid, select Guides | Celestial Grid.

The Ecliptic : This is the line in the sky which the sun moves though over the course of a year. Selecting Guides | Ecliptic turns on or off this path. Notice the constellations which it passes through-these are the familiar zodiac constellations. Because the planets all move in almost the same plane, with the exception of Pluto, they will all be found close to the line of the Ecliptic.

Vernal/Autumnal Equinox: The Vernal Equinox is the sun's position relative to the stars on the first day of spring (in the Northern Hemisphere), while the Autumnal Equinox is the sun's position relative to the stars on the first day of fall. More precisely, they are the sun's positions in the sky at the two exact times when the plane of the Earth's equator is the same as the plane defined by the Earth's revolution around the Sun. Selecting Guides | Vernal/Autumnal Equinox turns on or off these markers.

Summer/Winter Solstice: The Summer Solstice is the sun's position relative to the stars on the first day of summer, while the Winter Solstice is the sun's position relative to the stars on the first day of

summer. More precisely, they are the sun's positions in the sky at the two exact times when the plane of the Earth's equator is inclined at the largest angle (about 23.5 degrees) to the plane determined by the Earth's revolution around the Sun. Selecting Guides | Summer/Winter Solstice turns on or off these markers.

Zenith/Nadir: Selecting Guides | Zenith/Nadir turns on or off labels for the zenith (point directly above your head) and the nadir (point directly beneath your feet).

Note: If you are on the surface of a planet, you will not be able to look down to see the nadir.

Celestial Poles: The North Celestial Pole is the point in the sky which has a declination of 90 degrees. It is directly overhead the North Pole of Earth. The South Celestial Pole has declination -90 degrees and is directly above the South Celestial Pole of Earth. Selecting Guides | Celestial Poles turns on or off markers for these points.

Field of View Indicators: : Selecting Guides | Field of View Indicators gives you 4 options, representing 3 common sizes of binoculars, and the Telrad, a telescope attachment which is used to locate objects. For the binoculars, the first number is the magnification, and the second number is the width of the lens in millimetres. If you select one of these instruments, an outline appears in the centre of your screen which is the same shape and has the same field of view as the corresponding instrument. This is handy if you own one of these instruments, as the area inside the outline should correspond

very well to what you actually see through the eyepiece.

Tip: You can have more than 1 field of view indicator turned on at the same time.

Settings: This window allows you to change the colors of the celestial grid and ecliptic line, and also allows you to change the grid spacing.

Putting It All Together

This example combines all you have learned in this chapter by showing you how to change the look of Starry Night Backyard to locate an object. Your goal is to observe the Pleiades Cluster. The date is Dec.1, 2000 and you are located in Toronto.

1 Change the date to Dec.1, 2000 in the Control Panel.

2 Change your location.Click on your current location in the Control Panel. This brings up the Viewing Location dialog box. Click the lookup button. Select Toronto from the list of cities and then select Set Location.

3 Change the time to 6:30 PM in the Control Panel. This is when you plan to observe.

4 Select Edit | Find. Select Messier from the list of categories and enter M45. This is the Pleiades Cluster. Make sure that the option "Magnify for Best Viewing" is not selected. The program should put the Pleiades at the center of the screen.

5 In the Sky menu, make sure the following options are turned on: Small

City Light Pollution, Planets/Sun, Stars and Messier. This should show you enough stars to identify the general area of the Pleiades, but not too many to confuse you. Also open the Sky Settings window and make sure that the option Show Compass Points is turned on.

6 In the Labels menu: make sure the following options are turned on: Planets/Sun, Messier and Stars. Open the Label Settings dialog box and make sure that the settings for Messier labels have both common name and Messier number turned on. The Pleiades should now be named. You will notice that Jupiter and Saturn are both near the Pleiades. Jupiter is quite bright, and is a good guide for locating the Pleiades.

7 From the Guides menu, turn on the Celestial Grid.

8 Now assume you are observing the sky with a pair of 8 x 35 binoculars (if you own a different type which matches one of those listed in Starry Night Backyard, choose this instead). Go to Guides | Field of View Indicators and make sure that there is a checkmark beside 8 x 35 binoculars.You should see the small circular outline of the binocular eyepiece. This will show you where to point your binoculars.

9 Now we will get a close-up view which mimics what you would see through the binoculars. Zoom in using the Magnifying Glass in the Control Panel until the outline of the binoculars fills almost (but not quite) the entire screen.

If you want to observe the Pleiades in the sky and can't run Starry Night Backyard on a laptop, you may want to print two charts, one after step 8 to get a feel for where the Pleiades is in the sky, and one after step 9 to match what you should see through your binoculars. The two charts won't match your screen views exactly, because some of Starry Night Backyard's print settings are different than the options you selected, but they should appear similar. With these two charts in hand, you are well equipped to see this bright star cluster.

Chapter 6
Working With Files

In this chapter you will learn how Starry Night Backyard looks at files, and how to make your own Starry Night Backyard files. From these simple beginnings, you will move on to learn advanced topics such as making movies and viewing an eclipse from multiple windows.

Certain aspects of Starry Night Backyard are not specific to any one file, and will be the same every time you open the program. If you change these settings while using Starry Night Backyard, the program will use the changed versions the next time it starts up. These settings include the font and color of your labels, and all the options in the File | Preferences dialog box.

Tip: Whenever you see a button marked "Factory Defaults", this button restores all the settings in the dialog box to their original values.

You can open the File | Preferences window by selecting File | Preferences and any of the four options which then appear. You can scroll between these four types of preferences by using the dropbox at the top of the window.

General Preferences

Next and Previous: The Next and Previous buttons allow you to navigate through each window in the Preferences menu.

experience of panning across the sky to zoom in on the object of your search. To increase or decrease the speed of this animation, adjust the Panning Speed slider.
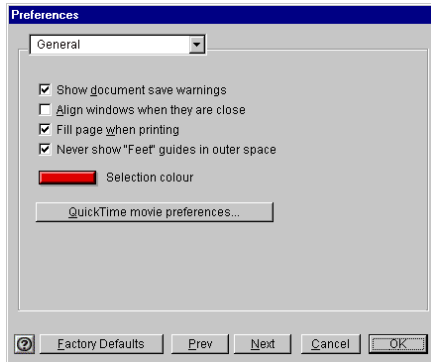
Show Document Save Warnings: When you close Starry Night Backyard, the program asks whether you want to save the changes to a Starry Night Backyard file. If you do not want this warning, deselect this option.

Align Windows When They Are Close: This option allows you to align the Planets List window with the border of the main Starry Night Backyard window.

Fill Page When Printing: If you select this option, Starry Night Backyard will print all of what you see on screen, plus part of the surrounding area to fill the page. If it is not selected, only what you see on screen will be printed.

You also have access to the QuickTime Movie Settings window. For more information, refer to "Making Movies" on page 60.

Scrolling Preferences

Panning Speed: Functions such as Find (choose Edit | Find) offer the exciting

Animate Location Change: Selecting this simulates the experience of flying through space and landing on an object after setting it as your viewing location (for example, selecting Go There for a planet in the Planets Window). We recommend leaving the animation speed slider set to its maximum, unless you have a very fast computer and find that the animation sequence is over too quickly. If you do not have this option selected, changing your location puts you instantly at the new location.

Note: Animated changes occur only when you change your location to a new celestial body. If you change to a new location on the same body, you will be placed instantly at the new location.

Time Step Delay: If you have the time mode in either Forward or Backward (see "Time Flow" on page 18 for more information on time modes), this controls how long the screen displays the current frame before advancing the time and drawing a new frame.

Update in Real Time: If you have the time mode in RealTime (see "Time Flow" on page 18 for more information on time modes), this determines how often the time is changed and the screen updated to reflect the new time. On slower computers, you should keep this value fairly high.

Cursor Tracking (HUD)

HUD stands for Heads-Up Display and refers to the information about an object that appears when you hover over it with the cursor. The normal information shown is the object's name, the constellation it belongs to, and the distance to the object (if known). Using this window, you can choose which of these three pieces of information you wish to show. The color bar beside each checkbox shows the color in which the information appears on screen. Clicking on the color bar allows you to change this color. You can also change the font, style and size of the top piece of information.
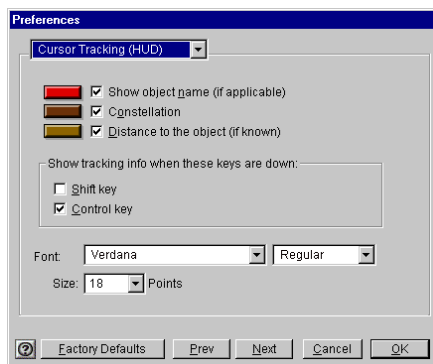
Show Tracking Info When These Keys Are Down: This will display the constellation which the cursor is currently pointing at, if the appropriate keys are held down.

What is a Starry Night File?

A file is a collection of information about the settings you have customized during your use of Starry Night Backyard. It includes information about your viewing time, your viewing location, and what you were looking at. It also includes information on how you have set up your view of the sky: whether you have light pollution turned on, whether the line of the Ecliptic is visible, and more. If you save a file in Starry Night Backyard, close the program, then open Starry Night Backyard again, you will see the default settings: your view will face south, the time will be the current time, etc. But if you open up the file you have just saved, then your screen should be restored to exactly the way it was before you saved the file.

What is a Starry Night Backyard file **not**? It is not a premade animation sequence which shows you blasting off from Earth, for example. All a Starry Night Backyard file does is establish the inital screen conditions-from then on you have complete control over how the program will evolve. If you want to make replayable animation sequences, read the section on "Making Movies" on page 60.

Using Files

This example teaches you how to use the File menu to save, open and modify files.

Example: Making a file of the August 11, 1999 solar eclipse (this eclipse is in the Interesting Events list, but it is instructive to learn how to recreate it yourself).

1 Click on the box in the Control Panel displaying your current location to bring up the Location menu.

2 Click the Lookup button and select Munich, Germany, from the list of cities.Click OK and then Set Location. The box in the Control Panel should now show Munich as your current location.

3 Set your time to 12:32:00 PM, and the date to August 11, 1999.

4 If the Planet List is not already open, open it by selecting Window | Planet List.

5 Click on the Sun in the Planet List and lock on it by clicking on the Lock icon. The Sun should now be in the center of your view, with the Moon almost directly in front of it, but not quite. The sky should still be bright (if you have daylight turned off, turn it back on now).

6 Set your time step to 3 seconds in the Control Panel.

You now have Starry Night Backyard set up perfectly to watch the solar eclipse.

7 To save your work, select File | Save. Name the file "Eclipse from Munich" and save it in the appropriate directory. Name the file "Munich Eclipse". Once you have saved the file, the main Starry Night Backyard window should now be called Starry Night Backyard-Eclipse from Munich, not Starry Night Backyard-Untitled.

You will now watch the eclipse.

8 Press the Forward button on the Time controls in the Control Panel. As time flows forward, the sky will gradually begin to get darker. The first object which you will see is Venus, to the

bottom left of the Sun. At about 12:38, the sky will go completely dark and all the stars will come out. This lasts only a few minutes before the sky gradually becomes light again. At about 12:42, stop time by pressing the Stop button on the Control Panel.

9 Close the file by selecting File | Close. Select Don't Save in the window which asks if you want to save changes. This will close Starry Night Backyard.

10 Restart Starry Night Backyard.After it opens, you should be at your home location at the current time.

11 Select File | Open. and choose "Eclipse from Munich" to open this file.Again you are in Munich, Germany at 12:32, looking at the Sun, in the best spot to watch the eclipse. You can press the Forward button on the Control Panel to watch it again, if you like.

Other File Features

The File Menu has many other features which are described below. These features work similarly to those found in most file-based applications.

New: This opens a new Starry Night Backyard window with all the default settings. The window you were originally looking at is not closed, but merely minimized.

Close: This closes the window which is currently active. If you only have one Starry Night Backyard window open, this will also exit the application.

Save As: This saves the file under a different name and changes the active window to this file.

Save a Copy As: This also saves the file under a different name, but doesn't change the active window to this file.

Revert: This command reverts the window to the last saved version of the active document. If you are not using a file which has previously been saved, this option is not available.

Exit: Closes Starry Night Backyard. If you have not saved changes made to any open documents, you are asked whether you want to save to a file. See "What is a Starry Night File?" on page 57 to learn what information is saved in a Starry Night file. If you added or edited an object using the Orbit Editor, you will also see a window reading "Planet Database Not Saved" which offers you the choice of saving the changes. **Any changes made with the Orbit Editor are not permanently saved unless you press Save in this window!**

Reversing Actions

If you have changed a saved file and resaved it, but find you want to go back to the original, you cannot use the Revert command, as it can only go back to the latest saved version. However, if you select Edit | Undo, you can reverse up to the last 50 actions you have done in your Starry Night Backyard file. Using Edit | Redo performs the actions again.

Multiple Windows

One of the most useful features of Starry Night Backyard is its ability to have multiple functional windows open at the same time. This opens up many exciting possibilities for the user. For example, you can view an event from several different locations at the same time, or view the sky at several different times.

Example: Simultaneously viewing a solar eclipse from the Earth, the Moon, and the Sun

Multiple windows are an excellent way to view the alignment of planets. In this exercise, we will examine a total solar eclipse from three viewpoints: the Earth, the Moon, and the Sun.

To view the eclipse from the Earth, just open the file you made earlier called "Eclipse from Munich" using the File | Open command.. After you have opened this file, don't start time moving forward, but leave it at 12:32.

To view the eclipse from the Moon:

1 Open a new window, and save it as "Munich Eclipse (from Moon)".

2 Adjust this window's size so that you can still see the "Eclipse from Munich" window that you previously created.

3 Using the Planet List, select the Moon and click Go There. Your viewing location is now on the Moon.

4 Set the time in the Control Panel to 10:32 for the "Munich Eclipse (from Moon)" window and the date to August 11, 1999. This is actually the same time as your other window viewing from Munich, even though it appears to be 2

hours different. If you look closely, you will see that the time is in UT. This is an abbreviation for Universal Time, which is defined to be the time in Greenwich, England, not taking into account Daylight Savings Time. Anytime you are in space or on another planet, your time will be shown in Universal Time. Munich is normally 1 hour behind Greenwich, and the Daylight Savings Time being used in Munich accounts for the second hour of difference.

5 On the Planet List, lock on the Earth. You should now be able to see the shadow of the Moon (the penumbra) projected onto the Earth.

6 If you want, use the Zoom tool and zoom up to about 1°. Use the Hand Tool to change your view northwards so that you see Europe. You should see a tiny black spot in the centre of the shadow. This is the umbra, the area on Earth which is currently seeing a total eclipse of the Sun. It should be almost above Munich at this time.

To view the eclipse from the Sun:

1 Open a new window and save it as "Munich Eclipse (from Sun)".

2 Adjust this window's size so that you can see the other two windows.

3 On the Planet List, select the Sun and click Go There. You are now located on the Sun.

4 Using the Planet List, lock on the Moon.

5 Set the time to 10:32 and the date to August 11,1999.

6 Using the Zoom tool, zoom in towards the Moon until about 17". This should give you a nice view of the Moon in front of the Earth, with the penumbra visible on the Earth's surface.

With three windows open, you can view the eclipse from all three locations simultaneously. Adjust your windows' sizes and positions so that they are all visible on your computer screen. Then press the Forward button in the Control Panel in each of the three windows to start their time moving forward. The eclipse now unfolds in all three windows.

Making Movies

You can make spectacular movies of any Starry Night Backyard view. Movies are played back using the QuickTime viewer, so you can send movies to your friends and colleagues. They do not need to have Starry Night Backyard to watch the movies.

To make a movie, select File | Make Movie. For reasons explained later in this section, it is best to hit the Stop button in the time controls on the Control Panel before you select Make Movie. After selecting File | Make Movie, the program will then open a window asking you to name your movie and pick a directory to save it in. The default name is Space Movie and the default location is the Starry Night Backyard directory. If you are making a movie for the first time, the Compression Settings window then comes up.

Compression Settings

If you have ever tried to download a video file from the Internet, you know how large these files can be. The same thing can happen with QuickTime movies because they are also composed of a series of still images. If you are using 30 frames per second (the standard rate for television images), this means 900 images for a 30 second video! It is easy to understand how even a short movie can easily be a few MB in size. The compression settings offer different ways to keep your movie files down to a manageable size.
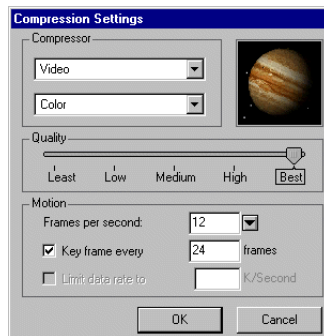
- *Compressor*: This popup lets you choose from several different compression formats. Depending on the compression format chosen, a second popup menu may allow you to choose from several colour options.

- *Quality*: The slider lets you adjust the quality of the recording. The better the quality, the larger the file size.

Motion: Within this box you can adjust how many frames per second are displayed when the movie is played back and how often to draw a key frame, and limit the amount of data stored per second to a maximum value.

Tip: After you have set your compression settings once, the Compression Settings window will not open automatically when you make subsequent movies. To change your movie preferences, you can select File | Preferences | Movies from the main menu.

Recording

Once you have closed the Compression Settings Window, a rectangular outline will appear in the center of the screen. The area inside the rectangle is being recorded.

Note: You cannot change the size of the movie window in Starry Night Backyard. Zoom in or out using the magnifying glass tools on the Control Panel to get the right scale for your movie.
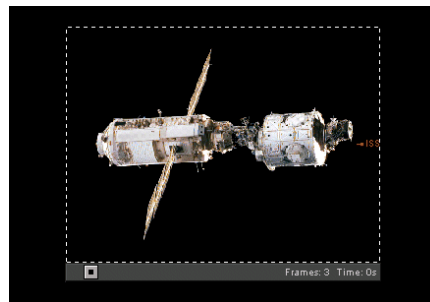
A new frame is added to the movie every time the screen is redrawn. There are two ways in which the screen is redrawn: if you change the screen display, or if time advances. Most changes you make in Starry Night Backyard change the screen display. Switching daylight on or off, changing the labels, zooming in or out and blasting off are just a few changes which

will cause a new frame to be recorded. Whenever the time changes the screen is also updated. Therefore, if you have time running before you select File | Make Movie, new frames will be added right away every time the time changes. This can happen before you have the screen set up so that the correct part of the sky is inside the movie frame. This is why it is best to stop time before you start to make a movie.

Once you are ready to start filming, just change the screen in any way you want or start time running. The number of frames currently recorded is shown in the bottom right corner of the window, along with the total running time of the movie. When you are finished recording, hit the Stop button along the bottom of the movie window.

Tip: To change viewing angles in the middle of a movie, stop time in the Control Panel and change your location (if you are going to a new celestial body, make sure that "Animate Location Change" is turned off in File | Preferencese | Scrolling). The movie will not start recording again until you restart time from your new location.

Playing Back Movies: You can use the QuickTime movie player to play back and/ or edit your movies. To play back a movie, double-click the file in the folder where you saved it.

Images

You can use images from Starry Night Backyard for many purposes: to post on your web site, to create images for teaching purposes, or perhaps even to make a birthday card for an astronomy

buff! To save a shot from Starry Night Backyard as an image, select File | Export as Image. This will bring up a familiar Save dialog box. One of the fields in this dialog box allows you to choose the format for your new image. You can choose from JPEG, bitmap, PICT, and many other popular formats.

The picture which is saved is an exact duplicate of what you see on your screen inside the main Starry Night Backyard window.

Appendix A
Frequently Asked Questions

This section answers the most common questions about Starry Night Backyard. If your question isn't answered here, check our Starry Night Backyard support web page:
www.siennasoft.com/english/support_backyard.shtml

If your question still isn't answered, contact us at
support@siennasoft.com

General Questions

Do I have the latest version of Starry Night Backyard?

From within Starry Night Backyard, select Help | Check for Starry Night Backyard Updates. This will connect you to the page on our website which describes the latest version.

As a registered user of Starry Night Backyard, do I get a special price if I want to upgrade to Starry Night Pro?

Yes, you will be able to upgrade to Starry Night Pro for a price which is approximately the retail price difference between the two versions. Check our website www.siennasoft.com for more details.

Is Starry Night Backyard Y2K compliant?

Yes. Neither the performance nor functionality of Starry Night Backyard is affected by dates before, during, or after the year 2000.

Can I post images made with Starry Night Backyard on my website?

Yes. We encourage you to put images and movies created with Starry Night Backyard on your website. We ask that you mention that the images were created with our software, and include a link back to our site. Beyond that, go for it!

Technical Stuff

How accurate are the positions of the planets and moons in Starry Night Backyard?

The position of the eight major planets should be accurate to within 5 arcseconds for times within 3000 years of the present. The theory used to predict Pluto's position is less accurate: between the years 1885 and 2099, its position is accurate to within 1 arcsecond, but the accuracy will decline significantly outside these dates. The position of our moon should be accurate to within 10 arcseconds for several thousand years in either direction. The theories used to predict the positions of other moons are simpler and, therefore, potentially less accurate.

How does Starry Night Backyard account for the refraction of light due to the Earth's atmosphere?

The bending of light due to the Earth's atmosphere is accounted for by simply lowering the horizon about 1/2 degree. This gives the correct rise and set times for the sun and moon but doesn't affect the relative positions of the stars.

Why doesn't the location of the International Space Station in Starry Night Backyard match what I see in the sky?

The orbital elements of artificial satellites (including the ISS) are constantly being adjusted slightly. You should check either www.siennasoft.com or www.livesky.com to find the latest orbital elements. You can then use the Edit command in the Orbit Editor to enter the new, correct elements in Starry Night Backyard.

Installation Problems

The QuickTime installer crashes when I run it or gives me an error message saying that there isn't enough space on the hard drive, even though there is. What should I do? (Windows only)

The first thing to do is make sure that you have enough free space on your hard drive. If you do, the problem may be that the "Temp" folder is full.

The QuickTime installer uses a temporary folder in your hard drive for storing files needed during installation. Under Windows 95 and 98, this directory is "C:\Windows\Temp". Under Windows NT 4, this folder is "C:\Temp". This folder may contain old files which interfere with the installation. To get around this:

1 Locate the original "Temp" folder and rename it "OldTemp".

2 Create a new folder named "Temp" and place it in the "C:\Windows" directory. Make sure it is named exactly as shown (i.e. make sure the first letter is capitalized).

3 Restart your computer.

The other possibility is that the QuickTime installer is conflicting with another application. You should try restarting your computer and running the installer immediately after startup. If this doesn't work, the conflicting problem may be a background application which is always active. Type Ctrl-Alt-Del to bring up a window which displays a list of all the programs running on your computer. Try shutting down the programs listed here one-by one and trying to run the installer after each program has been closed (Do not close the program named Systray-this is necessary to keep the computer running). The first programs you should try closing are those related to anti-virus software. Many of these programs cause conflicts with installers.

The Starry Night installer crashes when I run it. What can I do?

Please read the answer to the above question regarding the QuickTime installer. The information applies to the Starry Night installer as well.

Starry Night and QuickTime both installed OK, but when I try to run Starry Night, I get an error message. What can I do?

The first possibility is that you do not have enough RAM to run Starry Night Backyard. If your computer's RAM meets or exceeds the system requirements, you may have too many other open programs which are using up the RAM. Try closing other applications.

The second possibility is that there may be another application running which conflicts with Starry Night. Please read the advice about conflicting applications in the earlier question about installing QuickTime.

Time and Location

My city isn't in the list of cities in Starry Night Backyard's location window, and I don't know my latitude and longitude. Where can I find this information?

Several sites on the Web provide latitude/longitude information based on city name or zip/postal code. If you are located in the United States, try the Digital Map Company: www.geocode.com/eagle.html-ssi or the U.S. Census Bureau: www.census.gov/cgi-bin/gazetteer. If you are located elsewhere, try MapBlast: www.mapblast.com/mapblast/start.hm

Starry Night Backyard doesn't display the correct time when I start up. How do I fix this?

Starry Night Backyard reads the time from your computer's Control Panel. Make sure it is set correctly there, including any adjustments for Daylight Savings Time.

The correct time is shown when I start Starry Night Backyard, but the sun rises and sets at the wrong time. How do I fix this?

Most likely you have entered the wrong time zone for your home location. Select Go | Set Home Location to see what the time zone is set at. If you don't know your time zone, see this Internet site for a map of the world with time zones shown: http://aa.usno.navy.mil/AA/faq/docs/world_tzones.html If you are on Daylight Savings Time, do not compensate for this by adjusting your time zone. If you have set up your time settings in your computer's Control Panel correctly, this will be adjusted automatically.

I've moved. I've tried changing my location, but the next time the program starts up, it opens at my old location. How do I change my home location?

You have to change your home location by selecting Go | Set Home Location and enertering your new co-ordinates or looking up a new city from this window. Do not click on your location name in the Starry Night Backyard Control Panel to bring up the Location dialog box and change your information there. This just changes your current location, not your home location.

How do I...?

See an eclipse?

Select Sky | Interesting Events to bring up a list of eclipses and other astronomical events, sorted by date. Click on the one you want and select Local or Best View.
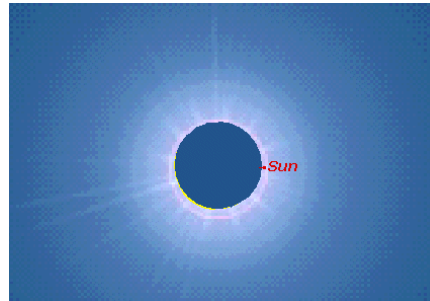
If you know the time and location of your eclipse, you can also reset your time and location in the Control Panel to that of the eclipse, and then press the Forward button to observe.

Go to Mars or another planet?

Open the Planets List by selecting Window | Planet List. Click on the planet you wish to go to, and press the "Go There" button.

Find a constellation?

Select Find from the Edit Menu, then type in the name of the constellation you want to find.

Find my Zodiac sign?

Adjust the date and time to your birthdate in the Control Panel. If you were born during daylight, choose Sky | Daylight to turn off daylight so that you can see the stars as they appeared at the moment of your birth. Turn on the Zodiac by selecting Constellations | Zodiac and labelling the Zodiac constellations by selecting Constellations | Labels. The constellation which the Sun is located in is your

astronomical Zodiac sign. This may not agree with your astrological sign. Astrology uses the constellation boundaries as they existed were set thousands of years ago, but they have shifted in the sky since then, due to the precession of the Earth.

Add my own planets or comets?

With Starry Night Backyard, you can add new or recently discovered planets using the Orbit Editor. For more information, refer to "Orbit Editor" on page 37.

Print star charts?

Adjust your window to the view you want, then choose File | Print.

Appendix B
Keyboard Shortcuts

Use these keyboard shortcuts to quickly access features you use frequently.

Keyboard Function	Windows	Macintosh
File Menu		
New	Ctrl-N	Cmd-N
Open	Ctrl-O	Cmd-O
Close	Alt-F4	Cmd-W
Save	Ctrl-S	Cmd-S
Print	Ctrl-P	Cmd-P
Exit	Ctrl-Q	Cmd-Q
Edit Menu		
Undo	Ctrl-Z	Cmd-Z
Redo	Ctrl-Shift-Z	Cmd-Shift-Z
Cut	Ctrl-X	Cmd-X
Copy	Ctrl-C	Cmd-C

Keyboard Function	Windows	Macintosh
Paste	Ctrl-V	Cmd-V
Find	Ctrl-F	Cmd-F
Find Again	Ctrl-G	Cmd-G
Select None	Ctrl-Y	Cmd-Y
Get Info	Ctrl-I	Cmd-I
Live Sky Info	Ctrl-Shift-I	Cmd-Shift-I
Go Menu		
Viewing Location	Ctrl-L	Cmd-L
Home	Ctrl-Shift-H	Cmd-Shift-H
Sky Menu		
Daylight	Ctrl-D	Cmd-D
Brightness/Contrast		Cmd-Option-M
Planets/Sun	Ctrl-Shift-P	Cmd-Shift-P
Artificial Satellites	Ctrl-Shift-A	Cmd-Shift-A
Planet List	Ctrl-Shift-T	Cmd-Shift-T
Stars	Ctrl-Shift-S	Cmd-Shift-S

Keyboard Function	Windows	Macintosh
Labels Menu		
Label Settings	Ctrl-E	Cmd-E
Constellations Menu		
Boundaries		Cmd-Shift-K
AutoIdentify		Cmd-K
Constellation Settings	Ctrl-K	Cmd-Option-K
Guides Menu		
Celestial Grid	Ctrl-Shift-C	Cmd-Shift-C
The Ecliptic	Ctrl-Shift-E	Cmd-Shift-E
Feet	Ctrl-Shift-F	Cmd-Shift-F
Guides Settings	Ctrl-R	Cmd-R
Scrolling		
Scroll Left	Left Arrow	Left Arrow
Scroll Right	Right Arrow	Right Arrow
Scroll Up	Up Arrow	Up Arrow
Scroll Down	Down Arrow	Down Arrow

Keyboard Function	Windows	Macintosh
Magnification		
Zoom Out	Page Up	Minus Sign
Zoom In	Page Down	Plus Sign

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