

SN8

STARRY NIGHT[®]

USER'S GUIDE FOR MACINTOSH AND WINDOWS

www.starrynight.com

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Chapter 1

Getting Started

Welcome

The invention of desktop astronomy software has been the most exciting new development in the astronomy hobby in years, perhaps since that night four centuries ago when Galileo pointed the newly invented telescope at the heavens for the first time! Starry Night is the premier astronomy software package on the market, putting more power and knowledge in your hands than even the world's preeminent astronomers had just a few years ago.

You can not only look into the past, but you can see how the sky will look tonight, tomorrow, or far into the 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.

This guide is designed to help you harness the full power of Starry Night. Enjoy the ride!

Outline Of This User's Guide

This User's Guide provides instructions for using Complete Space & Astronomy Pack (CSAP), Enthusiast, Pro, and Pro Plus. Follow the instructions for Pro if you own Starry Night High School, Starry Night Middle School or Starry Night College. Follow the instructions for Enthusiast if you own Starry Night Middle School. There are some exceptions for Podium where noted.

Everyone using Starry Night should read chapters 1 and 2 of this User's Guide for a basic understanding of how to use the program. Chapter 7 only applies to Starry Night Pro and Pro Plus, while chapter 10 applies exclusively to Starry Night Pro Plus.

After reading chapters 1 and 2, you may want to explore the program on your own and only refer to the User's Guide if you have questions about a specific feature. Alternately, you may wish to read the entire User's Guide. This is especially beneficial if you wish to learn more about features that may not be available in your current Starry Night product.

Below is a brief summary of each chapter in the User's Guide.

Chapter 1: Getting Started tells you how to get Starry Night up and running for the first time.

Chapter 2: Basics covers the most frequently used features in the program.

Chapter 3: Appearance of the Sky shows you how to modify the onscreen appearance of Starry Night.

Chapter 4: Sky Data shows you how to get more information about astronomy and the sky in general.

Chapter 5: Object Databases describes the different types of celestial objects included in Starry Night and the information you can learn about each object.

Chapter 6: Bending Space & Time takes a detailed look at the features of Starry Night that let you visit other locations in the universe, view the sky from dates in the past or future, and modify the speed at which time in Starry Night moves forward. This section will be particularly useful for educators who plan to use Starry Night simulations to demonstrate astronomical concepts.

Chapter 7: Observation Tools describes some of Starry Night's astronomy tools that go beyond displaying the sky. Some examples are telescope control, observation planning, and logging.

Chapter 8: Working With Files teaches you how to save files and capture color images using Starry Night.



Chapter 9: Adding Your Own Data teaches you how to expand the vast library of data that is built into Starry Night. You will learn how to create your own constellation sets, add custom images, and even build your own databases!

Chapter 10: Starry Night Pro Plus teaches you about the features that make Starry Night Pro Plus the most realistic astronomy program. You will learn about the AllSky CCD mosaic, exclusive databases, and the plug-in to MaxIm DL imaging software.

Appendix A: Keyboard Shortcuts is a handy reference table listing the Windows and Mac keyboard shortcuts for the features in Starry Night.

Feature Dividers

Because this is a universal User's Guide for all Starry Night products, not all features mentioned in this guide will be available in your specific product. These product specific differences are indicated either in the text or with dividers that specify in which products the features are available.

Features or controls being described for the specific product(s) are contained in the boxes shown below. Features that follow outside of this

PRODUCT SPECIFIC FEATURE

PRO PLUS ✓ **PRO** ✓ **ENTHUSIAST** —

Denotes features and controls that are available in Starry Night Pro and Starry Night Pro Plus.

PRODUCT SPECIFIC FEATURE

PRO PLUS ✓ **PRO** — **ENTHUSIAST** —

Denotes features and controls that are available in Starry Night Pro Plus.

box apply to all products applicable to the chapter you are currently reading.

Note: All screenshots shown in this User's Guide were captured with Starry Night Pro Plus. Unless otherwise noted, some features shown on the screenshots might not be available in your product.

If you read about a feature or control not in your current product, you can purchase an upgrade for one of the more advanced programs at any time by visiting <http://www.starrynight.com>.

Starry Night Companion

This User's Guide will teach you how to use Starry Night. The second book included with your package, Starry Night Companion, is a guide to learning more about astronomy and the night sky. This 200-page book, written by astronomer John Mosley, is your tour guide to the universe and will help you appreciate what you see when you are outdoors looking up at the night sky.

You can access an electronic version of Starry Night Companion by choosing **Help>Companion Book** from the main menu.

Special Fonts

Two special fonts are used throughout this User's Guide:

1) Command Font: This font is used to indicate a button, clickable area, keystroke, or menu choice.

Examples:

- 1 Click the **Online Info** button.
- 2 Press the **Ctrl-Alt-Delete** keys.
- 3 Choose **File>Open** from the menu.

2) File Font: This font indicates a folder or file, either on your hard drive or the Starry Night DVD. File and folder names are always enclosed in quotations.

Examples:

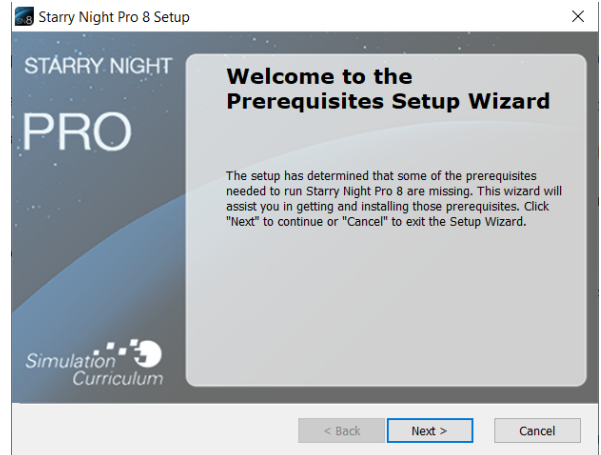
- 1 Locate the "satellites.txt" file on the DVD.
- 2 Your comet data is saved in the "Starry Night\Sky Data\" folder.

Installing Starry Night

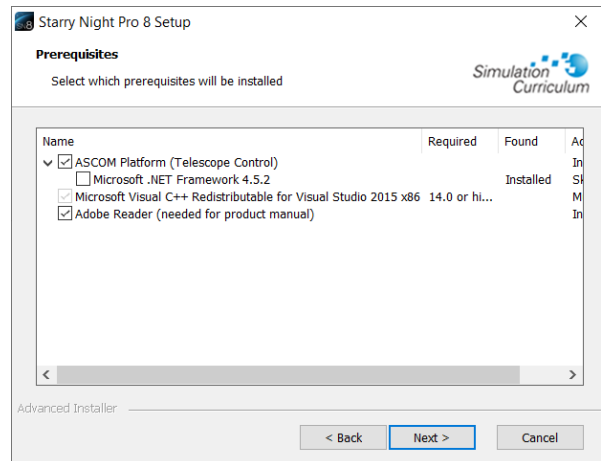
Depending on how you purchased Starry Night, you will either receive Starry Night via software download or DVD-ROM. The installation instructions will be the same for both options. However, you will need a DVD-ROM drive to install the program from a disc. All discs include both the Windows and Macintosh versions.

Windows:

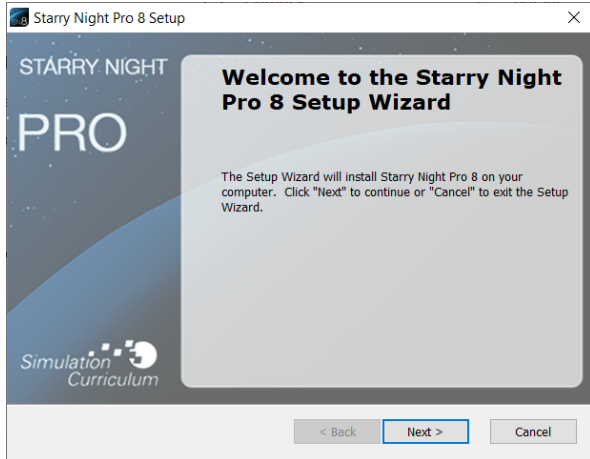
- 1 Click on the downloaded Starry Night file or insert the Starry Night disc in the DVD-ROM drive.
- 2 A window will pop up onscreen with instructions on installing prerequisites required to run Starry Night. Follow the instructions that appear.



The Prerequisites Wizard only installs a required program if it is not currently installed on your computer. Prerequisite programs include Adobe Reader (needed for product manual), Microsoft C++ Redistributable, and ASCOM (needed for telescope control in Pro and Pro Plus).



- 3 After the prerequisite install, a window will pop up onscreen with instructions on installing Starry Night. Follow the instructions that appear.



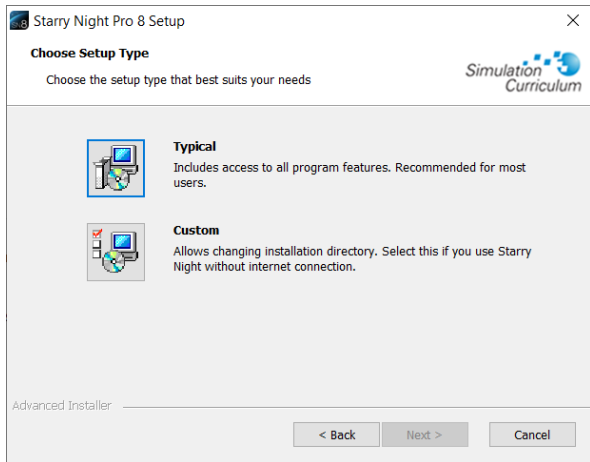
Pro and Pro Plus users have the option to select a **“Typical”** or **“Custom”** install. The **“Typical”** install option will install the most common program features and is recommended for most users. The **“Custom”** install option allows you to select which extra data to install and is recommended for advanced users.

The **“Custom”** install option in Starry Night Pro allows you to install horizon panoramas and Planet Images for offline use. Pro Plus users will have an option to install additional AllSky Image data for offline use.

PRODUCT SPECIFIC FEATURE

PRO PLUS ✓ **PRO** — **ENTHUSIAST** —

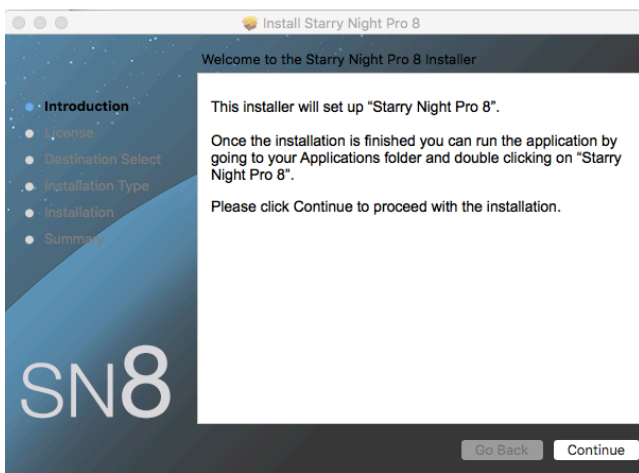
Windows users do not need to install a separate plug-in for Maxim DL imaging software, it is packaged into the main Starry Night installer. See **“MaxIm DL Plug-In (Windows only)”** on page 150 for more information on MaxIm DL.



Macintosh:

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

- 1 Click on the downloaded Starry Night file or insert the DVD into the DVD-ROM drive and double-click on the Starry Night installation icon.
- 2 A window will pop up onscreen with instructions on installing Starry Night. Follow the instructions that appear.



PRODUCT SPECIFIC FEATURE

PRO PLUS ✓ **PRO** ✓ **ENTHUSIAST** —

Macintosh users do not need to install a separate driver for telescope control, it is packaged into the main Starry Night installer. Telescope control is not available in Starry Night Enthusiast.

Running Starry Night

Once you have installed Starry Night, you can run the program as follows:



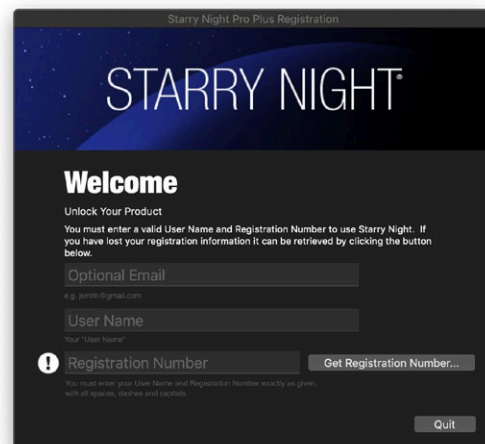
Windows: Double-click the Starry Night icon on your desktop, or select it from your start menu.

Macintosh: Double-click the Starry Night icon in the Applications folder.

Registering

When you run Starry Night for the first time, you will be prompted to enter your name and registration number. If you do not have your unique registration number, click **Get Registration Number**. For this to work, you must have an active Internet connection.

Registering makes it possible for us to notify you of any upgrades, bug fixes, or plug-ins as they become available. You may also be eligible for reduced upgrade prices to other astronomy software programs. You can update your registration information at any time in the future by visiting <http://www.starrynight.com/register>.



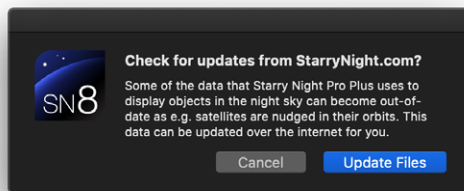
Tip: You can retrieve your registration number at any time by choosing **Registration** from the **Help** menu (Windows) or the **Starry Night** menu (Macintosh).



After you have typed in your name and registration number, press **OK** to begin Starry Night.

Data Updates

Starry Night will attempt to connect to our website and download updated data files each time you start the program. Downloading these files ensures that any new comets, asteroids, satellites, or tours are added to the program. You can update these data files at any time by choosing **Help>Update Data Files...** from the application menu. See “Database Updates” on page 67 for more information on updating data files.



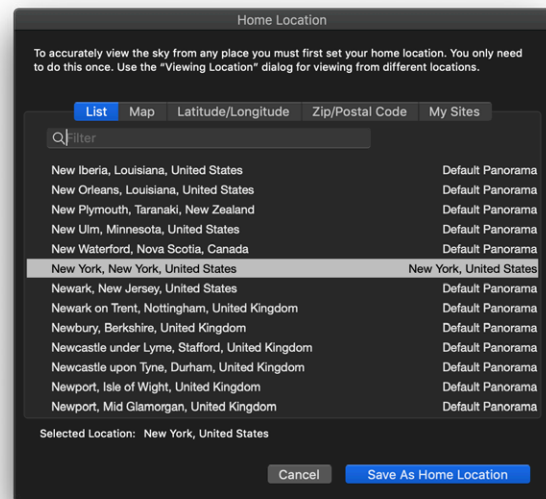
Note: Updating data files is not the same as updating the program itself. To ensure that you are running the latest version of Starry Night, see “Program Updates” on page 9.

Setting Your Home Location

The first time Starry Night runs, a dialog box opens that asks you to set your home location. Once you have done this, you do not need to change your home location unless you move.

Tip: If you have an active Internet connection, Starry Night will attempt to use your computer's IP address to set your home location automatically. This method should place your location within a few miles, which is sufficiently accurate for most astronomical observations.

1 Click the **List** tab. This displays a huge database of cities throughout the world.

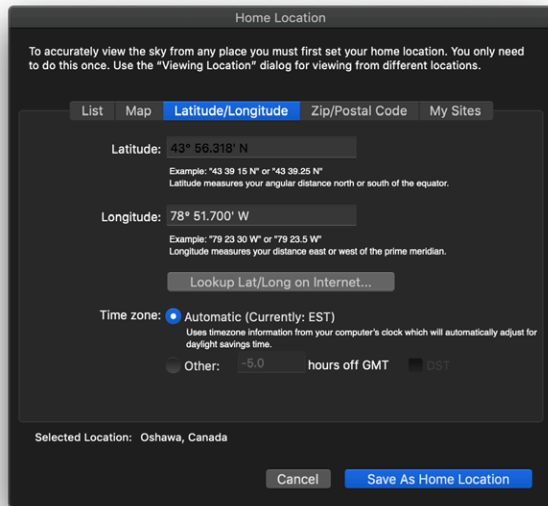


2 Type your location name in the search field or use the scrollbar on the right to look through the list. If your home city is listed, click on its name to highlight this city. Press the **Save As Home Location** button to save the changes. If your city is not listed, try entering your zip/postal code by pressing the **Zip/Postal Code** tab. If your city is still not listed, proceed to step 3.

Tip: A list of astronomical observatories is included in the location list. To see this list, type “Observatory” in the search field.

3 Click the **Latitude/Longitude** tab. Type in your latitude and longitude. You can enter these values in degrees, degrees & minutes, or degrees, minutes & seconds. Starry Night will convert your values to degrees and minutes. You must also enter the correct time zone. Time zones are calculated according to the time difference from London, England. For example, all communities on Eastern Standard Time are 5 hours behind London, so you would enter “-5” if you are on Eastern Standard Time. If you do not know your latitude, longitude, or time zone, click

Lookup Lat/Long on Internet for Internet resources that will help you find this information.



- Once you have entered your coordinates, click the **Save As Home Location** button.

Tip: If you ever move and need to change your location (or if you initially enter your home location incorrectly), choose **Set Home Location** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh) to enter a new home location.

Starry Night For the First Time

After you have entered your home location, the main screen of Starry Night appears. This window shows what you would see if you stepped outside at the current time, and looked south from your home location. Direction markers 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 is shown to give you some perspective.

The current time is shown in the upper left corner of the screen.

☰ December 4 2018 CE 8:39:25 AM

Note: The current date and time are calculated from your computer's clock. If your computer's clock is incorrect, Starry Night may show night when it is day outside, or vice versa. See "Time & Date" on page 15 if you do not know how to change your computer's clock settings.

Most of the controls in Starry Night will probably look unfamiliar to you. The next chapter will show you how to use them and become more comfortable with the program.

Importing Starry Night 7 Data

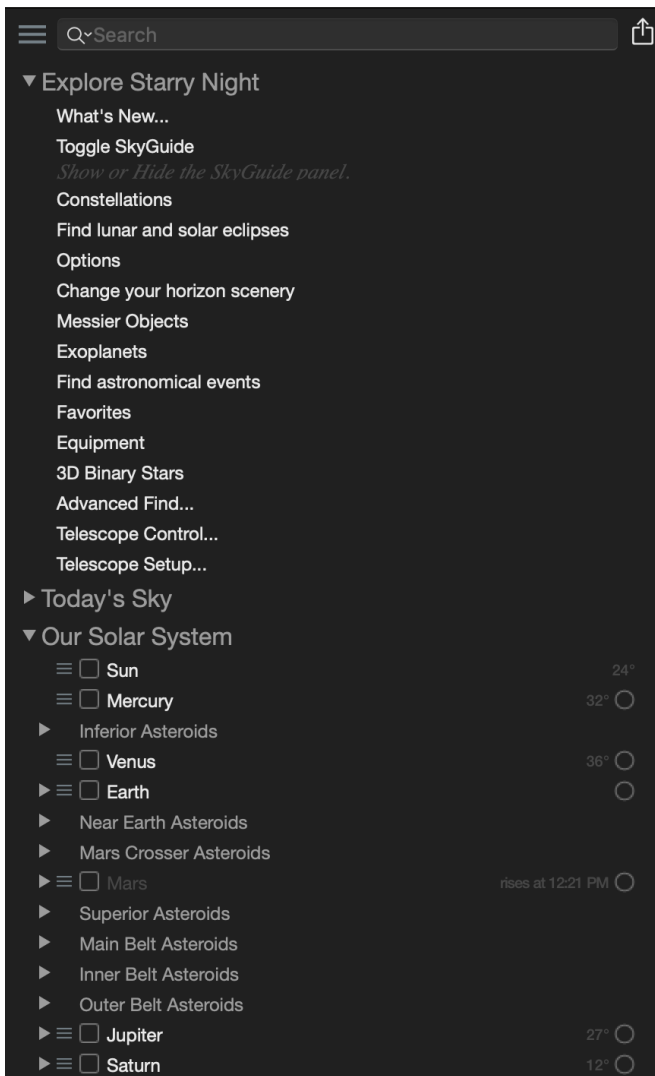
If you have version 7 of Starry Night installed on your computer then you can recover your previous custom data by importing it into Starry Night 8.

Starry Night 8 will recover your Equipment, FOV Indicators, Observing Lists, and Log entries.

To begin importing your Starry Night 7 custom data into Starry Night 8, select **Import V7 Data** from the **Help** menu.

The Search Results Pane

Each time you open Starry Night, the search results pane will open on the right side of the program window. By default, it lists all solar system objects and observable celestial events visible today from your current location.



To center an object or to view an event, double-click on its name. Click the ☰ button found immediately to the left of an object or event name to open a contextual menu with additional options.

Tip: If you wish to open Starry Night with different search results other than the default pane, choose **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh), press the **General** tab at the upper left corner of the Preferences dialog box, and type in a new default search. For example, typing “SkyGuide” will show the SkyGuide pane by default the next time you open a new Starry Night window. To open Starry Night with the search results pane closed, leave the default search field blank.

Getting Help

Hopefully this User's Guide will help you master Starry Night! But if you still have questions, there are plenty of places to turn for help.

Contextual Help: Hold the cursor over any of Starry Night's controls, and a text box will pop up that describes the function of that control.

Electronic Manual: Choosing **Help>User's Guide** from the menu opens the PDF version of this manual.

Discussion List: The Starry Night Discussion List is a newsgroup that allows you to ask questions and share tips with other owners of Starry Night. At press time, the Discussion List had more than 9,000 members, so it is an excellent resource. Sign up for this list at <https://groups.yahoo.com/neo/groups/StarryNight/info>

Contact Technical Support: You can contact our technical support staff at <http://www.astronomy-support.com> for help with your problems.

Social Media: Join us on Facebook <https://www.facebook.com/StarryNightSoftware> and Twitter <https://twitter.com/starrynightedu>

Program Updates

Starry Night is updated on a fairly regular basis. Updates may add new features, or may fix bugs in the existing program. To find out if you are running the latest version, select **Check For Application Updates** from the **Help** menu. The updater will automatically download and install any required updates.

To find out your current version number at any time, choose **About Starry Night** from the **Starry Night** menu (Macintosh) or the **Help** menu (Windows). A new window will open, and this window will have your version number in the bottom left corner.

Version 8.0.0

We recommend that you check for program updates soon after you install the program, to ensure that you are running the most up-to-date version of Starry Night.

Product Upgrades

Whether you're an astrophotographer, serious amateur astronomer or new to the night sky, Starry Night has software that meets your needs.

As a user of Starry Night, you qualify for discounts on upgrades to new and advanced versions of Starry Night.

An upgrade allows you to move from an old version to a new version of the same title, for example Starry Night Pro 6 to Starry Night Pro 7, or to a more advanced product, for example, Starry Night Enthusiast 7 to Starry Night Pro Plus 7.

Even if you own a planetarium software program other than Starry Night, you can still qualify for a discount.

Visit <http://www.starrynight.com> and click on the **"Store"** link for details on great offers.

Starry Night Website

More information about Starry Night and other astronomy products is available at our website, <http://www.starrynight.com>.

Chapter 2

Basics

It is impossible to cover all of the features of Starry Night in one short chapter. However, you will use certain features much more than others. This chapter will show you how to use the 13 most important features in Starry Night. Once you have read this chapter, you will be able to use Starry Night effectively as a guide to the night sky.

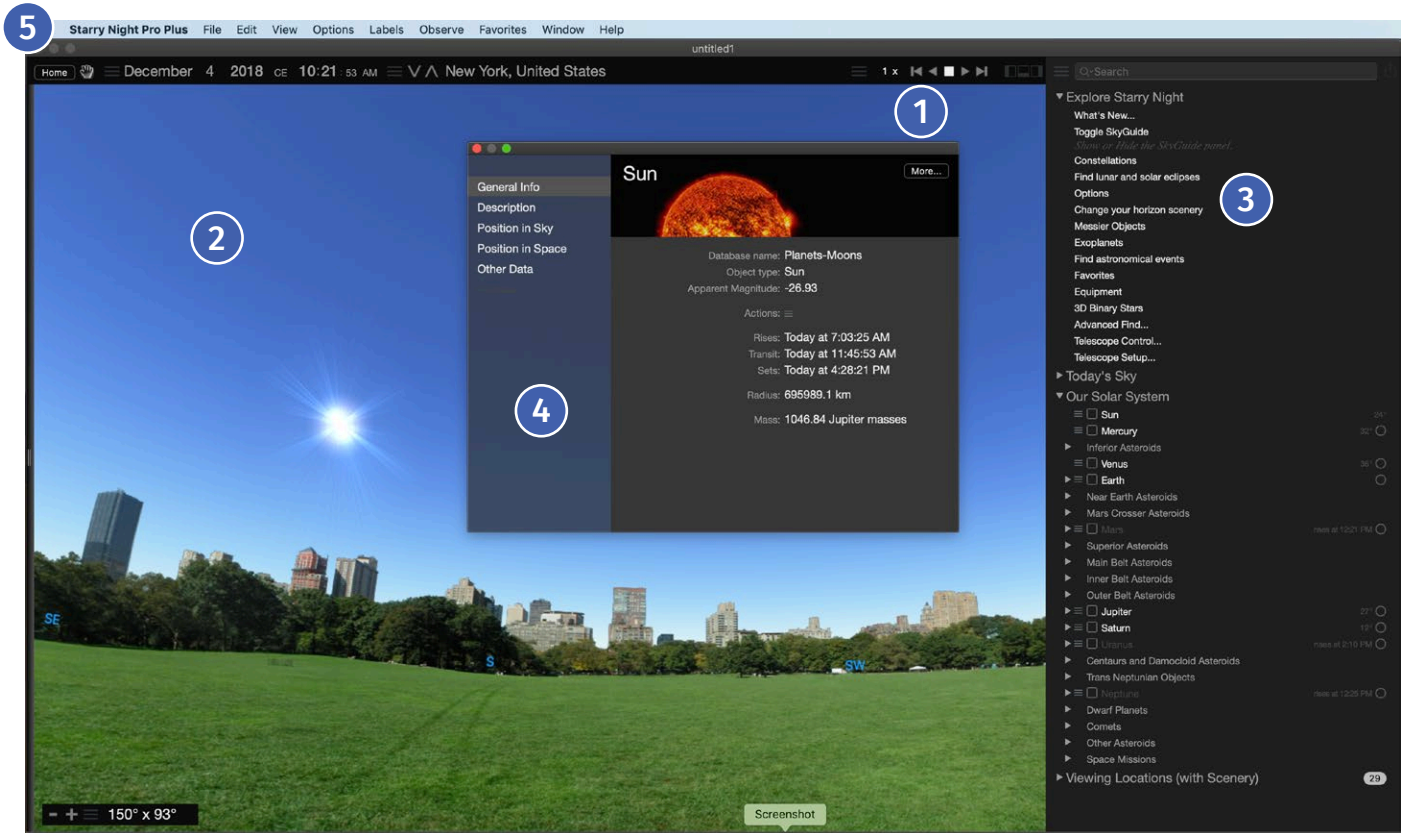
13 Important Features

Here are the key tasks you will learn to perform with Starry Night in this chapter:

- 1 Use the controls.
- 2 Take a Guided Tour (SkyGuide).
- 3 Change your viewing direction.
- 4 Change the date and time.
- 5 Identify objects in the sky.
- 6 Label objects.
- 7 Display constellation figures.
- 8 Find objects.
- 9 Find celestial events.
- 10 Zoom in on objects.
- 11 Learn more about any object.
- 12 Print star charts.
- 13 Tool Selection.

Using The Controls

All of the controls in Starry Night are in five areas of the screen: ① the toolbar, ② the main window, ③ the search results pane, ④ the floating info windows, and ⑤ the application menu. There is more than one way to access many of the features in Starry Night—for example, you may be able to access a feature through the main menu and through the search results pane.



Toolbar: The toolbar is the strip of buttons that runs just above the main window. The toolbar has the following controls (*each set of controls is explained in a later section*):

Time and Date

☰ December 4 2018 CE 8:39:25 AM

Time Flow Rate

☰ 1x ◀ ▶

Viewing Location

☰ ∨ ^ Minneapolis, United States

Pane (SkyGuide/Graph Tool/Search Results) Open/Close

☐ ☐ ☐

Pane Shortcuts

☰

Search

🔍 Search

Share

📤

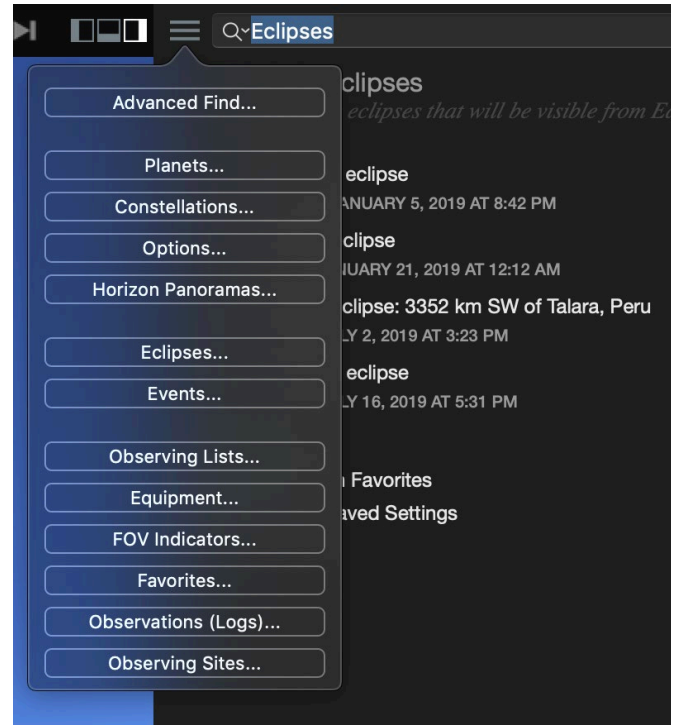
Main Window: The main window displays a realistic view of the sky. The main window has the following control:

Zoom (FOV)

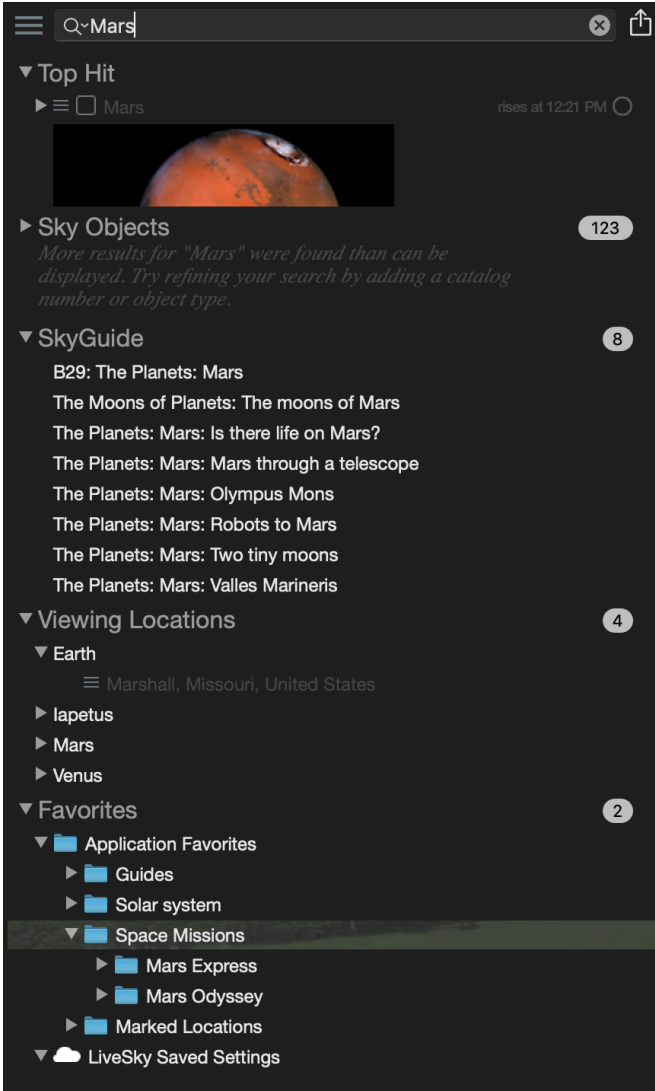
- + ☰ 150° x 106°

Search Results Pane: The search results pane appears along the right side of the screen.

Typing a search term or the name of a search results pane in the toolbar or selecting a search results pane by clicking the **Pane Shortcuts** button, causes the pane to slide out, revealing a set of controls.



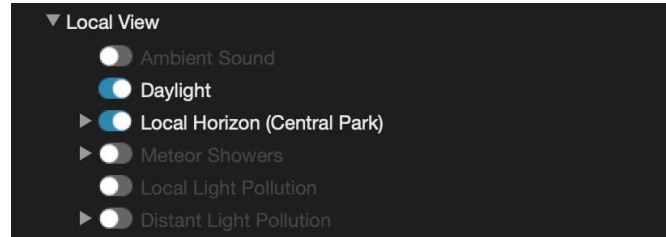
Tip: The search results pane opens to a default width. However, by clicking along the left edge of the pane and dragging the mouse, you can make the pane narrower or wider.



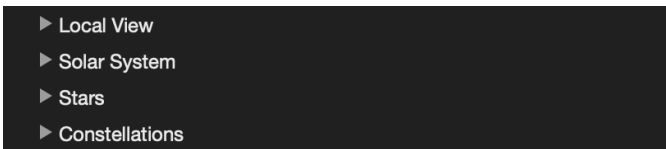
Within a pane, you can expand or collapse various layers by using these buttons:

Expanded layer. ▼ Collapsed layer. ►

Layer (expanded)



Layer (collapsed)



Each of the type of search result panes controls an important function in Starry Night, and is explained in detail in a later section.

Starry Night CSAP and Enthusiast includes the following search results panes:

Pane	Details on Page
Planets	34
Options	24
Favorites	117
SkyGuide	56
Events	92
Constellations	42
Eclipses	122

Starry Night Pro and Pro Plus include all of the search results panes listed above and adds the following:

Pane	Details on Page
Observing Lists	99
Equipment	108
FOV Indicators	108
Observing Logs	103
Observing Sites	105

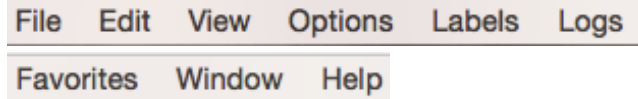
Floating Info Windows: In addition to the search results panes, some controls are available in floating windows. Floating windows can be moved anywhere onscreen or across multiple displays.

Floating Window	Details on Page
Object Info	76
View Status	57

Starry Night Pro and Pro Plus include all of the floating panes listed above and adds the following:

Floating Window	Details on Page
Telescope Control	108

Menu: The menu runs across the top of the screen, above the toolbar. Clicking on an item in the menu expands the menu to reveal additional options.



Taking A Guided Tour (SkyGuide)

The **SkyGuide** pane is a link to dozens of interactive multimedia tours that explore the fascinating science and history of the solar system, the stars, the galaxies, the beginning of time, and the fate of the universe. SkyGuide works just like a web browser; click on the links to take a tour.

To start exploring right away, type “SkyGuide” in the toolbar search text box and click on any of the tour links.



Changing Your Viewing Direction

By default, Starry Night always opens with your view facing south, looking slightly above the horizon. You can then adjust this view to look in any direction.

Tip: In *Starry Night Pro* and *Pro Plus*, if you would prefer that *Starry Night* open with your view facing in a direction other than south, choose **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh), click the **General** tab in the upper left corner of the **Preferences** dialog box, and adjust the “**Default Viewing Direction**” slider. You can also adjust the default altitude (how high above the horizon you are looking).

The default cursor icon in *Starry Night* is a hand. When you hold the mouse button down, you will see the hand close, as if it is “grabbing” part of the sky. If you hold the mouse button down and drag the mouse, your view shifts in the direction that you moved the mouse. You can also use the compass points marked along the horizon to find your viewing direction.



Zenith and Nadir Markers: If you adjust your view so that you are looking high above the horizon, you may see a red marker. This marker identifies the zenith, the point in the sky that is directly above your head. If you are located in space, you can also look straight down to see a marker for the nadir, the point directly beneath your feet. If you are located on Earth or another planet, you are limited in how far down you can look. You are able to look only slightly below the horizon, and cannot see the nadir.

Changing The Date And Time

When you open *Starry Night*, you may see a bright blue sunny sky, a dark sky filled with stars, or a twilight realm with only a few bright stars showing. This is because *Starry Night* always opens showing the sky at the current date and time. The date and time are shown in the upper left corner of the toolbar.

Starry Night uses your computer clock to determine if Daylight Saving Time should be turned on. Manually turn Daylight Saving Time on or off by selecting it from the Date and Time contextual menu.

To change the date or time, just click on it. The date or time will light up, and you can type in a new value. You can also use the up/down keyboard keys, the scroll wheel on your mouse, or click-hold on a value and drag your mouse left and right.

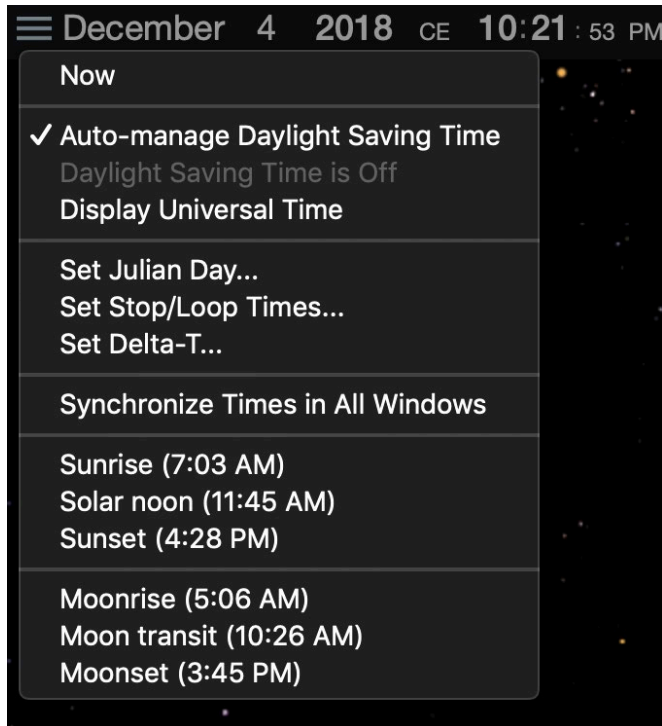
☰ December 4 2018 CE 10:21 : 53 AM

If *Starry Night* is showing a daytime scene, try changing the time so that it is night. If you already see a night scene, change the time so that it is day. *Starry Night* allows you to set the date from anywhere between 4 713 B.C. and 9 999 A.D. for *Enthusiast* and, 99 999 B.C. and 99 999 for *Starry Night Pro* and *Starry Night Pro Plus*.

Tip: As you are working through the rest of the features in this chapter, you will probably want to set the time in *Starry Night* so that the sky is dark. In the day, only the sun will be visible onscreen, and it will be difficult to use some of the features.

☰ December 4 2018 CE 10:21 : 53 AM

Special Times: Immediately to the left of the date display in the toolbar is a pull-down menu button ☰ that lets you quickly change the time to one of several key times. This menu is not available in Starry Night CSAP.



You can reset the time to the current time by selecting **Now** or set the time to **sunrise**, **sunset**, **moonrise** or **moonset**. You can also change to **solar noon**, the time at which the sun is highest in the sky, or **moon transit**, the time at which the moon is highest in the sky. Starry Night Pro and Pro Plus users have additional options to set the Julian Day and Delta-T values.

Identifying Objects In The Sky

If you point the cursor at any object shown onscreen, information about the object will automatically appear. This is Starry Night's **Heads-Up Display (HUD)**. Displayed are the object's name, the constellation it is in, and its distance (if known) from Earth. This makes it easy to identify any of the points of light displayed onscreen.



You can choose which information fields are displayed when you point the cursor at an object. See "Heads-Up Display (HUD) Options" on page 52 for more details.

Labeling Objects

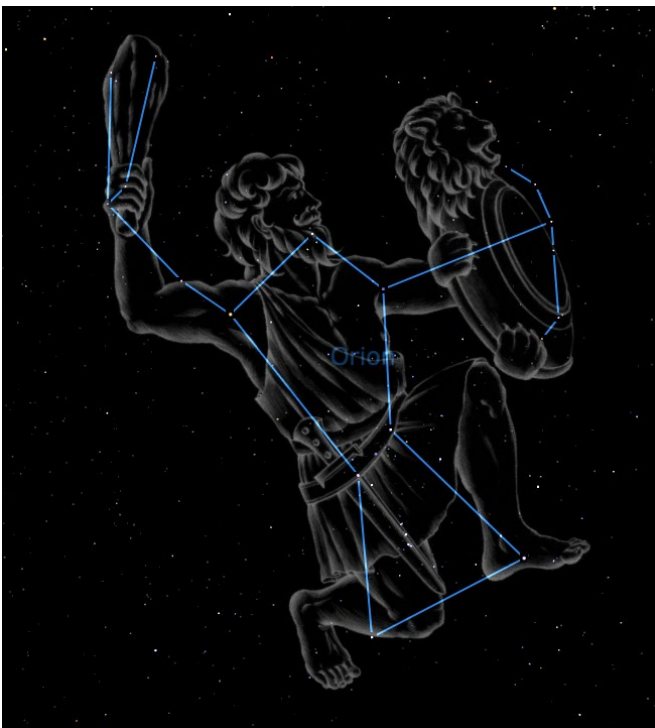
The Heads-Up Display is great for finding out what a specific object is, but it's not much help if you want a quick overview of all of the brighter objects onscreen. The best way to quickly identify all bright objects is to choose **Labels>Show All Labels** from the menu or by pressing the "L" keyboard key. This labels the brightest objects in each category (stars, constellations, planets, deep space objects). You can turn these labels off again by choosing **Labels>Hide All Labels** or by pressing the "L" keyboard key.

Starry Night offers much more precise control over object labels. You can label only certain types of objects, increase/decrease the number of labels, or label only the objects that you select. See "Labeling Celestial Objects" on page 29 for more information.

Displaying Constellation Figures

For thousands of years, stargazers have joined the brighter stars together into patterns that we call constellations. Astronomers currently recognize 88 constellations, which together cover the entire sky. Knowing which constellation an object is in is the first step to finding the object.

On most versions of Starry Night you can turn on the stick figures for the constellations by choosing **View>Constellations>Astronomical** from the main menu (or by pressing the **K** keyboard key). Choosing this option again will remove the figures. Use the **Labels** menu in Starry Night to turn on/off the constellation labels.



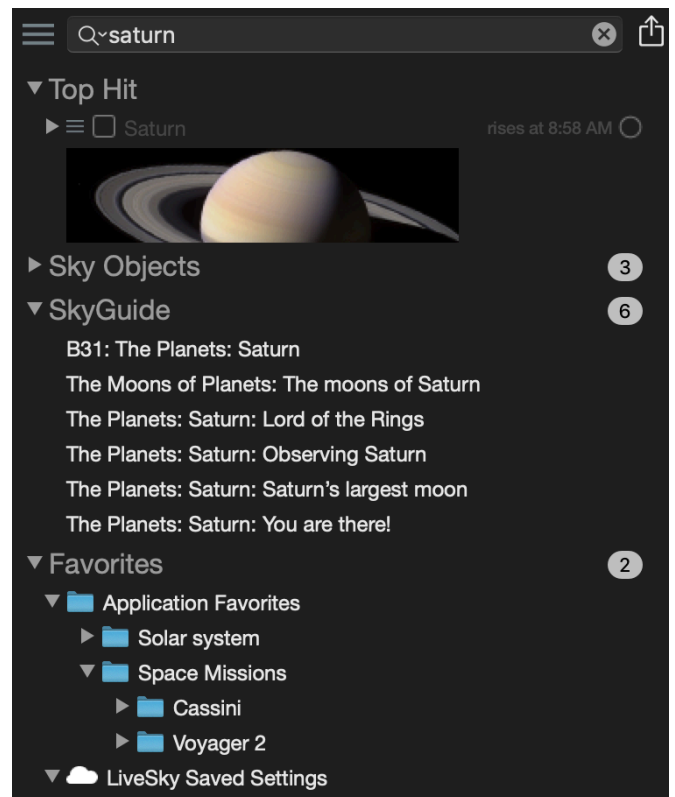
Many more options exist in Starry Night for displaying the constellations. These options are outlined in “Constellations” on page 42.

Finding Objects and more with Universal Search



Starry Night's *Universal Search* helps you locate not only sky objects but also celestial events, display options, favorite files, observing lists, SkyGuide pages, and viewing locations.

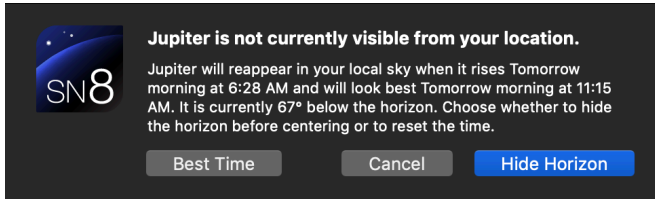
If you are interested in finding a specific object, such as a planet or a bright new comet, click in the text box at the top right of the toolbar and type in the first few letters of the object you are looking for. As you type, Starry Night displays a list of objects that match your name. Universal Search will also return any favorites, display options, events, observing lists or SkyGuide pages that might be relevant to your search.



Once the object that you are looking for appears in the list, double-click on its name, and Starry Night will center on the object.

You are not limited to searching for specific sky objects. Typing “planets” for example will display a list of solar system objects, SkyGuide pages about the planets, display options to control the appearance of planets in the main sky window, and favorite files that take you to previously saved views of the planets. If you want to turn on the constellations, learn about them or adjust their appearance, just type “constellations”.

Tip: The object you are searching for may be hidden beneath the horizon. If this is the case, Starry Night will offer you the option of hiding the horizon or advancing the time forward to a time when the object will be above the horizon. Objects below the horizon are greyed out.



Panning To Found Objects: By default, Starry Night slowly pans to objects that you have double-clicked on in the search results pane. This feature is handy because it allows you to see where the new object is relative to your current view.

If you choose **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh) and choose the **Step/Pan** tab at the top of the **Preferences** dialog box, you will see a slider and checkbox named “Pan to found objects”. Adjusting the slider changes the speed at which Starry Night pans to found objects. Unchecking the box disables the panning feature completely, so that your view changes instantly to the “found” object as soon as you double-click on it.

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 the **Esc** key.

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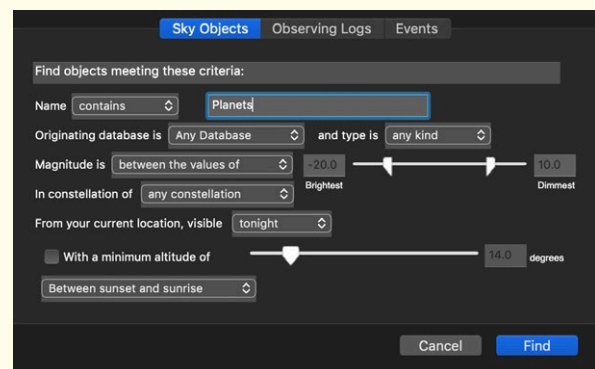
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Advanced Find: By default Starry Night searches for objects whose name contains the letters typed in the text box in the toolbar.

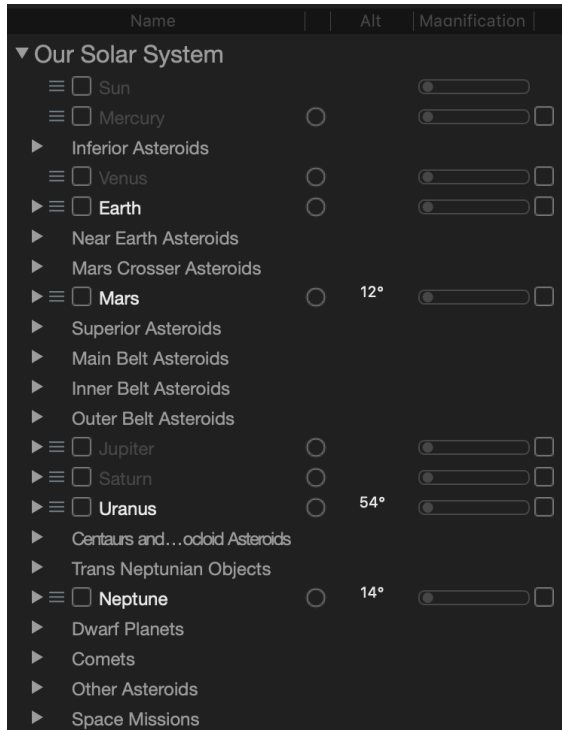
Clicking on the **Pane Shortcuts** button ☰ in the toolbar and selecting **Advanced Find** opens a dialog window with additional search options. You can customize your search by selecting to find objects that exactly match, contain or end with the letters you entered in the text box. Other options allow you to filter by database, constellation, magnitude and many other useful filters.

Click on the **Observing Logs** tab to search your object log entries. See **Log Book** on page 103 for more information on adding logs.

Click on the **Events** tab to search for celestial events. See **Event Finder** on page 91 for more information on filtering events.

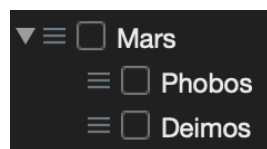


Solar System Object List: If you clear the text box on the right side of the toolbar, you will see a list of solar system objects and visible celestial events.



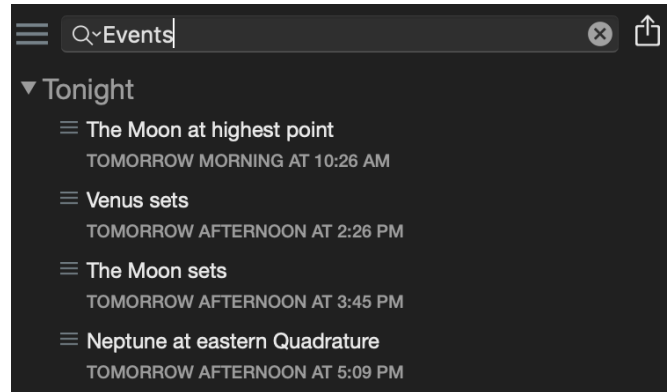
Click the ► symbol to the left of an object's name to expand the list to include all other objects that orbit this object.

For example, clicking on this ► symbol for Mars will expand the list to include the moons of Mars. Clicking again collapses the list and hides Mars's moons. You can double-click on any object in this list to center on the object in Starry Night's main window.

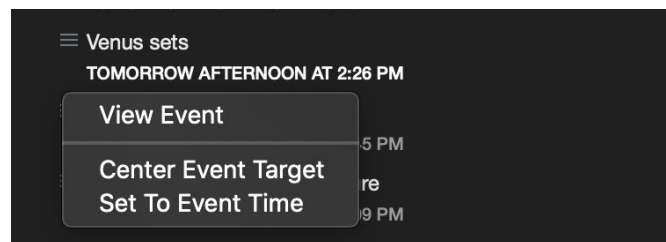


Finding Celestial Events

If you want to know what is happening in the night sky tonight, type "events" in the toolbar search text box or select **Events** from the **Pane Shortcuts** button menu in the toolbar. Events such as lunar phases, eclipses and meteor showers are listed for the current day.



To view an event, double-click on the event name or choose **View Event** from the **contextual menu** button ≡.



To view events for a specific object, mouse over the objects name in the search results pane and click on the "Events" label that appears to the right of the objects name.

Starry Night Pro and Pro Plus users should read "Event Finder" on page 91 for more information.

Zooming In On Objects

Now that you know how to find objects, you will probably want to know how to zoom in for close-up views of spectacular objects such as Saturn and the Andromeda Galaxy.

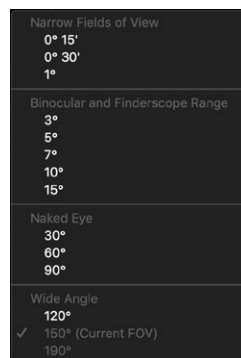
The amount of sky that you can see is called the **field of view**. If it were possible to see the entire hemisphere of sky that is above the horizon at any time, you would have a 180° field of view. Of course, this is impossible. Including some peripheral vision, the human eye can see approximately a 100° field of view. 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 (usually 5° to 7°). Telescopes have an even smaller field of view than binoculars.

Starry Night opens with a 150° field of view. Along the bottom left corner of the main sky window is a set of zoom buttons which adjusts your field of view.

- + ≡ 150° x 106°

Clicking the **(+)** zoom button on the right zooms in (reduces your field of view), while clicking the **(-)** button on the left zooms out (increases your field of view). Clicking the left zoom button and holding your mouse button restores your field of view to 100°. 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.

Your exact field of view is always listed to the right of the zoom buttons. Click on the field of view display to bring up a contextual menu with preset field of views.



Note: When you zoom in to a very small field of view, your field of view will be shown in arc minutes. If you zoom in even closer, your field of view will be shown in arc seconds. One arc minute is 1/60 of a degree, and one arc second is 1/60 of

an arc minute. The smallest field of view which Starry Night can display is 1 arc second.

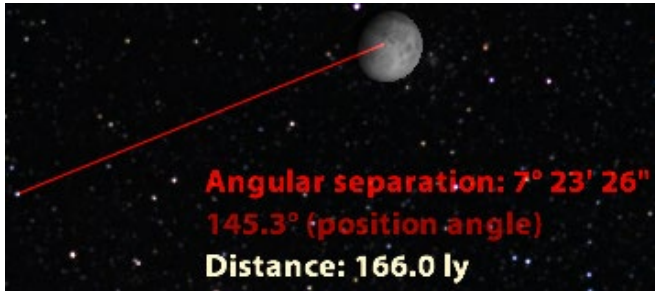
Maximum Zoom Out: By default, you are unable to zoom out past the standard view of 150°. To zoom out to see an even larger field of view, choose **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh), choose **General** from the tabs at the top of the Preferences dialog box, and adjust the field of view slider. Then continue zooming out using the left zoom button until you have a circular field of view of 180°, which is the entire hemisphere of sky that is above the horizon at any one time. This is the view of the sky that most planispheres (handheld circular star charts) represent.

Changing the Zoom Step: If you choose **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh) and choose **Step/Pan** from the tabs at the top of the **Preferences** dialog box, you will see a slider named **Zoom Step**. This slider adjusts the rate at which Starry Night increases and decreases your magnification when you use the Zoom buttons. By setting this slider farther to the right, you will zoom in or out faster, because each zoom step will be larger.

Angular Separation: Angular separation provides another way of understanding fields of view and angles in the sky. If you point at an object and click and hold the left mouse button and then drag the mouse to a second object, a line appears that connects the two objects. The angular separation between the two objects is displayed, along with the direction of the line and the actual distance between the two objects (if known).

The angular separation measures how far apart in the sky two celestial bodies appear. The entire sky is divided into 360°, so an object that is directly in front of you and an object directly behind you in the sky have an angular separation of 180°. If you measure the angular separation between two objects on opposite sides of your screen, you

should find that it is very close to the field of view that Starry Night is showing. Note that the angular separation of two objects has no connection to how far apart these objects really are: two bodies that appear side by side in the sky may be hundreds of light-years apart!



Example: Magnifying Jupiter

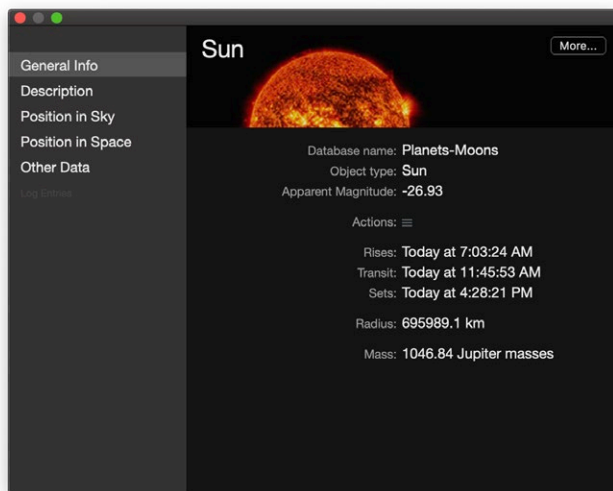
- 1 Type "Jupiter" in the toolbar search text box.
- 2 Double-click on Jupiter's name to center on Jupiter. If a dialog box shows that Jupiter is beneath the horizon, choose the **Best Time** option.
- 3 If Starry Night is displaying a daylight sky, choose **View>Hide Daylight** from the menu to turn off daylight.
- 4 Click the **(+)** zoom button to slowly zoom in on Jupiter. As you zoom in, Starry Night automatically shows dimmer stars. Once your field of view reaches about 30 arc minutes, Jupiter will start to look like a ball instead of a point.
- 5 Continue clicking the **(+)** zoom button all the way until your field of view is about 6 arc minutes. Note that Jupiter will still not fill the screen.
- 6 Press the **(+)** zoom button to continue zooming in on Jupiter. Once you reach a field of view of about 35 arc seconds, Jupiter should fill the screen.
- 7 Click the **(-)** zoom button and hold your mouse button down to restore your field of view to 100°.



Learning More About Objects

You can double-click on any object displayed onscreen in Starry Night to learn more about it. Double-clicking will open the floating **Info** Window, which has information on the object organized into different categories. All of the information fields in the Info window are described in detail in “Info Window” on page 71.

Tip: Right-clicking (**Ctrl**-click on the Mac) on any object onscreen will open a contextual menu of options. Select **Show Info** from this menu to open the **Info** Window and learn more about the object.



Printing Star Charts

Starry Night has a special set of print settings that make printing informative, legible charts a snap. You can then take these charts outside to help with your stargazing.

Once you have set the time, viewing direction and field of view, select **File>Print** from the menu. You will get a full-page printout of the area shown onscreen.


Starry Night Pro and Pro Plus users should read “Printing” on page 115 for more information.


Tool Selection Control

Now that you know about some of the major features in Starry Night, we'll take a quick look at the Tool Selection Control. This control (in the upper left corner of the toolbar, to the right of the Home button) alters the functionality of the cursor, giving you easier access to a variety of the program's features.



The Tool drop down menu contains a number of selections. To use a tool, click on its name. When selected, the tool's icon replaces the mouse pointer on your computer screen.

Adaptive Hand Tool: By default, the adaptive hand tool is selected. This tool allows you to change your viewing direction. However, unlike the regular Hand Tool, the adaptive hand tool can change to other tools automatically. For example, it will change to a selection tool when you point to a selectable object, a location scroller when viewing from space or an angular separation tool when you click-hold on an object and drag to another. 

Arrow Tool: This tool highlights objects in the sky. Press the **Ctrl** key to select this tool. To select multiple objects, press the **Shift** key while making selections. 

Tip: When using any other tool, you can temporarily switch to the Hand tool by holding down the keyboard's space bar.

Hand Tool: Changes the direction in which you are viewing. Use this tool to drag the sky to the left or right, up or down, until you reach the area you want to see.

Constellation Tool: Selects constellations. Choose this tool and click anywhere in the sky to select the constellation that contains that point.

Location Scroller: This tool changes the latitude and longitude from which you are observing. Press and hold the **Shift** key to select this tool. Dragging up or down adjusts your latitude, while dragging left or right adjusts your longitude. For example, while viewing from Earth, you can use this tool to quickly travel anywhere on the Earth's surface.



Tip: This tool is particularly useful when you've lifted off into space and want to adjust your view of the planet below you.

Angular Separation Tool: This tool displays the angular separation between two objects, as seen from your current viewing position. Press the **Cmd-Ctrl** key (Macintosh) or **Ctrl-Shift** (Windows) to select the tool, then click on one object, and drag to another.



Magnification Tool: Magnifies your current view. Select the tool and click anywhere in the window to zoom in that direction. To magnify a specific area of the sky, hold down the mouse button and drag to encompass the area you want magnified.

Tip: Holding down the **Ctrl** key (Windows) or the **Option** key (Macintosh) while using the Zoom tool zooms you back out.

Chapter 3

Appearance of the Sky

Unlike the real world, Starry Night 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. This chapter will look at all of the functions that let you modify Starry Night's simulation of the night sky.

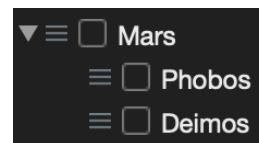
Select Sextans (Constellation)
Center R.A.: 9h 56.037m Dec.: -5° 3.568'
Add Image...
Hide Horizon Hide Daylight
Show Ecliptic Hide Planets Hide Stars Show Constellations
Local Light Pollution Distant Light Pollution
Add FOV Indicator ▶

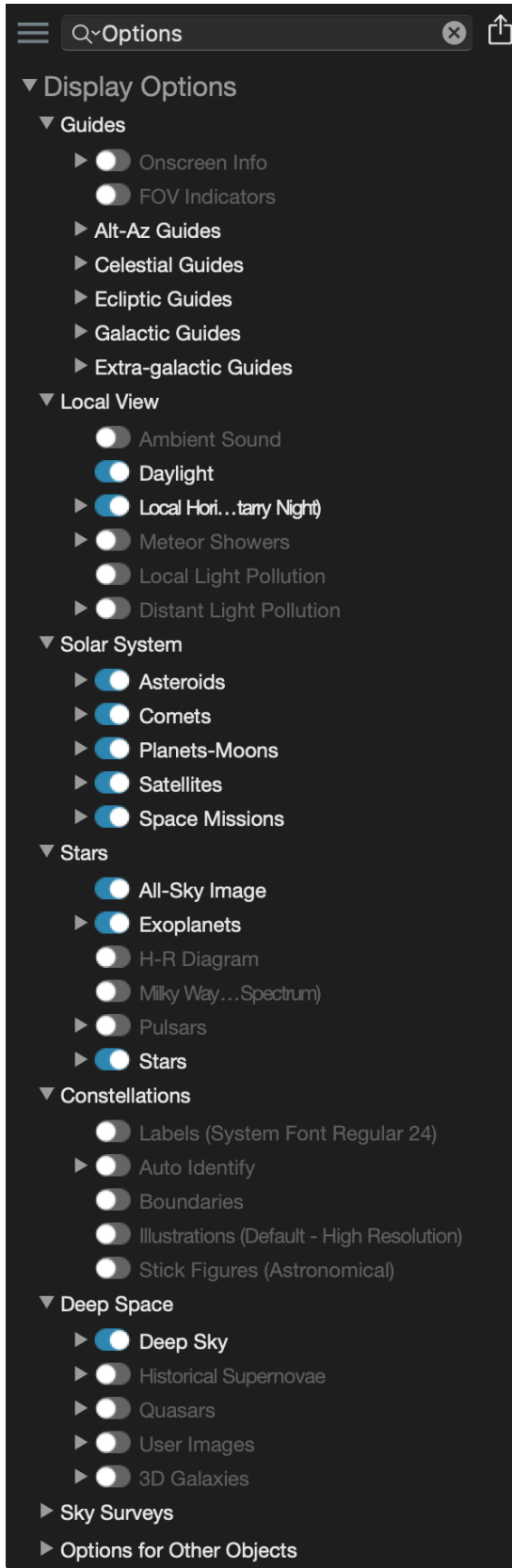
Sky Contextual Menu

You can open a contextual menu in Starry Night by pointing the cursor at any area of the sky and right-clicking (**Ctrl**-click on the Mac). If you are pointing the cursor at a specific object, the contextual menu will provide options specific to that object. If you were not pointing the cursor at a specific object, the menu gives you options for the appearance of the sky as a whole and the constellation which you are pointing at. Many of the most used functions relating to the appearance of the sky are in this contextual menu (for example, turning daylight on/off, turning light pollution on/off and, in Starry Night Pro and Pro Plus, turning the horizon on/off).

Options Search Results

Many of the options for modifying the appearance of the sky are available by typing "options" in the search field of the toolbar or by selecting Options from the Pane Shortcuts button in the toolbar (found immediately to the left of the search field). The **Options** search results pane is organized in a layered framework, based on the distance of various celestial objects from Earth. Controls for altering the appearance of the sky are slotted into the appropriate layer. For example, controls for adjusting the appearance of the planets fall into the "Solar System" layer. Any of the layers in the **Options** search results pane can be expanded by clicking the **Expand** button to the left of the layer's name.





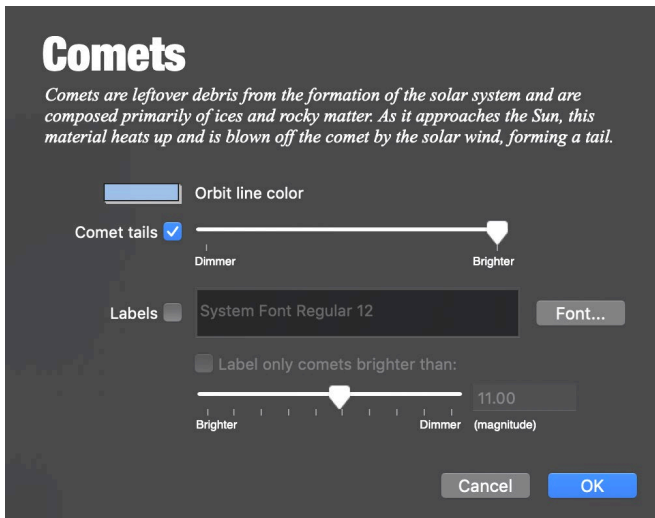
Most controls fall naturally into one of four layers. These layers correspond with different databases—see “Introduction to Databases” on page 62 for a description of these databases.

- 1 **Local View.** Controls that affect the view of the sky from your location. For example, turning the horizon on/off.
- 2 **Solar System.** Controls for objects in our solar system. For example, planets, comets, and asteroids.
- 3 **Stars.** Controls for objects outside the solar system, but inside the Milky Way. For example, stars, exoplanets, and the appearance of the Milky Way itself.
- 4 **Deep Space.** Controls for objects outside our galaxy. For example, other galaxies.

Tip: This layer also includes databases that include objects both within and outside of our galaxy. For example, the Messier database includes globular clusters, which are inside our galaxy, but it also includes other galaxies, so it is classified in the “Deep Space” layer.

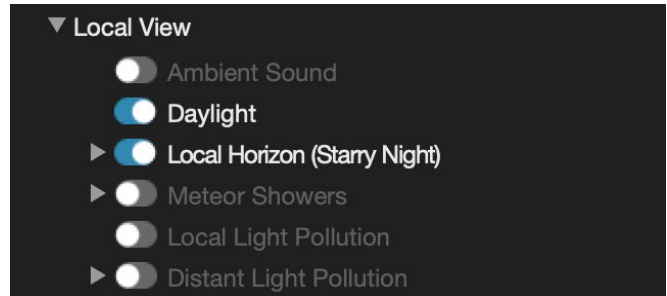
Guides, Constellations, and Sky Surveys (Pro Plus only) do not fall naturally into this layered scheme, so they are given their own layers. Finally, certain databases overlap with other databases, so their controls are placed in the “Options for Other Objects” layer. See “Databases 4 (Other Objects)” on page 66 to see which objects fall into this category.

Most of the object classes listed in the **Options** search results pane have special options associated with them. Clicking on the object name in the pane will open a dialog box with options for that object class. For example, clicking on the word “Comets” in the **Options** search results pane (“Solar System” layer) will open a dialog box with options for altering the appearance of comets.



Light

Many celestial objects are only visible during certain times of the year. At other times in the year, they are above the horizon only during the daytime, when they are washed out by the sun's light. With Starry Night, you can get around this problem by selecting **View>Hide Daylight** from the main menu, or unchecking "Daylight" in the **Options** search results pane (Local View). This 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 that are normally hidden.

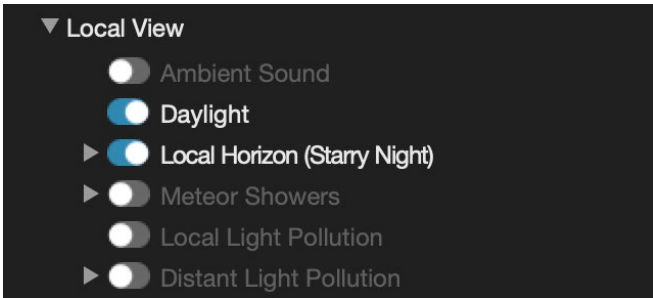


Tip: This feature works on any planet that has an atmosphere. On Mars, the atmosphere scatters sunlight and makes the sky look pink. Turning off daylight eliminates this effect. Our moon has no atmosphere, so turning daylight off on its surface has no effect.

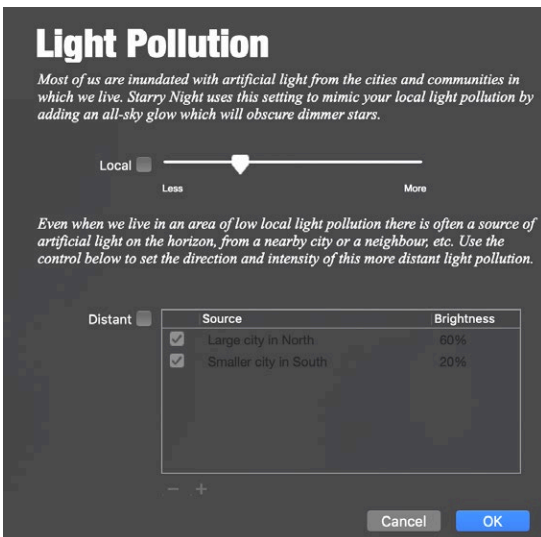
Light Pollution: There may be times when you want to add light, instead of eliminating it. This is because the default night view in Starry Night assumes the observer is far from bright lights, under dark skies. As a result, many stars are visible, perhaps too many for the urban stargazer.

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. Starry Night 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. To turn light pollution on or off, check or uncheck the "Light Pollution" box in the "Local View" layer of the **Options** search results pane.

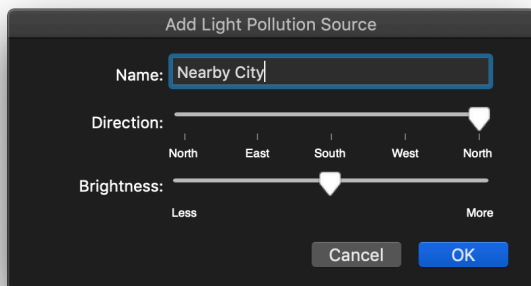
Distant Light Pollution: Even when we live in an area of low local light pollution there is often a source of artificial light on the horizon. A nearby city for example, can create a light pollution dome, washing out celestial objects that are low on the horizon. You can add light pollution domes for one or more nearby cities.



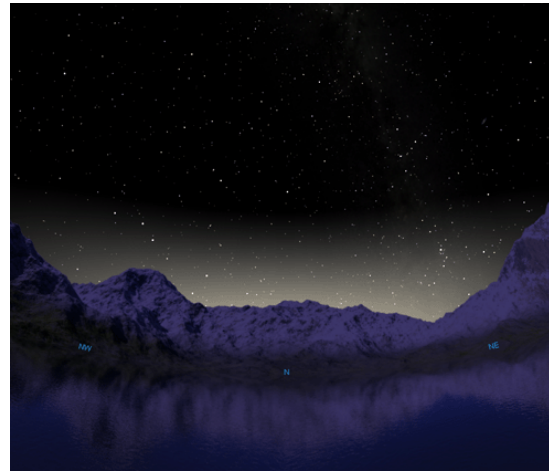
To add the light pollution dome of a nearby city, click on “Distant Light Pollution” in the “Local View” layer of the **Options** search results pane. This will open a dialog box with options for adding distant light pollution sources.



Click the **(+)** button in the Distant Light Pollution section of the dialog box to bring up another dialog box that will allow you to name the light source, set the direction and control the intensity of the light pollution dome.



Your new distant light pollution entry will be added under “Distant Light Pollution” in the **Options** search results pane (“Local View” layer).



Tip: You can also turn on light pollution by right-clicking (**Ctrl**-click on the Mac) on the background sky in the main window. This will open a contextual menu with two light pollution options: *Local Light Pollution* and *Distant Light Pollution*.

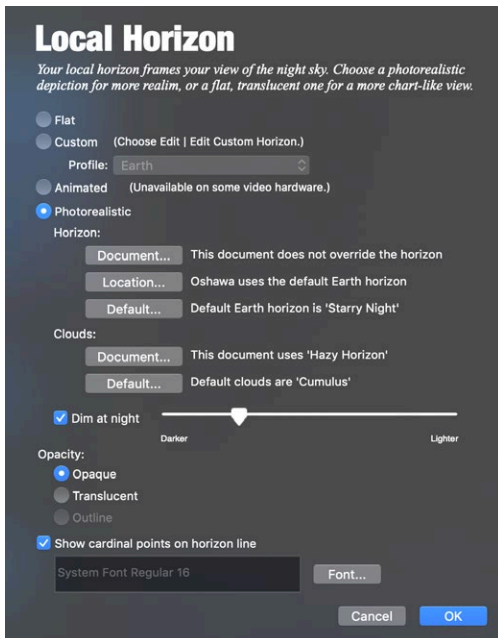
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Another way to customize light pollution levels is to specify a limiting magnitude for celestial objects, especially stars. See “Constrain” on page 30 for more information.

Changing the Horizon

By default, Starry Night shows a photorealistic horizon. Photorealistic horizons are panoramic images. A pull-down menu lets you choose from one of several horizon images and also cloud types. To view a dialog box with options for changing the horizon, choose **Options>Other Options>Local Horizon** from the main menu located above the toolbar.



For example, to change the default panorama, press the **Default** button under “Photorealistic”. Select the panorama you want to use and press **Select**.

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Horizon Styles: You can choose from one of four horizon types. Flat horizons have no variation in elevation or scenery. Custom horizons are illustrated horizons with images of trees, hills and clouds. See “Custom Horizons” on page 139 for information on modifying custom horizons. Photorealistic horizons use panoramic images. Animated Horizons show a live landscape view with moving elements such as grass.

Tip: There may be times when you wish to hide the horizon (for example to view a close-up image of an object that is beneath the horizon). You can turn the horizon on/off by checking/unchecking the “Local Horizon” checkbox in the **Options** search results pane (“Local View” layer), or by choosing **View>Hide Horizon** from the main menu.

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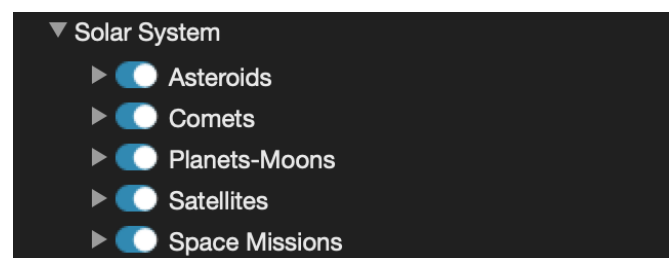
Options: The standard horizon view is opaque, but you can make it semitransparent by checking “Translucent” or reduce the horizon to a thin line by checking “Outline”. This will help you determine which objects and constellations are about to rise above the horizon.

SE By default, Starry Night displays compass points on the horizon. If you find that you don’t use or need them, you can turn them off by unchecking “Show Compass Points”.

Nighttime Slider: Adjusts the brightness of a photorealistic horizon at night.

Displaying Celestial Objects

Checkboxes in the **Options** search results pane for each database of celestial objects let you turn on or off these databases. See “Object Databases” on page 62 for a complete listing of the object databases included in Starry Night. You can turn databases on/off so that only the objects that you are interested in appear onscreen. For example, you may want to find out which of the many points of light shown onscreen represent planets. By turning the database of stars off, it will be much easier to identify the planets.



Tip: You can also turn databases on/off by choosing **View** from the main menu and checking the appropriate database.

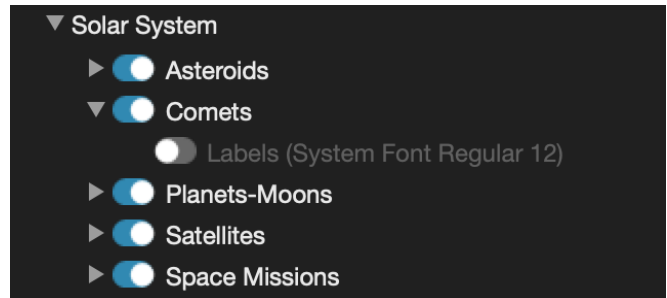
If a database is turned off, no objects from this database will be displayed. However, if a database is turned on, not **all** of the objects in the database will be displayed.

There are two reasons for this. First, several databases are very large. It would be impossible for Starry Night to show all of the millions of stars in its database onscreen at one time! Second, Starry Night strives to present a realistic representation of the sky, so it only shows those objects bright enough to be visible. As you zoom in to a smaller field of view, dimmer objects are automatically shown (remember that zooming in is equivalent to looking through a more powerful telescope). Many databases have options that let you adjust how many objects are displayed. See “Celestial Object Display Options” on page 30 for more information.

By default, all databases are turned on, with the exception of those databases in the “Options for Other Objects” layer, which are turned off because they may overlap with the core databases. See “Databases 4 (Other Objects)” on page 66 for a listing of these “other” databases.

Labeling Celestial Objects

In “Labeling Objects” on page 16, you learned how to turn on labels for all types of objects. You can also selectively choose which types of objects to label. Expanding each database listed in the **Options** search results pane reveals a **labels** checkbox. Checking this option will label the brightest members of this database. Labeling certain object types makes it easier to identify these objects. For example, deep space objects may be hard to identify among the glare of the brighter stars and planets. By labeling only deep space objects, these objects will be easy to locate.



Tip: You can also turn database labels on/off by choosing **Labels** from the main menu and checking the appropriate database.

Labeling Select Objects: If you only want to label a few specific objects, point the cursor at the first object, and click the left mouse button. This “selects” the object, and its label will appear, along with an arrow pointing to the object. For subsequent objects, right-click (**Ctrl**-click on the Mac), hold down the **Shift** key and select the object from the pop up menu that opens. You can deselect all objects by choosing **Edit>Select None** from the menu.

Database Label Options: You have great control over how labels appear in Starry Night. You can



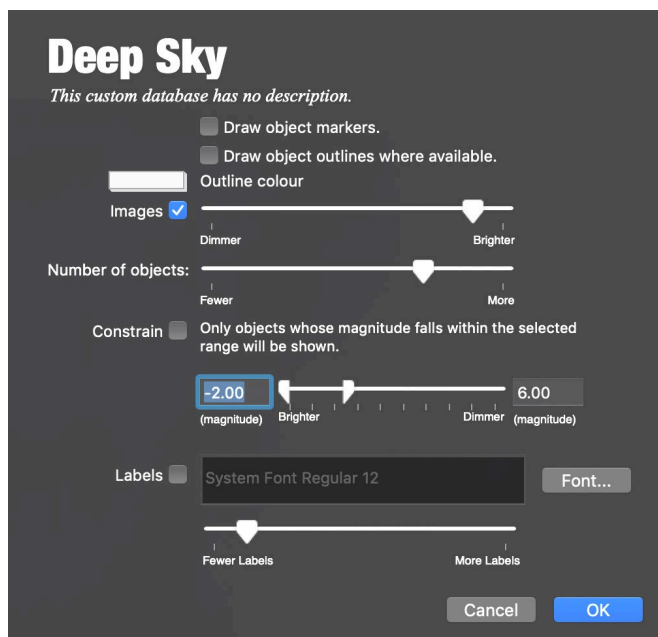
change, the size, color, font and number of labels for each database. See “Label Options” on page 40 for more information.

Celestial Object Display Options

As mentioned in “Displaying Celestial Objects” on page 28, clicking on a database name in the **Options** search results pane will open a dialog box with display options for that database. The options fall into two categories: options for displaying the objects in the database, and options for displaying the labels for these objects. This section focuses on the options for displaying the objects, while “Label Options” on page 40 will look at label options.

Tip: You can also access database options by choosing **Options** from the main menu and selecting the appropriate database.

Some display options are common to all object databases, while some are specific to certain databases.



Most (but not all) databases have these two options.

Number of objects: This slider controls how many objects from this database are displayed on-

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Constrain: If this box is checked, only objects that fall within the **apparent magnitude** range that you specify will be displayed onscreen. For example, if you live in a city, and your naked eye **limiting magnitude** is around 4.00, you could use this function so that Starry Night displays all stars whose magnitudes are between -2 and 4. That way, what you see on the computer screen will be similar to what you actually see while observing from your urban location.

You may also want to use this control to simulate your telescope view on a given night. If you know the magnitude of the dimmest star that your telescope can make out, setting the “Dimmer” end of the slider to this magnitude gives you a good idea of what you can view through your instrument.

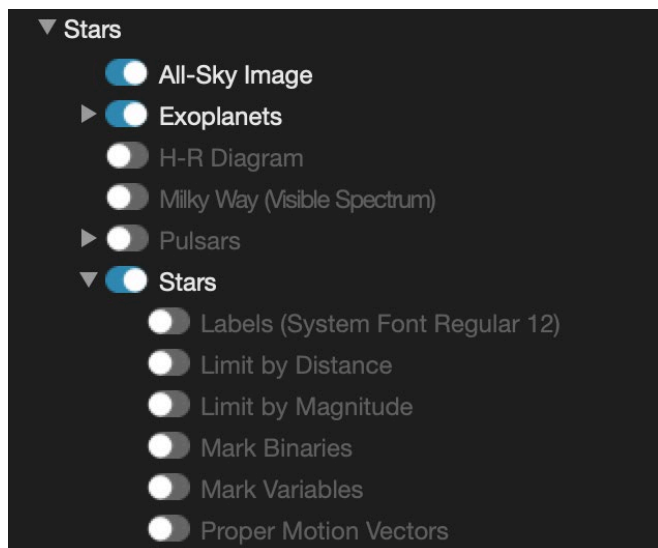
Tip: The “Constrain” function only displays a subset of the objects that would be shown if this function was turned off. For example, assume you want to increase the number of stars onscreen so that all stars brighter than magnitude 7 are visible. If you are at a 100° field of view, then Starry Night will only show stars up to a magnitude of 5.7, by default. Increasing the apparent magnitude range using the “Constrain” function would have no effect. To increase the number of stars shown, you would first move the “Number of objects” slider farther to the right (so that stars as dim as magnitude 7 are now visible), and then use the “Constrain” function to ensure that no stars dimmer than magnitude 7 are shown.

screen. Moving the slider to the right will display more objects.

Many databases have unique options. We will look at these options in the next few sections.

Star Display Options

There are more options for displaying stars than for any other database of objects in Starry Night. Many of these options can be turned on/off from a checkbox in the **Options** search results pane, while clicking the option name will often open a dialog box with more controls.

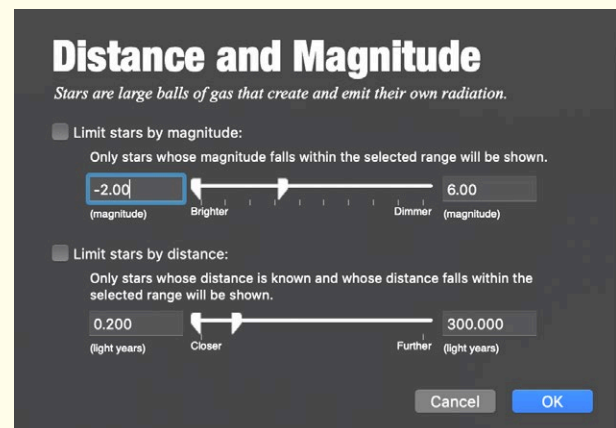


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Limit by Distance/Magnitude: These options let you set up Starry Night to display only those stars whose distance from Earth or whose apparent magnitude (brightness) fall within a certain range. One use of this function would be to identify which bright stars are within 100 light-years of Earth, for example.

In Starry Night Pro and Pro Plus, clicking the words “Limit by Distance” in the **Options** search results pane opens a dialog box that lets you set numeric values for limiting by distance or magnitude.

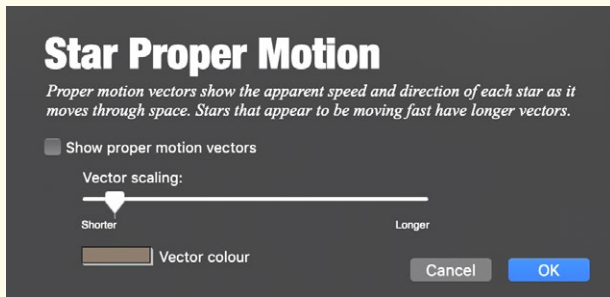


Mark Binaries/Mark Variables: You can set special markers for variable stars (stars whose brightness varies) and binary stars (double stars that orbit around a common center of mass. Variable stars are marked with one of four symbols, according to how much they vary in brightness.

Proper Motion Vectors: Every star is moving rapidly through space, in a unique direction. However, because the stars are so far away, they appear to remain in the same place in the sky. Only over thousands of years can we see the stars shift position with respect to each other. This slow movement of the stars is

CONTINUES NEXT PAGE

called proper motion. Starry Night lets you display proper motion vectors, lines that represent the speed and direction of each star's motion. The length of a star's proper motion vector indicates its relative speed.

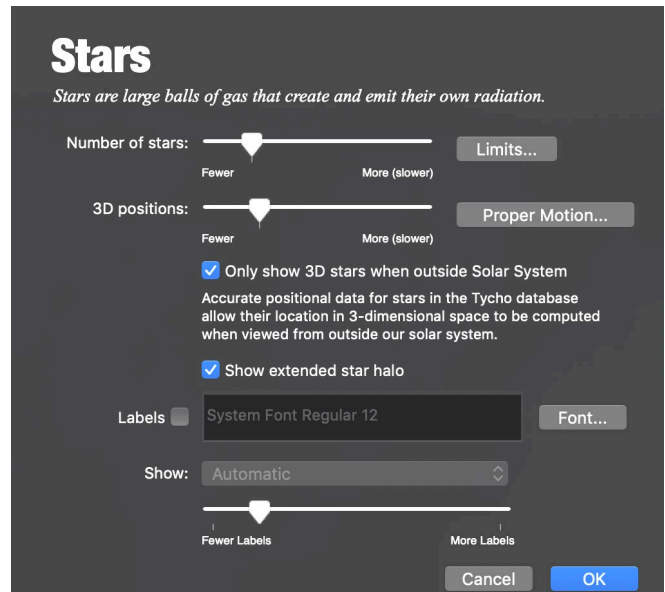


The **Star Proper Motion** Options dialog box has a “vector scaling” option that allows you to change the length of all proper motion vectors, and a “vector color” option that allows you to change the color of these vectors.

Mark Stars With Exoplanets: These options let you display special markers for stars that are known to harbor planets.

Tip: If you turn on markers for exoplanets, the star's **Info** window will include information about the exoplanet, such as the planet's mass and distance from its central star. See “Exoplanet information fields” on page 74 for more details.

Additional Star Options: The main **Star Options** dialog box lets you control how many stars are displayed and how they are labeled.



It also has a “3D Positions” slider that lets you determine how many stars are drawn in the correct position in 3-dimensional space. This feature is only useful when your viewing location is outside the solar system, in such a manner that you can see the 3-dimensional arrangement of the stars in our solar neighborhood. See “Changing Your Viewing Location” on page 80 to learn how to change your viewing location. **“Only show 3D stars when outside Solar System”** hides those stars for which we do not have accurate 3-dimensional positions, making it easier to see the 3-dimensional structure of our solar neighborhood.

Example: Isolating the Hyades Cluster

This example will show you how to use star display options in Starry Night Pro and Pro Plus to separate stars in the Hyades cluster from other stars.

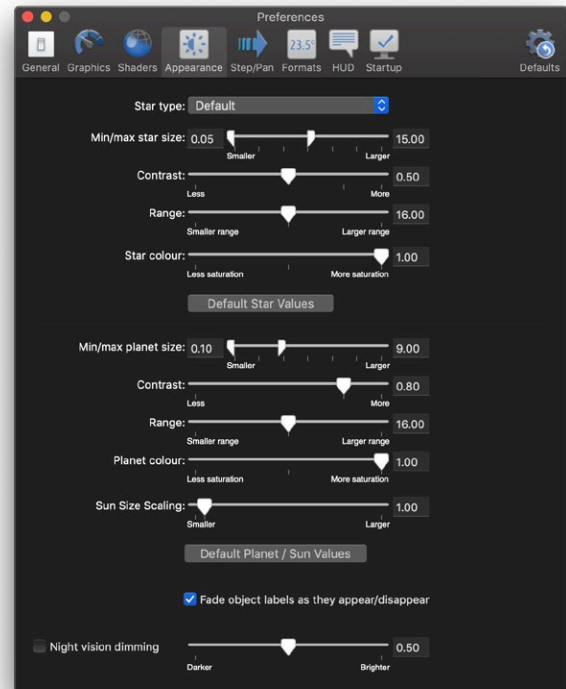
- 1 Turn off daylight and hide the horizon by checking the appropriate boxes in the **Options** search results pane (“Local View” layer).
- 2 Ensure that the star database (in the “Stars” layer of the **Options** search results pane) is turned on, and the “Bright NGC Objects” database (in the “Deep Space” layer) is turned off. We need to do this because the Hyades

is an object in the “Bright NGC Objects” database—and that would be too easy!

- 3 Type “Epsilon Tauri” in the search text box in the toolbar. This is a bright star in the Hyades cluster. Double-click on this star's name to center on the Hyades cluster.
- 4 Use the zoom buttons in the lower left of the main window to zoom in to a field of view of about 15°.
- 5 Turn on proper motion vectors for stars, using the checkbox in the **Options** search results pane (“Stars” layer). Increase the length of proper motion vectors to maximum, by pulling the “Vector scaling” slider in the “Proper Motion Vectors Options” dialog box all the way to the right. You should see that many of the stars have vectors pointing in the same direction, indicating that they are moving together through space and are part of the same cluster. However, many other stars, such as the bright star Aldebaran, are moving in very different directions.
- 6 Open the “Limit by Distance Options” dialog box for stars. Check “Limit stars by distance” and set the distance range from 140 to 170 light-years, the distance of the Hyades cluster. This will cause almost all stars that do not belong to the cluster to disappear, leaving only stars in the Hyades cluster, all with proper motion vectors pointing in the same direction. Those few stars with vectors pointing in different directions (likely not cluster members) are now very easy to identify.

Star Brightness, Contrast & Color

Starry Night gives you complete control over the brightness, contrast, and color of star display. To access these options, choose **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh) and select **Appearance** from the top of the Preferences dialog box.



The Star type dropdown menu lets you choose from several different types of star images.

This preference will be applied to every star drawn onscreen. Try testing out each of these different star images and seeing which one you prefer.

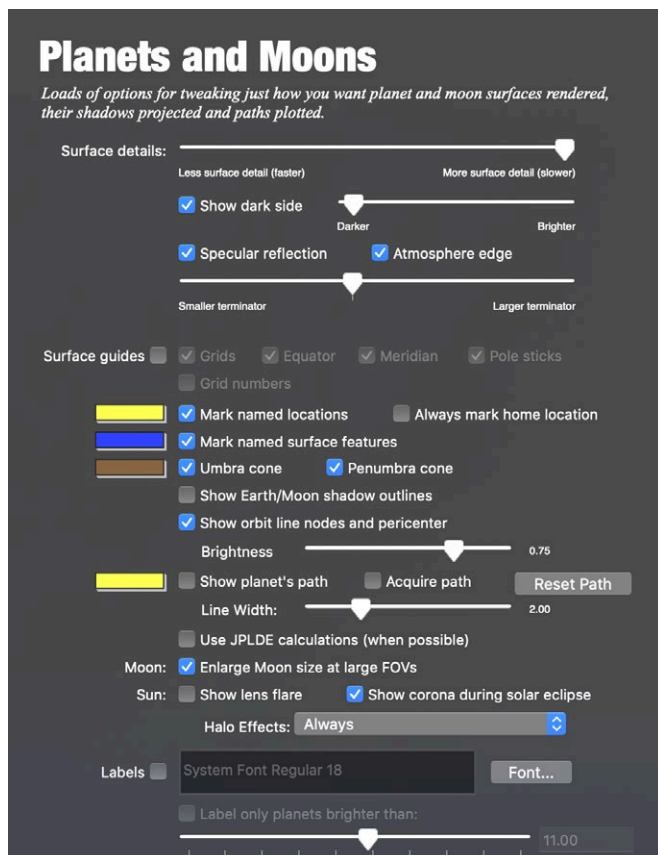
The “Min/max star size” slider determines how large stars appear onscreen.

The Range slider increases or decreases the size distinction between the brightest and dimmest objects in the sky, while the Contrast slider increases or decreases the color 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'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 night sky.

A star's color is determined by its surface temperature, ranging from blue (hottest) to red (coolest). The Color slider increases and decreases the extent to which Starry Night displays star color. Pulling the Color slider to the right shows more and more of the full spectrum of star colors, to an extent you would never see from Earth. Pulling the Color slider to the left strips away color distinctions until all stars appear white.

Planet Display Options

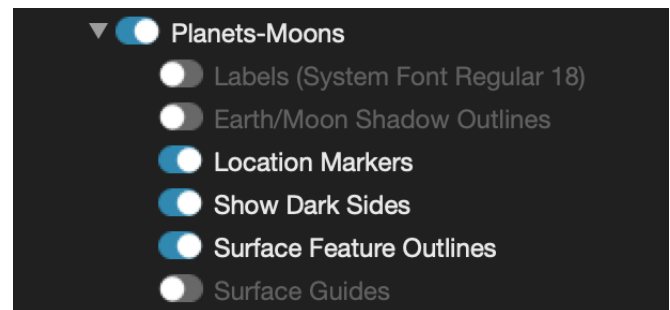
Starry Night gives you many options for the display of our sun and its planets and moons. A variety of guides are also available to give you perspective.



At a 100° field of view, planets are displayed like stars, which is how they appear to us from Earth's surface. As you get closer to a planet (by zooming in on the planet or by changing your location) you begin to see the disc image and any phase information.

Starry Night depicts the planets using the latest images from NASA and other space agencies. 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 uses the time-honored tradition of deploying space artists to create the surfaces of distant worlds.

Several of the planet images in Starry Night were created or enhanced by astronomy enthusiasts. Choose **Help>Image Credits** from the menu to see thumbnails and credits for the planet surface images and the images of deep space objects.



Earth/Moon Shadow Outlines: Earth and the moon cast shadows upon one another in certain alignments with the sun. The two circles of this target represent the limits of the umbral and penumbral shadows projected out at the Earth/moon distance. The umbral shadow encloses the area experiencing a total eclipse, while the penumbral shadow encloses the area experiencing a partial eclipse. This feature is useful when watching a solar eclipse from the moon — you can see the moon's shadow approaching Earth before it actually casts its shadow upon Earth.

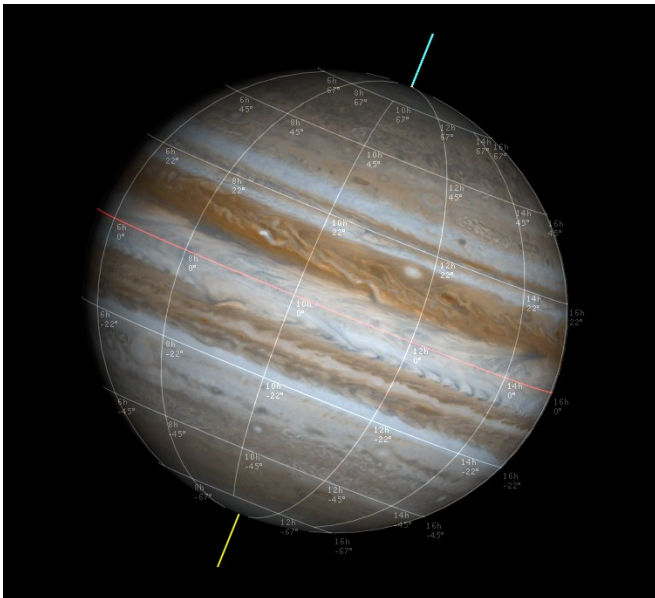
Location Markers: This feature turns on all the location markers you have selected in the Markers and Outlines dialog box. See "Location Markers and Surface Feature Outlines" on page 35 for more information on Surface Features.

Show Dark Sides: For more realistic and exciting viewing, you can choose to display the dark sides of planets. The slider lets you control the sharpness of the transition between the dark and lit side.

Surface Feature Outlines: Turn on all the surface feature outlines you have checked in the Markers and Outlines dialog box. See “Location Markers and Surface Feature Outlines” on page 35 for more information on Surface Features.

Surface Guides: You can turn on several types of guides to help you determine a planet's orientation in space, or to locate features on the planet surface.

The grid draws planetary lines of latitude and longitude. You can also turn on the planet meridian and equator lines. The pole sticks show you the north and south poles of the planet. Grid numbers mark the lines of latitude and longitude on the grid.



In the following image, we magnified Jupiter and turned on all of its surface guides.

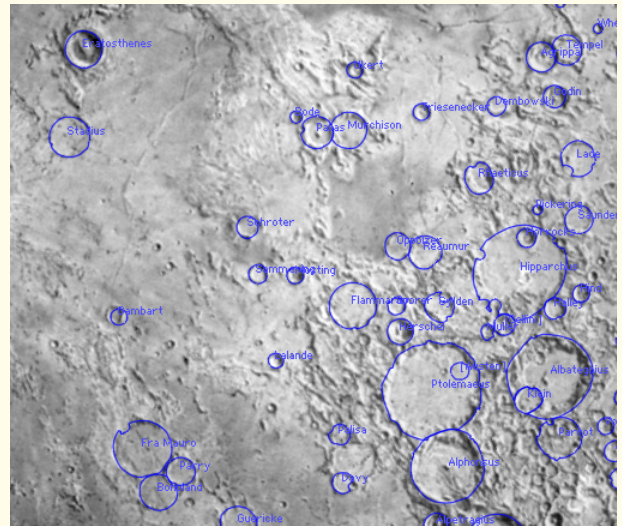
Location Markers and Surface Feature Outlines

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Starry Night allows you to search for and identify thousands of predefined locations and features on the surface of the Earth or any other rocky planet or moon where surface data is available. For example, you can zoom in on the moon and flag all of the Apollo moon landing sites, display the location of all the astronomical observatories on Earth, or draw an outline around the craters on Mars.

Starry Night can display location markers and surface feature outlines. It is important to distinguish between a marker and an outline. A marker places a flag or pole on the surface of a planet to identify a location. An outline draws a contour around a surface feature.



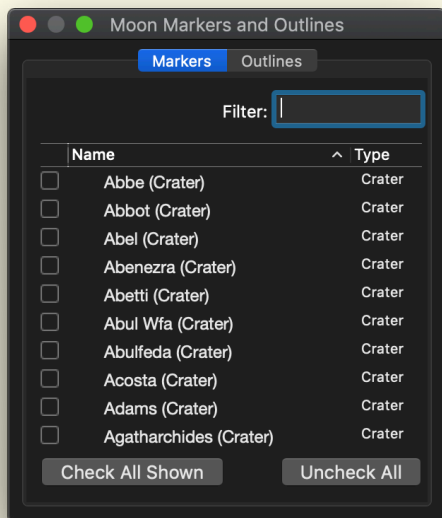
To display markers and outlines, you should first zoom in on the object of interest. This will allow you to see the markers and outlines. Then right-click (**Ctrl-click** on the Mac) on the object and select **Markers and Outlines...**

CONTINUES NEXT PAGE

from the object's contextual menu. This will open the Markers and Outlines dialog box.

Note: Location markers are available for Mercury, Venus, Mars, Earth and moon. Surface feature outlines are only available for the moon and Mars.

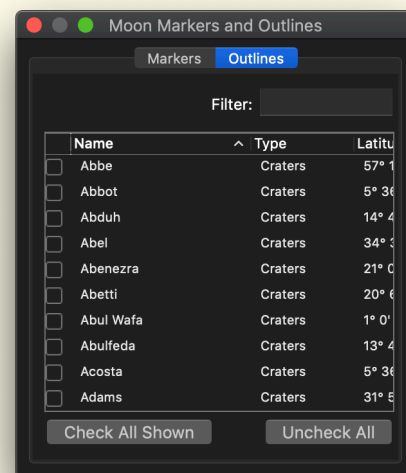
Adding markers and outlines: Click on the **Markers** tab to add a location marker or click on the **Outlines** tab to draw an outline around a feature.



By default, **List All Locations** and **List All Surface Feature Outlines** is selected. To show a location marker or outline on the surface of an object, check the box to the left of the location or feature name. Pressing the **Check All Shown** button will select all locations and features. Press the **Unmark All** button to uncheck all of your selections.

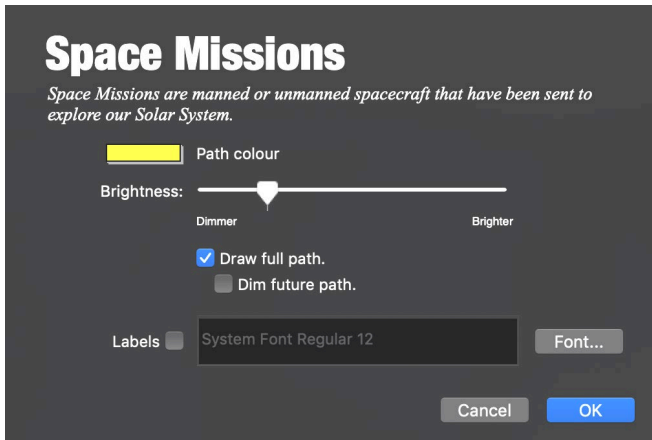
Tip: You can also add location markers by right-clicking (**Ctrl-click on the Mac**) on the object's surface and choosing **Mark "Location Name" On Surface** from the contextual menu. Repeat to add additional location markers. To unmark a location, right-click (**Ctrl-click on the Mac**) on the location marker and choose **Un-Mark "Location Name"**.

Searching for locations and features: To search for a specific location or geological feature, type in the name of the location or feature in the "Filter" text box.



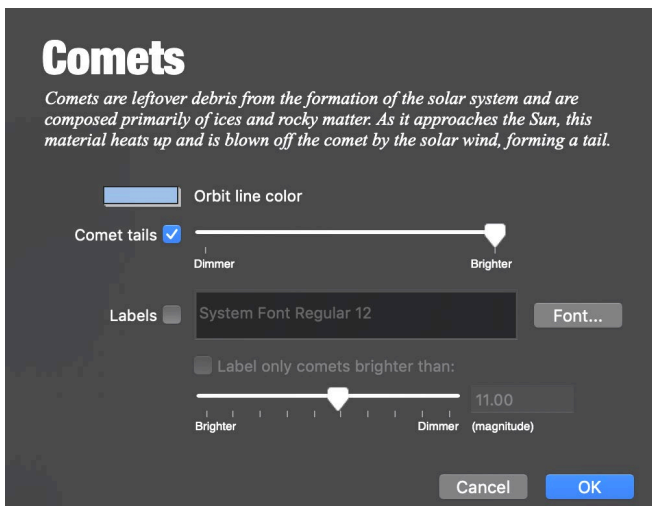
Space Mission Display Options

Space Mission Paths: By default, Starry Night displays the full path line or trail an interplanetary space probe makes from launch to mission end. The future path of the probe can be dimmed to aid in orientation. You also have the option to only display the path line up to the current date (does not draw the future path) by unchecking the "Draw full path" box.



Comet, Asteroid & Satellite Display Options

Brightness: For these three classes of objects, a slider lets you adjust the apparent brightness of the objects. For comets, the slider actually adjusts the brightness of the comet tail. You also have the option to turn comet tails off entirely.

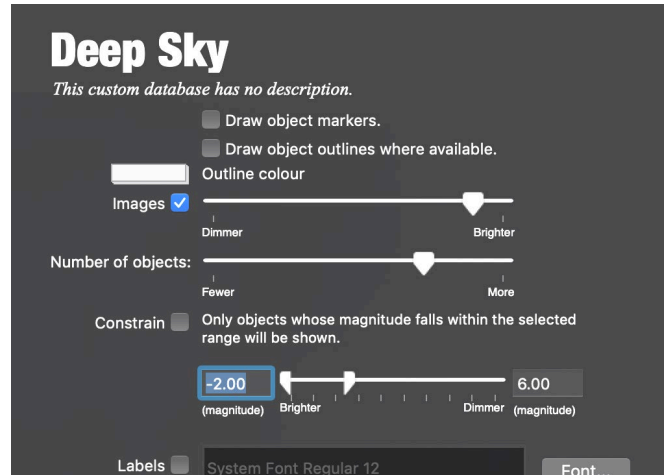


Orbit Line Color: This lets you choose a new color for the orbit lines of these objects. See “Orbits” on page 85 for more information on object orbits.

Deep Sky (Including Messier Objects/User Images) Display Options

These databases can have specific images associated with objects. Most of these images were photographed by astronomy enthusiasts.

Choose **Help>Image Credits** from the menu to see thumbnails and credits for the planet surface images and the images of deep space objects.



Starry Night lets you adjust the brightness of images using the slider provided. Using this control, you can adjust the image so that its brightness appears as it would through a backyard telescope (as a very dim image), or as captured by a long exposure observatory photograph (a much brighter image). You also have the option of selecting to display the outlines for these objects instead of their images.

Milky Way Display Options

By default, Starry Night displays a stunning photographic image of the band of the Milky Way. If you find this image is too bright, you can use the Brightness slider to tone down the image



brightness, or uncheck the Milky Way box in the **Options** search results pane, to turn off the image entirely.

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From the Wavelength dropdown menu, you can select from several images of the Milky Way taken at different wavelengths. These include X-Ray, Infrared, Gamma, Radio and more.

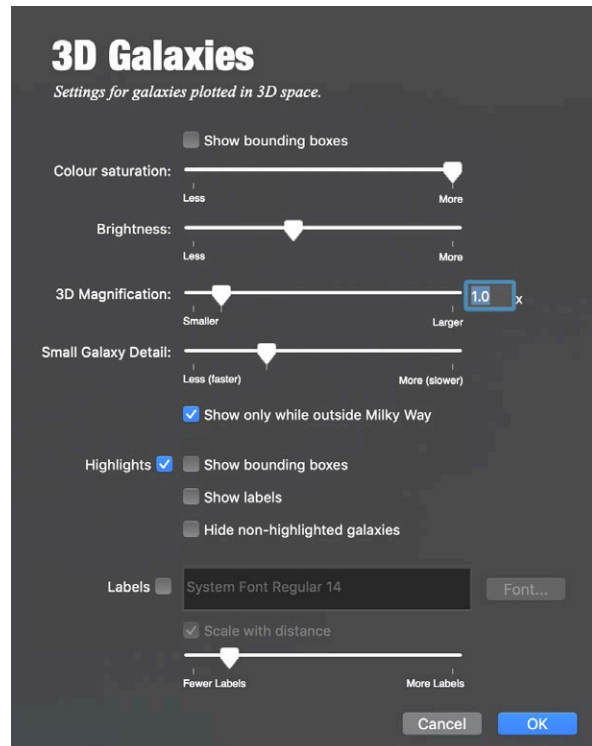
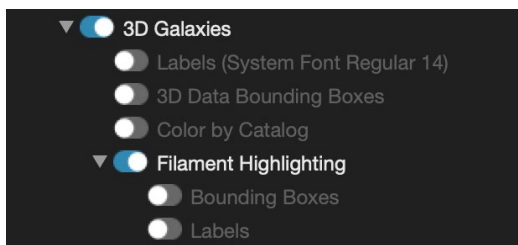
3D Galaxy Database Display Options

One of the core databases in Starry Night contains over 2 million galaxies plotted in 3D. This database was compiled by Starry Night staff astronomers, hence it is referred to as the **Starry Night 3D Galaxy Database**. This galaxy database is very special because it shows the 3D position in space of each galaxy, not just the galaxy's position as seen from Earth.

In Starry Night you have great control over how this database is displayed onscreen. To open the "3D Galaxies Options" dialog box, click on the words "3D Galaxies" in the Deep Space layer of the **Options** search results pane.

You will find the following options:

- **Bounding boxes:** If you have "Show bounding boxes" checked, all galaxies will be surrounded by a 3-dimensional box, letting you see the spacial area occupied by the Starry Night 3D Galaxy Database.



- **3D Magnification:** When a galaxy is very close, it is represented by a full-color image instead of a dot. This slider lets you enlarge these galaxy images. The "correct" position of the slider is all the way to the left—this will draw galaxies the proper size, and you will rarely see more than one or two galaxy images onscreen at the same time. Moving the slider to the right allows you to see many galaxy images at the same time, producing some spectacular views.
- **Visibility range:** Use this slider to display only those galaxies that lie within a certain range. If you move the slider all the way to the left, only those nearby galaxies that are bright enough will be displayed, moving the slider all the way to the right will display all the galaxies in the Tully Collection at the same time.
- **Color saturation:** Each different type of galaxy is represented with its own color image. The dots used to represent a distant galaxy are the same color as the full-size image. Moving this slider to the right makes

the color of the dots closer to that of the galaxy image, while moving the slider to the left strips away all color distinctions until all galaxies are represented by white dots. The advantage of having the slider far to the right is that you can quickly identify the galaxy type. For example, a cluster of blue dots indicates a group of elliptical galaxies. The disadvantage is that the sky becomes gaudy and unrealistic-looking.

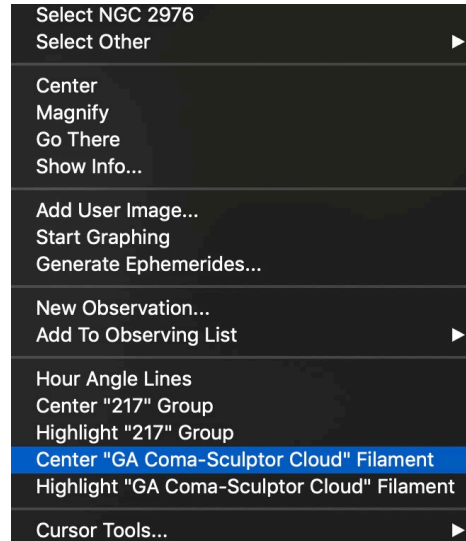
- **Brightness:** When a galaxy is too far away for its image to be visible, Starry Night will represent its position in space with a dot. This slider controls the brightness of these dots. The ideal position of this slider will depend on the brightness of your monitor and the lighting conditions in your computer room. Moving this slider to the right makes the dots larger and brighter, while moving it to the left makes the dots smaller and dimmer.

Selecting Filaments and Groups in the 3D Galaxy Database

When exploring the 3D Galaxy Database, you can get more information by pointing the cursor at an object (you should see the cursor icon change to a pointer) and then right-click or **Ctrl**-click (Macintosh). This opens a contextual menu with specific options for the object you have clicked on. Some of the options specific to the 3D Galaxy Database are described below. But first let's look at some terms you may not be familiar with.

Groups are gravitationally bound clumps of galaxies. Membership can range from a few to a few thousand galaxies. Large groups are also known as clusters.

Filaments—or their kin walls, clouds, and arcs—are formations of galaxies in expanding space, which are not necessarily gravitationally bound. These formations can be string-like or sheet-like. They can have curvature like a bow or like a sail. Filaments can be grouped together into even larger structures called **filament families**.



Center sun: If you are centered on another galaxy, selecting Center sun will move your view so that you are looking toward the sun (and hence our galaxy the Milky Way). If you are centered on the sun, you can use the **Elevation** buttons in the toolbar to go back to our solar system.

Center Group: Each galaxy belongs to a larger group of galaxies. This option will place that group at the center of your screen.

Highlight Group: This displays a special marker for all other galaxies that are in the same group as the object you have clicked on.

Center Filament: Many (but not all) galaxies can also be classified as belonging to a filament. This option centers on the filament containing your object.

Highlight Filament: This displays a special marker for all galaxies belonging to the same filament as the object you have clicked on.

Other Object Display Options

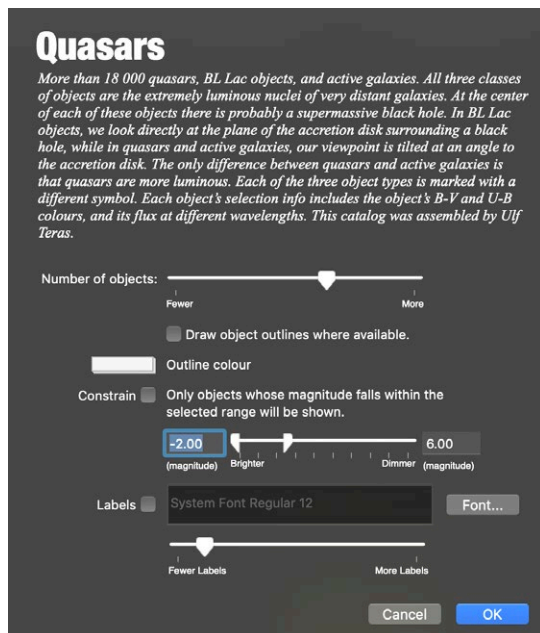
The options for other databases in Starry Night vary greatly. Open the Options dialog box for any database to see its display options.

Label Options

Every database in Starry Night has label options. To access these options, open the **Options** search results pane and click on the name of the database you are interested in. This will open the “display options” dialog box for this database. The label options will be at the bottom of the dialog box.

Most databases share the following label options:

Appearance: For all databases, you have the option of changing the label appearance. Buttons allow you to change the font and size of the label, and choose whether you want the labels to be in bold or italics.



Color: This determines the color that labels appear onscreen. Click on the color bars to choose a new label color. Many users use differ-

ent label colors for each of the major databases, making it easier to quickly distinguish between planets, stars, and deep space objects.

Number of Labels: A slider allows you to change the number of objects that are labeled onscreen for each database. If the slider is near the left edge, only the brightest members of the database will be labeled. As you move the slider farther to the right, dimmer objects will be labeled as well.

Some other label options appear only for certain databases. These options are listed below:

Label by Magnitude Slider: This is an option for planets/moons, comets, asteroids, and artificial satellites (when open, it replaces the “Number of Labels” slider). 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. Neptune is generally too dim to be seen, but by selecting this option, you will still be able to see where it is in the sky.

Star Label Options: The “Show” dropdown menu in the Star Options dialog box allows you to label a star by its common name, catalog number, Bayer letter, or 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 “Bayer” on page 75. You can also choose to show the magnitude of stars, an option that is particularly useful for printed charts, as you will often use the brightness of an object to help you determine if you are looking at the right object.

Sky Surveys

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Sky Survey images from Planck, IRAS-COBE and 2 Micron reveal a dramatically different view of our sky and even let you explore the relic radiation left over from the Big Bang.



InfraRed 2 Micron: This 2MASS survey image uses near-infrared light at wavelengths longer than that of visible light. At these wavelengths, clouds of dust that obscure our view of more distant stars in our Milky Way galaxy become increasingly transparent. As a result we can see all the way to the very center of the galaxy, showing its overall structure far more clearly than is possible in visible light.

IRAS-COBE Galactic Dust (Color): This image shows the dramatically different view of our sky when viewed in far infrared light. The dust in the Milky Way is mostly distributed in a disk that is very thin. This bright narrow band shows most of the dust in our galaxy. The fainter filaments above and below this disk represent only the very closest dust clouds as seen from our vantage point in the middle of this disk.

Planck CMB: This image shows the oldest light in our universe, as detected with the greatest precision yet by the Planck mission. The ancient light, called the cosmic microwave

background, or CMB, was imprinted on the sky when the universe was 370,000 years old. It shows tiny temperature fluctuations that correspond to regions of slightly different densities, representing the seeds of all future structure: the stars and galaxies of today.

Planck CMB (Alternate): This image shows the oldest light in our universe, as detected with the greatest precision yet by the Planck mission. The ancient light, called the cosmic microwave background, or CMB, was imprinted on the sky when the universe was 370,000 years old. It shows tiny temperature fluctuations that correspond to regions of slightly different densities, representing the seeds of all future structure: the stars and galaxies of today.

Planck Mass Distribution: This image from the Planck mission shows matter between Earth and the edge of the observable universe. Regions with less mass show up as lighter areas while regions with more mass are darker. The greyed-out areas are where light from our own galaxy was too bright, blocking Planck's ability to map the more distant matter.

Tip: Clicking on the name of a sky survey image opens a dialog box that lets you adjust the brightness of the image.

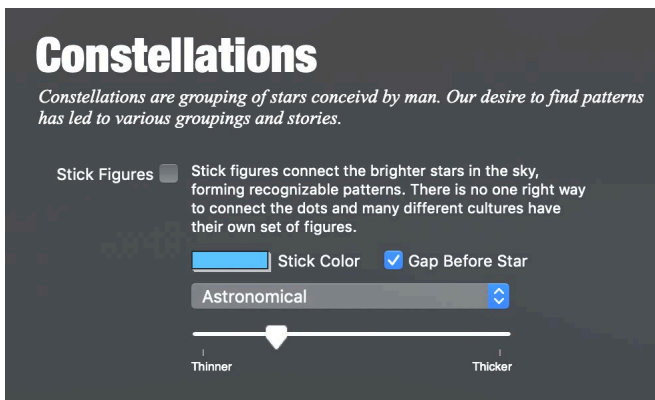
Planck CMB

This map shows the oldest light in our universe, as detected with the greatest precision yet by the Planck mission. The ancient light, called the cosmic microwave background, or CMB, was imprinted on the sky when the universe was 370,000 years old. It shows tiny temperature fluctuations that correspond to regions of slightly different densities, representing the seeds of all future structure: the stars and galaxies of today.

Brightness:  Dimmer Brighter

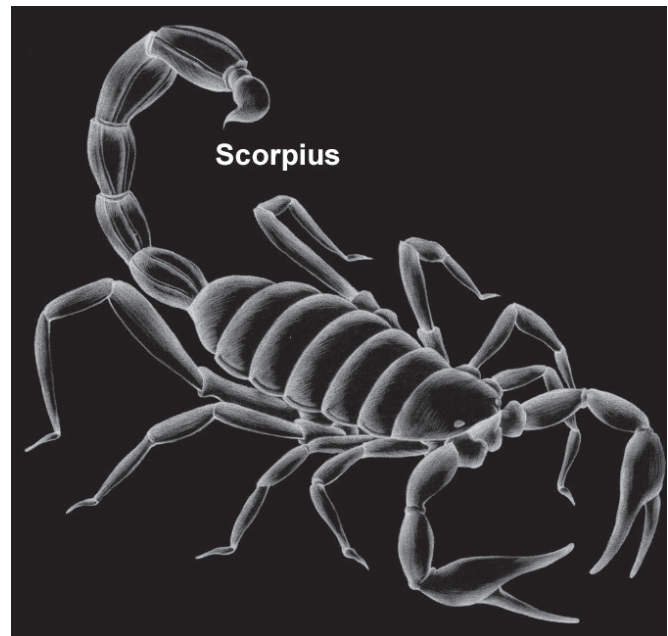
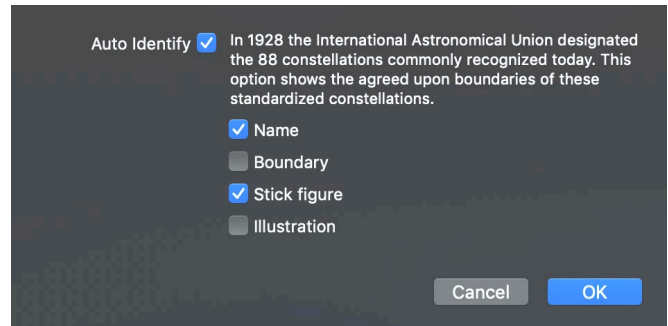
Constellations

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 Arabs, 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 has many options for drawing the constellations. All constellation options can be accessed by expanding the “Constellations” layer in the **Options** search results pane.



Auto Identify: Checking this box will highlight the constellation that is at the center of the screen. If you scroll around the screen, the highlighted constellation will change.

Tip: Clicking on “Auto Identify” opens a dialog box that lets you choose how to display the highlighted constellations. The display options are the same as for displaying all constellations (name, boundary, stick figure or classical illustration), except they only apply to the highlighted constellation. If you choose to display an illustration, you can also control the brightness of this illustration.



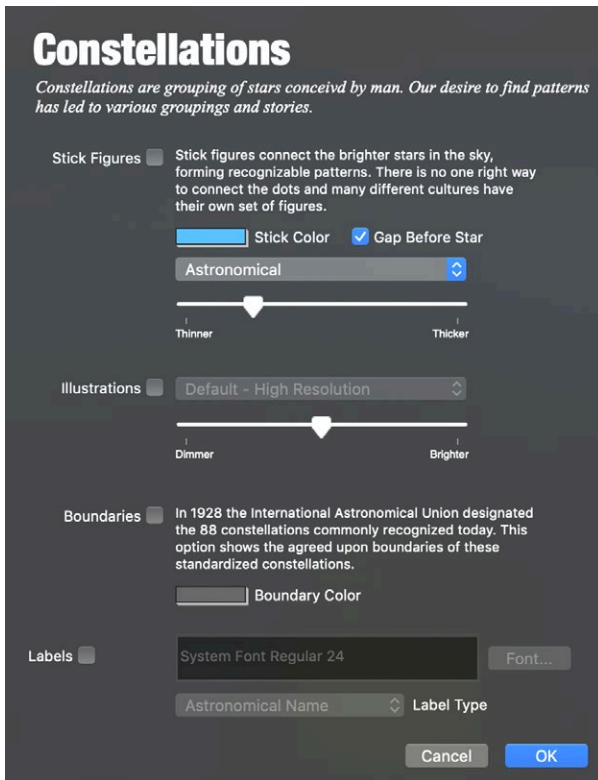
Boundaries: Checking this box displays the boundaries of the 88 official constellations.

Illustrations: Checking this box displays classical illustrations for the constellations.

Labels: Checking this box turns on or off constellation labels.

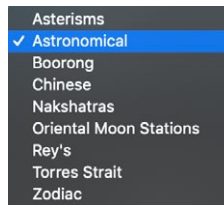
Stick Figures: Clicking this box turn on or off stick figures for the constellations.

Constellation Options: Clicking on the words “Boundaries”, “Labels”, or “Stick Figures” will open the Constellation Options dialog box.



This dialog box lets you adjust the color of the constellation figures, boundaries and labels. You can also adjust the size and font of the labels. For the labels, a dropdown menu lets you choose whether to display the constellation's astronomical name, its common translation, or both. For the stick figures, you can choose from several different figure sets.

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 the asterisms, stick figures that are not formal constellations. It



is also possible to create your own stick figures. See “Custom Asterisms” on page 140 for information on creating your own figures.

Note: It is not possible to view more than one set of stick figures onscreen at the same time.

By default Starry Night shows the “Classical” image set for constellation illustrations. If you have more than one set of illustrations, you can select which one to display from the “Image set” dropdown menu.

Guides 1 (Coordinate Systems)

The Guides layer in the **Options** search results pane allows you to display reference points and grids for different astronomical coordinate systems. These coordinate systems can be used to help you locate objects in the sky. This section describes the coordinate systems, while the next section describes the options in the Guides layer that control the display of these coordinate systems.

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

All spherical coordinate systems require two independent coordinates, which are determined by an object's distance in the sky from two “great circles” which are perpendicular to each other. For example, the great circles in Earth's latitude/longitude coordinate system are the equator (which runs east-west) and the Prime Meridian (which runs north-south).

The most commonly used systems are the alt/az and equatorial systems. You may also use ecliptic and, in Starry Night Pro and Pro Plus, galactic and extra-galactic.

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You can find the coordinates of any object in any of these coordinate systems using the **Info** window. See “Info Window” on page 71 for more details.

Alt/Az: The alt/az coordinate system is the most useful system for figuring out where to actually look in the sky to find a particular object. The two coordinates 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° means the object is right on the horizon, and an altitude of 90° 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° , one that is due east has an azimuth of 90° , and one that is due south has an azimuth of 180° . The **local meridian** is the line passing directly overhead in the sky that runs from 0° azimuth (due north) to 180° azimuth (due south).

Equatorial (aka Celestial): The equatorial coordinate system is the most common system for describing the position of objects in the sky. Its two coordinates 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 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, arc minutes, and arc seconds ($^\circ$, $'$, $''$). 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 Earth rotates, it is not possible to equate longitude on Earth with right ascension. Think of lines of right ascension as longitude lines that are fixed in space, not rotating with the Earth-centered 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.

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 26,000 years. Because of this, the Vernal Equinox slowly changes over time and so do the equatorial coordinates of an object. These changes are quite small and often unimportant for the amateur astronomer.

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To standardize astronomical positions, astronomers often refer to an object's position using the coordinate system of a particular date. For example you will often see positions given in J2000 coordinates, using the equatorial coordinate system of Jan 1, 2000. Starry Night's **Info** window displays equatorial coordinates for the current time (JNow) and for the year 2000 (J2000).

Note: *The book Starry Night Companion (included with your copy of Starry Night) has more information on using the alt/az and equatorial coordinate systems.*

Ecliptic: This reference system uses ecliptic latitude and longitude as its two coordinates. Ecliptic latitude is similar to declination, except the line of 0° latitude is the ecliptic line (a projection onto the celestial sphere of the plane of Earth's revolution around the sun), instead of the

plane of Earth's equator. Notice the constellations that the ecliptic line passes through—these are the familiar Zodiac constellations. The sun will always be found directly on the ecliptic line, passing through the constellations of the Zodiac over the course of a year. Because the planets all move in almost the same place, they will all be found close to the ecliptic line. Ecliptic longitude has the vernal equinox as its zero point.

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Galactic: This system uses the center of the Milky Way as a reference point. Its coordinates are galactic latitude and galactic longitude. Galactic latitude describes how far an object is from the plane of the Milky Way (an object with a galactic latitude of 0° is in the plane of the Milky Way). The zero point of galactic longitude points directly toward the galaxy's center.

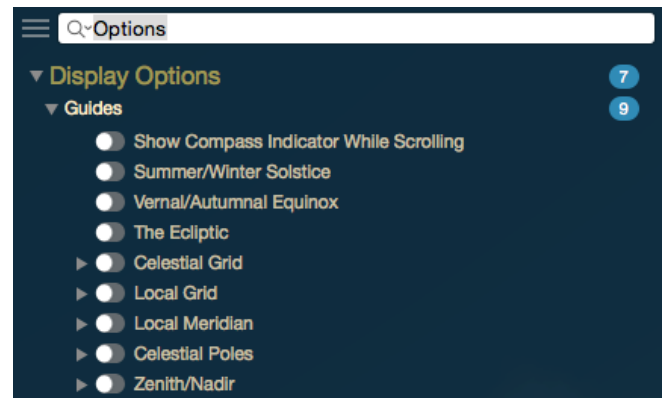
Extra-Galactic: The coordinates of this system are extra-galactic latitude and longitude. A large fraction of the nearest few thousand galaxies from Earth are concentrated in a narrow band. The center of this band is defined as the plane of 0° extra-galactic latitude, the extra-galactic equator.

Guides 2 (Display Options)

Now that you know what each of the different coordinate systems are, let's look at the options for displaying markers for these systems. Recall that all of these options are in the "Guides" layer of the **Options** search results pane.

The Guides display looks very different in Starry Night Enthusiast compared to Starry Night Pro and Pro Plus. First we'll look at the "Guides Layer" in Enthusiast. Skip to the next section if you are using Starry Night Pro or Pro Plus.

Guides Layer in Starry Night Enthusiast



The Guides layer in the **Options** search results pane allows you to display reference points for different astronomical coordinate systems. These reference points can be used to help you identify the position of objects in the sky.

Celestial Grid: The celestial grid shows the grid-lines of the Equatorial coordinate system mapped onto the sky. See "Position in Space" on page 73 for a description of the equatorial coordinate system.

Celestial Poles: The **North and South Celestial Poles** are projections into space of Earth's north and south poles. Polaris, the North Star, is very close in the sky to the North Celestial Pole.

Local Meridian: The **local meridian** is an imaginary line running from due north along the horizon through the zenith, through to due south along the horizon. During a given night, a celestial object will be at its highest point in the sky when it is on the local meridian line.

Show compass indicator while scrolling: This turns on or off the compass image in the upper right corner of the screen, which appears when you scroll around the sky to help you determine your viewing direction.

The Ecliptic: The **ecliptic line** is the apparent path in the sky which the sun moves through over the course of a year. Notice the constellations the

ecliptic line passes through—these are the familiar Zodiac constellations. The sun will always be found directly on the ecliptic line, while the moon and planets will always be found close by.

Zenith/Nadir: The **zenith** is the point in the sky directly above your head, while the **nadir** is the point directly below your feet.

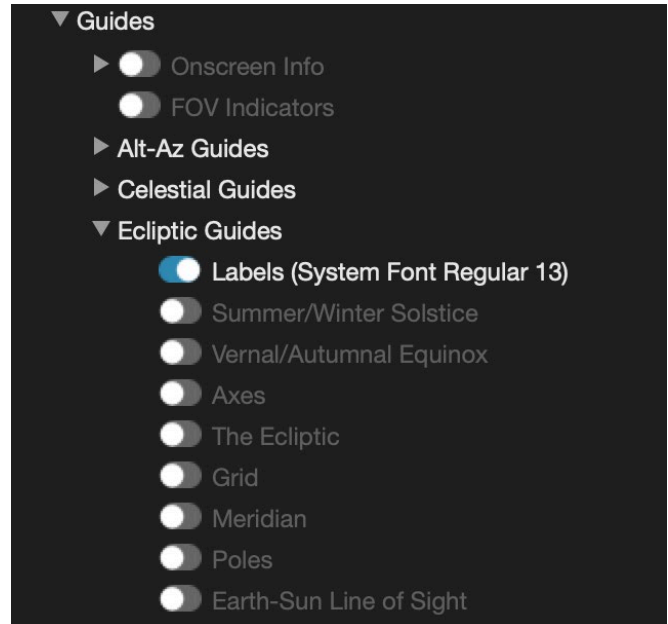
Summer/Winter Solstice: The **Summer Solstice** is the sun's position relative to the stars on the first day of summer (in the Northern Hemisphere), while the **Winter Solstice** is the sun's position relative to the stars on the first day of winter. More precisely, they are the sun's positions in the sky at the two exact times when the plane of Earth's equator is inclined at the largest angle (about 23.5 degrees) to the plane determined by Earth's revolution around the sun.

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 Earth's equator is the same as the plane defined by Earth's revolution around the sun.

Guides Layer in Starry Night Pro and Pro Plus

Axes: In Starry Night Pro and Pro Plus, this option displays a 3-dimensional set of reference axes and/or a reference plane for the coordinate system in question. Options for changing the look of the reference axes are in the Guides Options dialog box. It is not possible to turn on reference axes for the alt/az system.

Equator: This displays the line of 0° "latitude" for the coordinate system in question. For the alt/az system, this is the horizon line. For the equatorial system, this is the celestial equator, a projection of Earth's equator into space. For the ecliptic system, this is the ecliptic line, a projection of the plane of Earth's orbit around the sun onto the celestial sphere.



For the galactic system, available in Starry Night Pro and Pro Plus, this is the galactic equator, a line passing through the center of the band of the Milky Way.

Grid: This displays a grid with the latitude and longitude gridlines for the coordinate system in question. As you change your field of view, the grid spacing will automatically change. You can change the default spacing of these gridlines in the Guides Options dialog box.

Meridian: This displays the line of 0° "longitude" for the coordinate system in question. For the alt/az system, this is the local meridian, a line running from due north along the horizon through the zenith, through to due south along the horizon.

For the equatorial system, available in Starry Night Pro and Pro Plus, this is the **Celestial Meridian**, the line of 0° right ascension which passes through the Vernal Equinox.

Poles: This displays markers for the points at "latitudes" of 90° N and 90° S for the coordinate system in question. For the alt/az system, these are the zenith (the point in the sky directly above

your head) and the nadir (the point directly below your feet). For the equatorial system, these are projections of Earth's north and south poles, known as the **North** and **South Celestial** poles, respectively.

Vernal/Autumnal Equinox: This displays markers for the Vernal and Autumnal Equinoxes. 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 Earth's equator is the same as the plane defined by Earth's revolution around the sun.

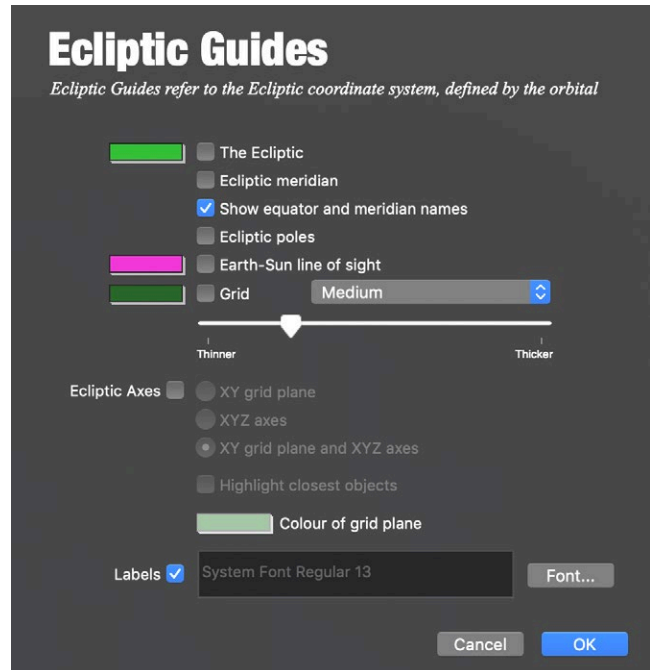
Summer/Winter Solstice: This displays markers for the Summer and Winter Solstices. The **Summer Solstice** is the sun's position relative to the stars on the first day of summer (in the Northern Hemisphere), while the **Winter Solstice** is the sun's position relative to the stars on the first day of winter. More precisely, they are the sun's positions in the sky at the two exact times when the plane of Earth's equator is inclined at the largest angle (about 23.5 degrees) to the plane determined by Earth's revolution around the sun.

Guides Options: Clicking on the words "XXX Guides" in the **Options** search results pane will open the Guides Options dialog box for the coordinate system in question.

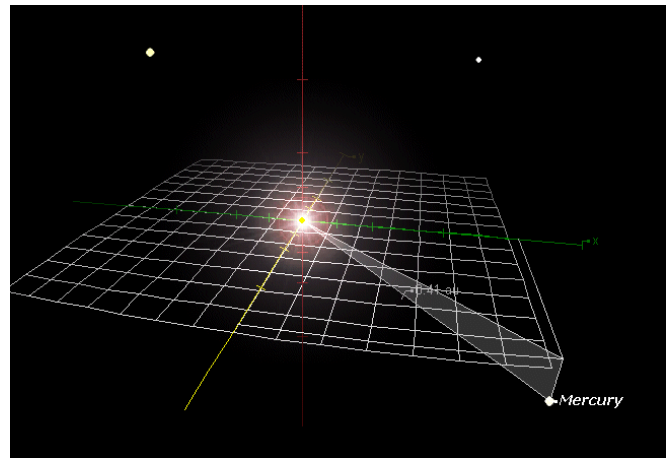
You can change the color of the markers, gridlines, and reference axes. You can also turn on/off numerical labels for the markers and gridlines.

A dropdown menu lets you control the spacing of the guides grid, choosing fine (lots of gridlines close together), medium, or coarse (a few lines, widely separated).

The bottom set of controls in the Guides Options dialog box affects the look of the guide axes. You



can choose whether to draw just the XY grid plane, just the XYZ axes, or both. Finally, you can choose to highlight the closest objects. This will give a 3-dimensional view of the position of these objects in relation to the coordinate system in question.



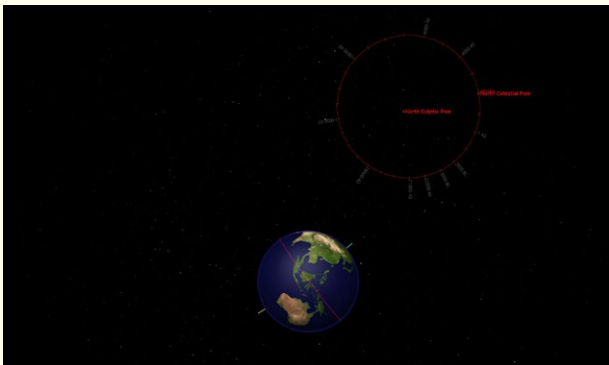
Tip: Any objects that you select (by clicking on the object) will automatically have their positions highlighted on the 3D grid.

Precession Dials and Circumpolar Regions

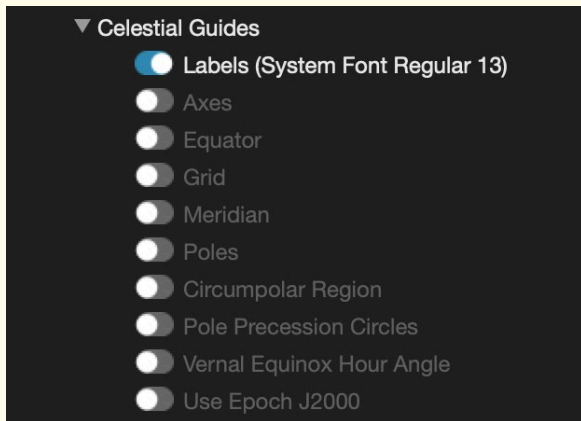
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A **Precession Dial** guide shows a ring in the northern and southern sky marked in 1,000 year increments depicting the rotational axis "wobble" of the Earth over its 26,000 year cycle.

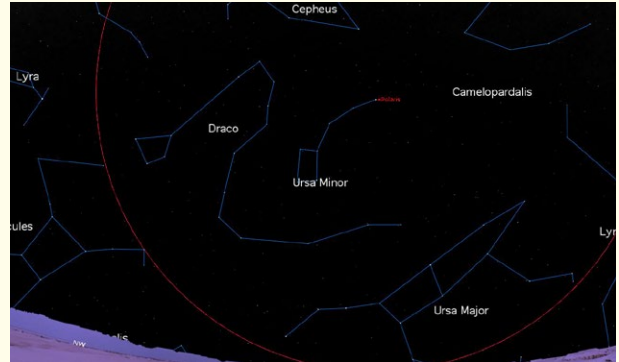


To display the precession dials, open the **Options** search results pane, expand the "Guides" layer and then the "Celestial Guides" sub-layer. Under Celestial Guides check the "Pole Precession Circles" box.



The **Circumpolar Region** guide shows the stars (and other 'fixed' deep sky objects) that never disappear below the horizon for a given latitude on Earth. Polaris for example is a circumpolar star for Northern Hemisphere observers.

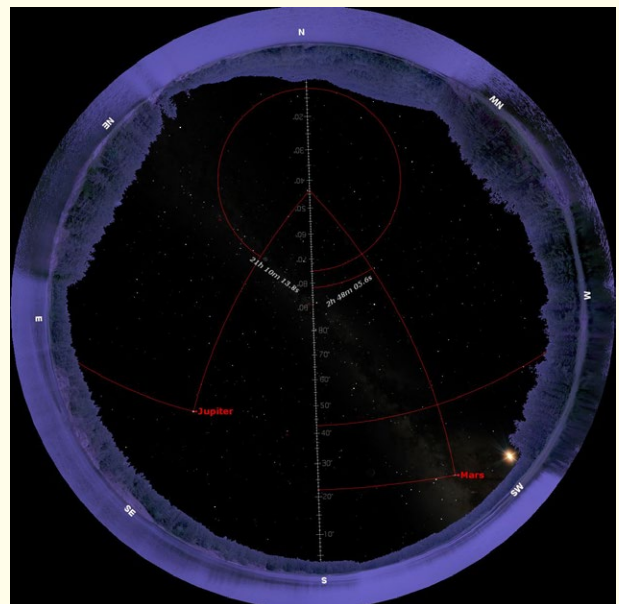
To display the precession dials, open the **Options** search results pane, expand the "Guides" layer and then the "Celestial Guides" sub-layer. Under Celestial Guides check the "Circumpolar Region" box.



Hour Angle Lines

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Our time systems are based on what is defined as the Local Hour Angle (LHA) of a celestial object. The LHA is the angular

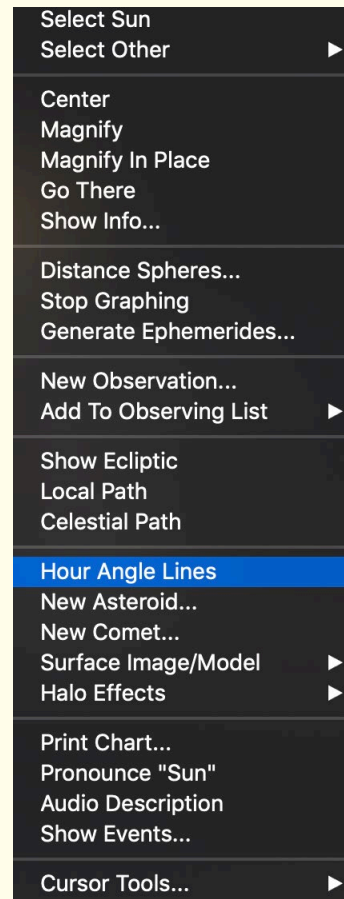
CONTINUES NEXT PAGE

distance that a celestial object is from the observer's local meridian measured westward along the declination circle to the position of the object. Usually the object in question is the sun, but the LHA of an object will tell the observer exactly where the object is relative to his/her local meridian, and therefore where to locate it in the sky.

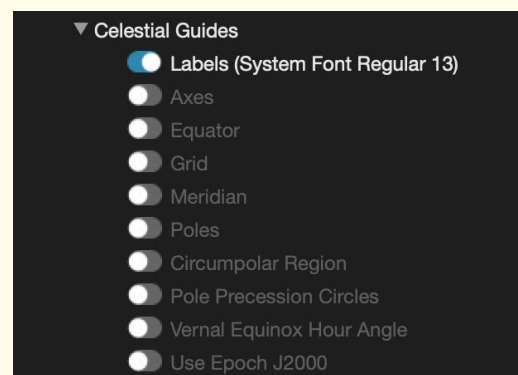
Local Apparent Solar Time (LAST) is defined as the LHA of the sun + 12 hours. The 12 hours is tacked on because people didn't want the day to start when the sun is on the local meridian (so astronomers get the inconvenience instead!). So, for example, if the sun is on the observer's local meridian, the LHA = 0 h and the LAST = 0h + 12h = 12 noon. When the sun is beneath your feet (LHA = 12 h) the LAST = 12h + 12h = 24h = 0h = 12 midnight. Note that AM (ante meridian) and PM (post meridian) have no meaning for 12 noon and 12 midnight, i.e., the sun can't be before or after the meridian if it's on the meridian.

Sidereal Time is defined as the LHA of the Vernal Equinox. This tells us exactly how the celestial sphere is oriented at any time and is required in order to determine an object's position. If you look at the LHA of the Vernal Equinox depicted close to the North Celestial Pole you will note that it is identical (by definition really) to the Right Ascension that is on the observer's local meridian at that instant. This is because the Right Ascension scale was defined as starting at 0h at the location of the Vernal Equinox.

To display the Local Hour Angle right-click or **Ctrl**-click (Macintosh) on a solar system object and select **Hour Angle Lines** from the contextual menu that pops up. Alternatively, you can do a search and click on an object's **Contextual Menu** button in the search results pane (first button located on the left of the object's name) to view the contextual menu.



To display the Vernal Equinox Hour Angle, open the **Options** search results pane and expand "Celestial Guides" under the "Guides" layer. Under Celestial Guides check the "Vernal Equinox Hour Angle" box.



Field of View Indicators

If you own binoculars or a telescope, you may wonder how the views that you see onscreen match up with what you would see outdoors using your astronomical instrument.

The **FOV** side pane allows you to display an outline onscreen that shows the shape and typical field of view (FOV) of any of your astronomical instruments.



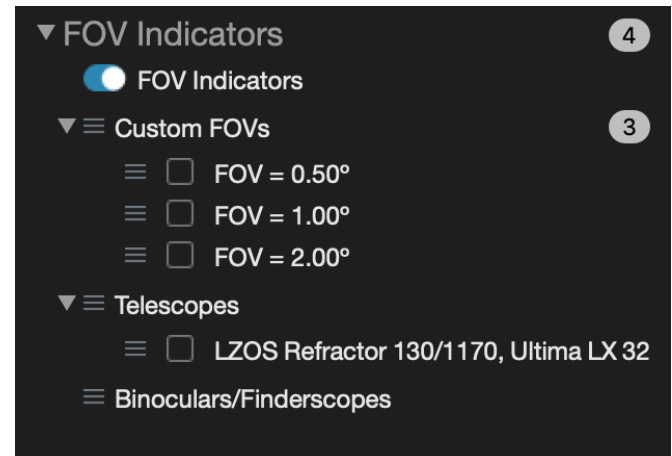
Starry Night lets you display an outline onscreen that shows the shape and field of view (FOV) of any of your astronomical instruments. We call these outlines field of view (FOV) indicators. Field of view indicators are useful because they show the exact size of the patch of sky that you will be able to see through a given astronomical instrument. Therefore, the area shown inside the indicator by Starry Night should correspond very well to what you actually see outdoors when you are observing.

Indicator List: To see a list of available FOV indicators open the **FOV** pane by typing “FOV” in the toolbar search text box or by selecting **FOV Indicators** from the **Pane Shortcuts** button.

The name of each indicator and its field of view are shown.

Turning indicators on/off: Checking/unchecking the box to the left of the indicator name turns on/off the outline for that indicator.

After you have turned an indicator on, you should see the indicator in the main Starry Night sky view at the center of the screen.




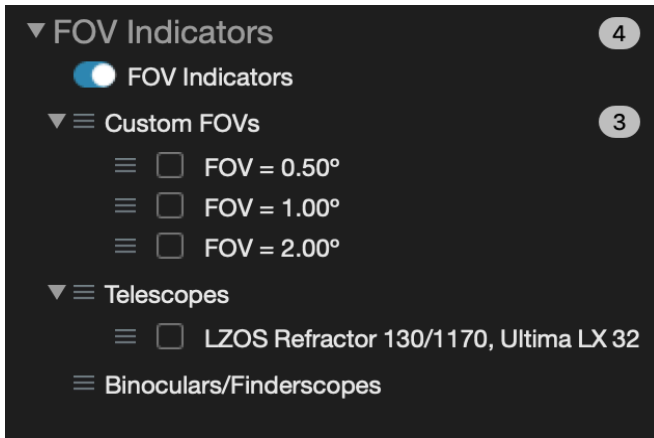
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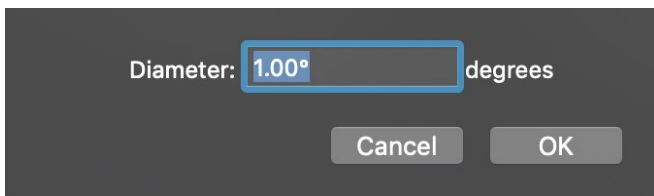
See “Field of View Indicators 1 (Creating an Equipment List)” on page 106 for more information on FOV indicators and on how to create an Equipment List.

Multiple Indicators: You can turn on more than one FOV indicator at a time. One situation where you might wish to display indicators is if you are using a primary telescope and a finderscope.

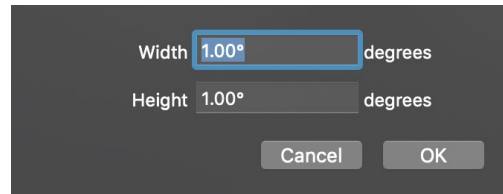
Adding Indicators: To add a new indicator, click the **contextual menu** button  in the “Custom FOVs”, “Telescopes” or “Binoculars/Finderscopes” layer in the **FOV** pane.



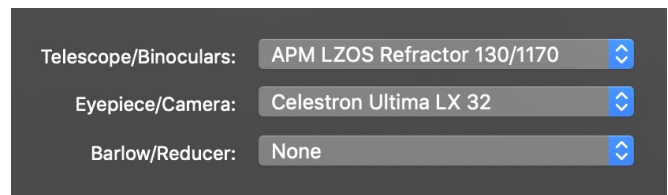
- **Circular FOVs:** Select **Circular...** to add a circular field of view indicator. Then enter the diameter in degrees and press the **OK** button.



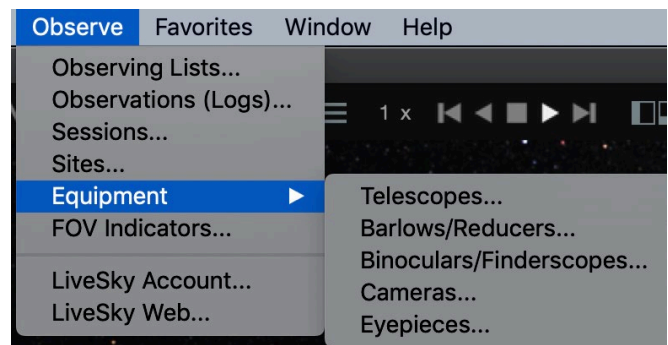
- **Rectangular FOVs:** Select **Rectangular...** to add a rectangular field of view indicator. Then enter the width and height in degrees and press the **OK** button.



- **From Equipment:** Select **From Equipment...** to add a field of view indicator based on an exact combination of equipment you own - Telescope/Binoculars, Eyepiece/Camera, and Barlow/Reducer.



If no equipment is listed, you need to first enter the information about your equipment by selecting **Equipment** from the **Observe** menu.



See “Equipment List” on page 106 for information on creating an equipment list.

Deleting indicators: You can delete any of your Field of View indicators by clicking on the **contextual menu** button located on the left of the indicator's name in the FOV pane, and then clicking the Delete button in the menu that opens.

Heads-Up Display (HUD) Options

In “Identifying Objects In The Sky” on page 16, you learned that pointing the cursor at an object onscreen causes Starry Night to display the object's name, constellation and distance. This feature is known as the Heads-Up Display (HUD).

You can change the look of the HUD and also change the information fields that it displays, by choosing **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh) and selecting **HUD** from the top of the Preferences dialog box.

You can set the HUD to display information only when you are holding down a certain key. This is useful if you find that the HUD information appears too frequently and gets in your way. You can also avoid this problem by moving the

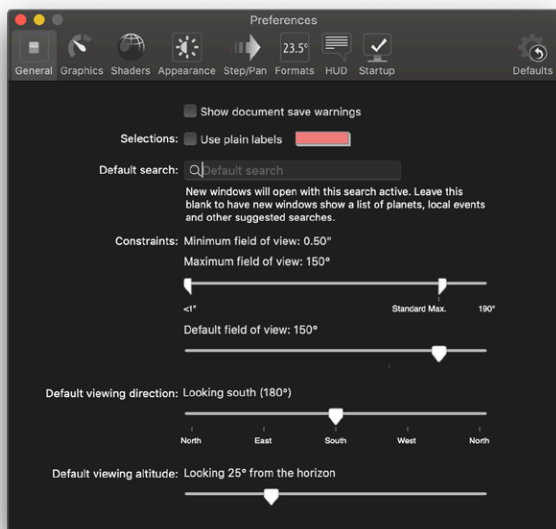
“Mouse is idle for...” slider farther to the right. This slider controls how long the cursor must be pointing at an object before the HUD information is displayed.

Unchecking the “Show info only when over an object” option causes the HUD information to appear even when you point the cursor at the black background sky. This can be useful in determining the coordinates of any position in the sky.

A long list of information fields gives you control over which object information is displayed, including name, magnitude, distance, and so on. You can also choose the color in which you want to display these information fields.

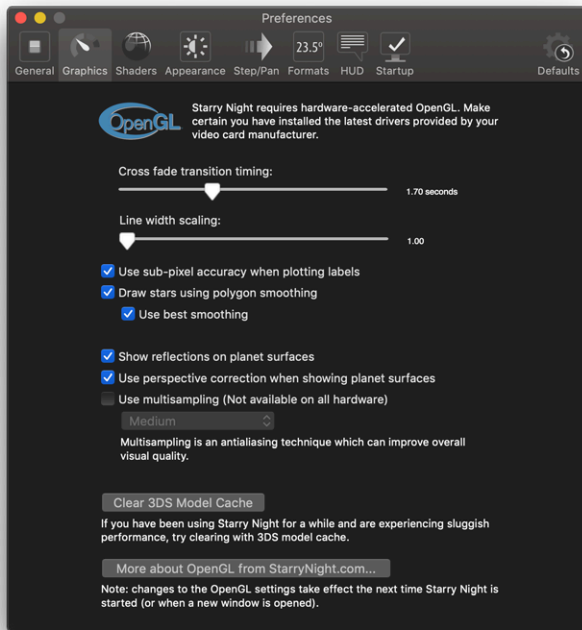
Finally, you can choose the font, style, and size of the text in which the HUD information is displayed.

Tip: You can choose to display the HUD information on the upper left side of the screen instead of directly beneath the object, by checking the “Show info in upper left corner of the screen” box.



Graphics Options

OpenGL offers improved graphics on computers whose video hardware supports it. You can access the OpenGL preferences by choosing **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh) and selecting **Graphics** from the top of the Preferences dialog box. The Graphics dialog box allows you to select a number of options.



Cross fade slider: Rather than jumping straight into a new scene, instantly loading a new Starry Night File (SNF) or labeling an object, you can add a fade 'break' between actions that change your sky view. Think of it as the fade-in/fade-out effect between images in a photo slideshow. Use this slider to control the cross fade transition timing between actions in Starry Night.

Use sub-pixel accuracy when plotting labels:

Sub-pixel accuracy gives labels a smooth feel as they move on the screen. However, depending on your video card, this can cause labels to flicker.

Draw stars using polygon smoothing: Some video

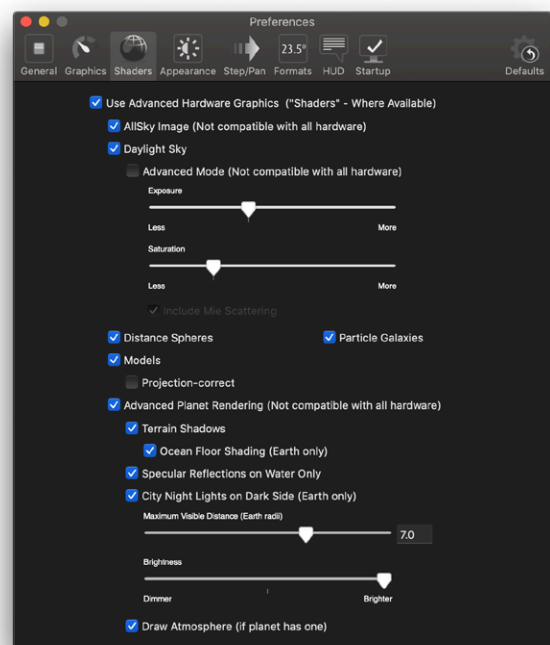
cards have trouble doing what's called polygon smoothing and this can cause "blocky stars". By default, polygon smoothed stars are turned off on the PC and turned on on the Mac. If you are experiencing the "blocky star" effect on the Mac you can try turning this feature off. On the PC, if your card supports it, turning this feature on can improve the speed at which stars are drawn; if your card doesn't support it, it can result in stars being drawn more slowly or having a blocky appearance.

Show reflections on planet surfaces: This realistically models the sun's glare on planet surfaces.

Use perspective correction when showing planet surfaces: this corrects for perspective when viewing planet surfaces.

Shaders Options

The Shaders options menu allows you to choose whether or not to use pixel shaders for special effects. Shaders are used to produce lighting, shadows, specular highlights, translucency and other effects to improve the appearance of 3D objects.

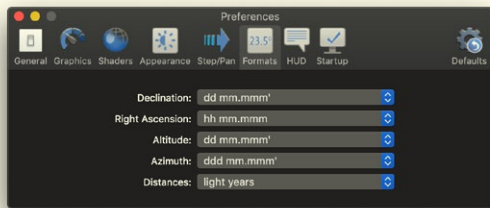


Formats

PRODUCT SPECIFIC FEATURE

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You can change the number format for the information displayed by the HUD by choosing **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh) and choosing **Formats** from the top of the Preferences dialog box.



There are a number of different formats in which declination, altitude, right ascension, and azimuth can be displayed, and you can choose appropriate formats for each of these options using the dropdown menu.

- **d**: degrees
- **m**: minutes
- **s**: seconds

The number of occurrences of each letter indicates the number of decimal places. For example, “dd mm.mmm” indicates that degrees will be displayed by up to two digits, with minutes being displayed by up to two digits rounded off to three decimal places — 25° 30.123’.

For distances, you can choose to view the distance between you and any celestial object in either light-years or parsecs. One parsec is equal to about 3.26 light-years.

Full screen mode

PRODUCT SPECIFIC FEATURE

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Selecting **View>Fullscreen** hides the main menu and the window frame to give you a full screen view of the sky.

Tip: Once you are in full screen mode, you will need to find your way back out! Press the **F7** key to restore the main menu.

Saving Your Settings

Now that you know all of the features for adjusting the appearance of the sky, you may wish to make some changes to Starry Night’s default settings. For example, you may want Starry Night to always open with daylight turned off.

Choosing **Options>Save Current Options as Default** will save all of your appearance settings so that Starry Night will use these settings whenever you start the program or open a new window. This allows you to set up Starry Night to look exactly the way you like, every time you use the program.

Restoring Default Settings: Choosing **Options>Presets>Default** will restore all of the settings in Starry Night to the default values you have chosen (or the built-in default settings, if you have never used the **Save Current Options as Default** option).

Multiple Settings: You may wish to create a set of appearance settings that is not used as the default. To do this, set Starry Night up the way that you want, then choose **Options>Save Preset...** from the menu. This will open a dialog box that allows you to name your new settings files. Any settings files that you create can then be turned on from the **Options>Presets** menu.

Adding Print Presets: You may wish to modify Starry Night's default print presets or add additional print presets. To modify an existing print preset, first apply the preset by choosing **Options>Presets>[preset name]** from the menu. Next, make any changes to these settings. Finally, choose **Save Preset...** from the **Options** menu and click on the file "<Preset Name>.sno" in the Save dialog box that opens. This will replace that print preset with your own changes. You may also choose to create an entirely new print preset by making your own settings and then choosing **Save Preset...** from the **Options** menu and naming the preset in the Save dialog box. Your new preset will then be listed in the **Options>Presets** menu.

Global Preferences. Certain aspects of Starry Night are treated differently than your appearance settings (which you save by choosing **Options>Save Current Options as Default**). These aspects are called global preferences. When you change a global preference, the change will be saved automatically (there is no need to choose **Options>Save Current Options as Default**). All of the options in the Preferences menu are global preferences.

***Tip:** You can restore the global preferences which initially accompanied **Starry Night** by choosing Preferences from the **File** menu (Windows) or the **Starry Night** menu (Macintosh) and pressing the **Defaults** button in the Preferences dialog box.*

Chapter 4

Sky Data

This chapter will show you how to use several different Starry Night features and functions that teach you more about the night sky and give you more information about astronomical events and the sky in general. In the next chapter, “Object Databases” on page 62, you will learn how to access information about specific objects.

Note: *Some of the features in this chapter require an Internet connection. If you are not connected to the Internet when you try to access these features, Starry Night will try to connect you. If you do not have Internet access, you will not be able to make use of these features.*

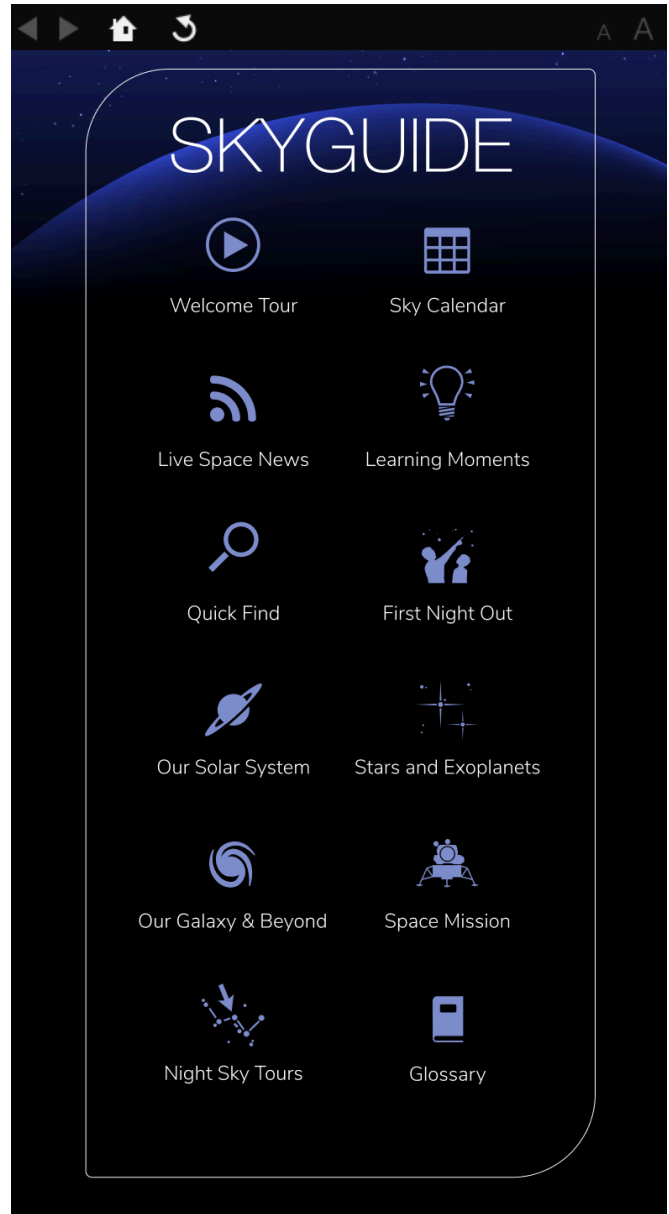
SkyGuide

Dozens of interactive multimedia tours await you in the **SkyGuide** pane. These in-depth experiences reveal the fascinating science and history of the solar system, the stars, the galaxies, the beginning of time, and the fate of the universe. It also includes daily headline news on astronomy and step-by-step instructions on how to use the most common Starry Night features.

There's no interface to learn: it works just like a web browser!

As you and SkyGuide explore together, you will learn tips for navigating the sky, fun facts of the solar system, seasonal tours of the sky, and much, much more. Throughout this multimedia matrix you'll discover images and movies to enhance the experience.

This section highlights some of the main features in SkyGuide.



Type “SkyGuide” in the search text box or select **SkyGuide** from the **Pane Shortcuts** button in the toolbar to open the SkyGuide panel.

From the home SkyGuide page you can select several main categories:

Welcome Tour: A guided introduction to Starry Night and the things you can do.

Sky Calendar: A curated list of stargazing events for each day of the month.

Live Space News: The latest space and astronomy news from our partner Space.com.

Quick Find: Find a planet, star, constellation and other interesting objects. These lists of objects are usually organized by season, letting you know when they can be best observed.

First Night Out: An introduction to the night sky and how to navigate your way around.

Our Solar System: An introduction to objects in our solar system. This section tells you what to look for and how to locate them in the night sky.

Stars & Exoplanets: An introduction to objects beyond our solar system, including stars and planets around other stars.

Our Galaxy & Beyond: Explore the Milky Way galaxy and our local corner of the universe.

Space Missions: Explore the solar system through the “eyes and ears” of interplanetary spacecraft such as Voyager 2 and Cassini. Step on the moon with an in-depth tour of all Apollo Lunar Missions.

Night Sky Tours: Take guided tours of selected objects in the night sky. Take a seasonal tour of the night sky or explore the images taken by space observatories.

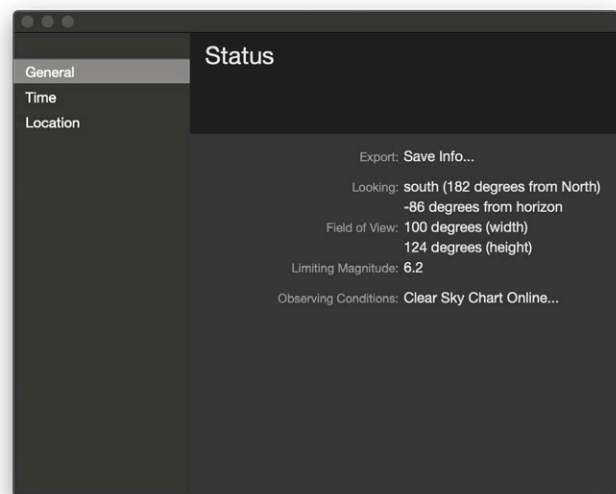
Glossary: This is a list of the most common astronomical terms.

We suggest you start with the Welcome Tour and then explore the other sections of SkyGuide. Have fun browsing!

View Status Info

The **View Status** floating window provides a handy summary of all of the general information about your sky view—for example, your viewing location, time, and viewing direction. All of the information in the Status window is dynamic—if you change your view onscreen (for example, by changing your time or viewing direction), the fields in the Status window will automatically update to reflect the new view.

To open the **View Status** window, select **Show View Status Panel** from the **View** menu.



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Some of the fields in the **Status** window are only useful to specialists. These fields are marked with three asterisks (***) and are only available in Starry Night Pro and Pro Plus.

The information displayed falls into three areas: general information, time information, and location information.

1 General Information:

Export: Clicking the **Save Info** button will export the information in the Status window to a text file.

Looking: The direction in which you are viewing. Both the distance from the horizon and the compass direction are listed.

Field of View: The exact width and height of your current field of view.

Limiting Magnitude: The magnitude of the dimmest object visible in your current view. Magnitude is a measure of the brightness of objects and is discussed in "Magnitude" on page 75. As you zoom in to smaller fields of view, Starry Night automatically shows dimmer objects, or in other words, increases the limiting magnitude.

Observing conditions: Local astronomical weather forecast to help plan your observing session. Internet connection required.

2 Time:

Universal Time: This field displays the Universal Time of your current view. Because of time zones, an astronomical event (such as a lunar occultation) could take place at any of 24 different times, depending on your location. To avoid confusion, astronomers often report event times using a standard time known as Universal Time, which is

the same everywhere in the world. Universal time is equal to the local time in Greenwich, England (without Daylight Saving Time), 5 hours ahead of Eastern Standard Time.

Local Time: The local time of your current view.

*****Julian Day:** The Julian Day is another astronomical time concept, used by astronomers to avoid the problems resulting from historical calendar changes. The Julian Day is simply the number of days that have elapsed since noon, January 1, 4713 B.C. Fractions of days are given in decimal values. For example, the Julian day 2451544.5 is 2 451 544 days and 12 hours after noon, January 1, 4713 B.C., which happens to be midnight on Dec. 31, 1999!

Tip: *If you want to set the date in Starry Night to a specific Julian day, open the dropdown menu to the immediate right of the date/time display in the toolbar and choose Set Julian Day from the menu.*

*****Sidereal Time:** The local sidereal time of your current view, which ranges from 0 hours to 24 hours. Sidereal time measures the rotation of Earth with respect to the background stars, not the sun. A sidereal day is about 4 minutes shorter than a solar day. Astronomers find sidereal time helpful because objects with a right ascension equal to the sidereal time are crossing the local meridian at their highest point in the sky, and this is often the best time to observe the object.

*****Delta T:** Delta T measures the difference between terrestrial time (aka ephemeris time) and Universal time. Historians use delta T to date historical events precisely using solar eclipses.

3 Location:

Location: The name of your current viewing location (usually a city name).

Latitude/Longitude: The latitude and longitude of your current viewing location.

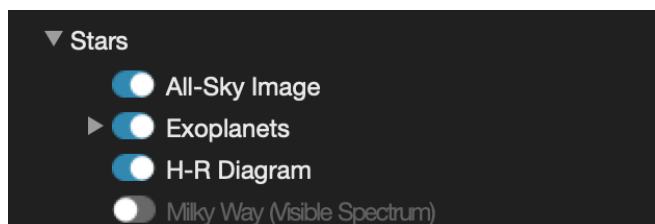
*****Heliocentric X, Y, Z:** Heliocentric coordinates reference your position in space with respect to the sun. Heliocentric coordinates of (0, 0, 0) would place you at the center of the sun. The X and Y coordinates mark your position along the ecliptic plane (the plane of Earth's orbit around the sun). The Z coordinate indicates your distance from the ecliptic plane. Earth travels along the ecliptic plane, so if you are on Earth's surface, your heliocentric Z value will be close to 0. Heliocentric coordinates are given in astronomical units (AU's). One AU is the average distance between Earth and the sun, about 150,000,000 km.

*****Distance from sun/Angle from Ecliptic Plane/**

Phi: Another set of heliocentric coordinates, using angular measures instead of X, Y, Z coordinates. Phi specifies the angle along the ecliptic plane, with the zero point being the position of Earth on the autumnal equinox.

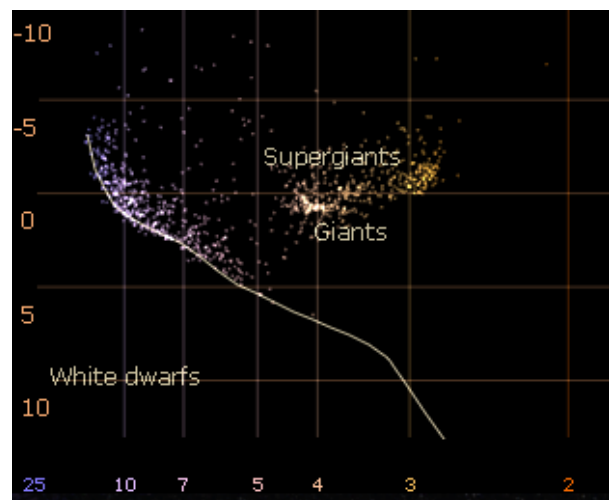
The Hertzsprung-Russell Diagram

Open the **Options** search results pane and expand the "Stars" layer. Click on the "H-R Diagram" checkbox to view a special kind of graph known as an H-R (Hertzsprung-Russell) diagram.



An H-R diagram tells us about a star's age and its mass. Each dot on the diagram represents a star. The diagram plots star luminosity (amount of light & energy emitted by the star) on the vertical axis versus star temperature on the horizontal

axis. Young stars that are still burning hydrogen in their cores are found in the "Main Sequence", the curve along the left side of the graph. The larger and heavier a star is, the farther it will be to the upper left along this curve. Older stars in the "red giant" phase of their lives are no longer on the main sequence, and will be found in the upper right corner of the H-R diagram. Finally, "white dwarf" stars will be found along the bottom left of the H-R diagram, beneath the main sequence.

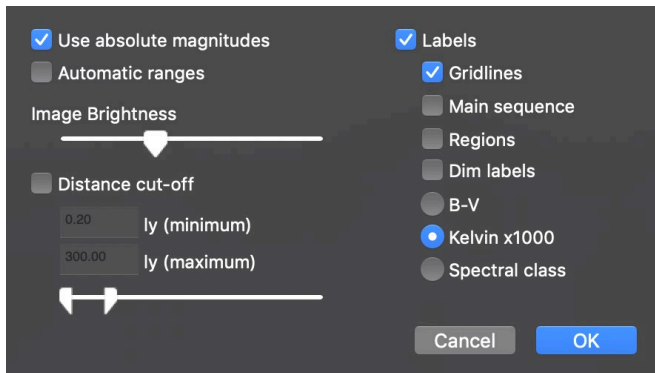


The stars plotted in the H-R diagram are the same stars shown onscreen in the main window. You can click on any star in the H-R diagram, and Starry Night will draw a circle around this star on the main window, allowing you to identify it. This makes it easy to identify stellar oddballs, such as white dwarfs, supergiants, and extremely massive main sequence stars. Conversely, you can point the cursor at any star in the main window, and Starry Night will highlight this star's position (with a red dot) on the H-R diagram.

Tip: The H-R diagram is fully dynamic. If you scroll around the screen or change your field of view, the stars shown onscreen will change, and the H-R diagram will update to plot these new stars.

H-R Diagram Options:

Expand the H-R Options layer beneath the H-R diagram to access options that affect the appearance of the diagram.



Use Absolute Magnitudes: Unchecking this option will plot apparent magnitude instead of absolute magnitude on the vertical axis.

Automatic ranges: Checking this option will cause Starry Night to select the smallest possible ranges for the X and Y axes that still manages to include all stars visible onscreen.

Image Brightness: This slider controls how bright the star dots in the H-R diagram are drawn.

Distance Cut-Off: This plots only those stars with distances from Earth that lie between the minimum and maximum distances that you specify.

Labels: Unchecking this option draws a blank graph with no labels. Checking this option allows you to turn on any of the label options listed below.

Gridlines: Draws gridlines from the vertical and horizontal axes.

B-V: Uses a star's B-V color as the field along the horizontal axis. Hotter stars have a lower B-V value.

Kelvin X 1000: Plots star temperature (in thousands of degrees Kelvin) along the horizontal axis. Degrees Kelvin are equal to degrees Celsius + 273.

Spectral Class: Plots star spectral class along the horizontal axis.

Main Sequence: Draws a line representing stars on the main sequence. Any star that appears close to this line is probably a main sequence star (a star that is still burning hydrogen fuel).

Regions: Labels the areas of red giants, white dwarfs, and main sequence stars.

Note: *White dwarfs are very dim and few are in Starry Night's star catalogs (the Hipparcos/Tycho-2 catalogs), so few will be found in Starry Night's H-R diagrams.*

Dim Labels: Draws the diagram labels much dimmer than the stars.

Downloading Photographic Images

PRODUCT SPECIFIC FEATURE

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Starry Night Pro shows over 2.5 million objects and Starry Night Pro Plus shows over 17 million celestial objects, but this is only a tiny fraction of the stars and objects that can be seen from Earth using telescopes.

On the Internet, various institutions host large image databases. One example, called the Digitized Sky Survey (DSS), is hosted by the Space Telescope Science Institute (STScI). This survey contains large, high-resolution pictures of the entire night sky. The database is so large that it is distributed on a few hundred DVD-ROMs. Starry Night makes it easy to look at the thousands of galaxies, nebulae, and other astronomical phenomena that are contained in this database and others.

CONTINUES NEXT PAGE

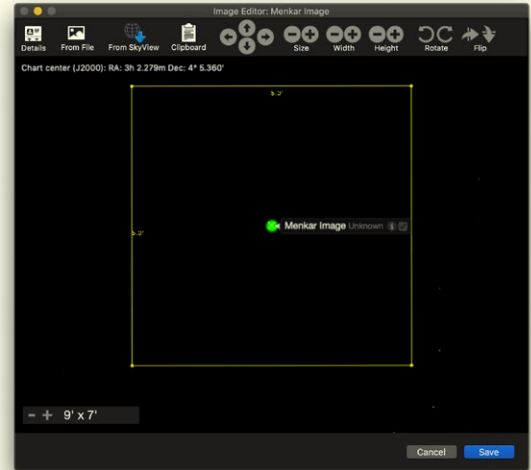
The STScI offers an online form you can fill out to request a picture of the sky. Starry Night makes this process considerably easier. Just zoom in on the part of the sky that you want an image of, and right-click (**Ctrl**-click on Mac) and select **Add Image** from the sky contextual menu.

Getting a picture from an online database such as the Digitized Sky Survey to your browser can take up to a few minutes, so you have to be patient. The reason for the delay is that the Digitized Sky Survey's computer has to assemble your request from its extensive database.

Tip: You can only download images when your field of view is between about 1.5 arc minutes and 30 arc minutes. If your field of view is outside this range, this menu item will appear greyed out.

Example: Viewing the Horsehead Nebula using the Digitized Sky Survey

- 1 In the search text box in the toolbar type in "horsehead". Starry Night should list the Horsehead Nebula.
- 2 Double-click on the Horsehead Nebula's entry in the list, to center on this object.
- 3 Now use the zoom buttons in the main window to zoom in to a field of view of about 20' (20 arc minutes), so that the Horsehead Nebula almost fills the screen.
- 4 Right-click (**Ctrl**-click on Mac) and select **Add Image** from the sky contextual menu. Pressing the **From SkyView** button in the dialog window that opens, reveals several Internet survey databases. Select "DSS" to obtain an image of the Horsehead Nebula from the Digitized Sky Survey. Press **Save** to keep the image.



In this example, we used the Digitized Sky Survey to load an image of an object that Starry Night already had an image for. You would be more likely to use the Digitized Sky Survey to download images of areas of the sky for which Starry Night does not have a detailed image. One way to explore with the Digitized Sky Survey is to turn on the NGC/IC database or the Galaxies database and look for an interesting cluster of galaxies. Zoom in on a promising cluster and then request the Digitized Sky Survey image for a detailed view.

Tip: After you have loaded an image from the Digitized Sky Survey and saved it, it will remain there every time you run the program.

For more information, refer to "Adding Images from the SkyView" on page 135.

Chapter 5

Object Databases

This chapter will show you how to learn more about galaxies, meteor showers, planets, and all of the other marvelous denizens of the night sky. You will first learn about all of the different object databases included in Starry Night. Next, you will learn how to get more information about any of the objects in these databases.

Note: *Some of the features in this section require an Internet connection. If you are not connected to the Internet when you try to access these features, Starry Night will try to connect you. If you do not have Internet access, you will not be able to make use of these features.*

Introduction to Databases

Starry Night includes literally millions of celestial objects, from dozens of different databases.

Accessing Databases: As you learned in chapter 3, “Appearance of the Sky”, you can use the **Options** search results pane to turn databases on/off, turn their labels on/off, or modify the database display options. All of these functions can also be accessed from the main menu, by choosing **View**, **Labels**, or **Options**, respectively.

We’ll now briefly describe each of the databases included in Starry Night. The databases in your version of Starry Night may be slightly different from those listed here, as we are continually updating and adding new databases. As you learned in “Options Pane” on page 24, databases are organized in a layered framework, based on their distance from Earth.

The three major database layers are:

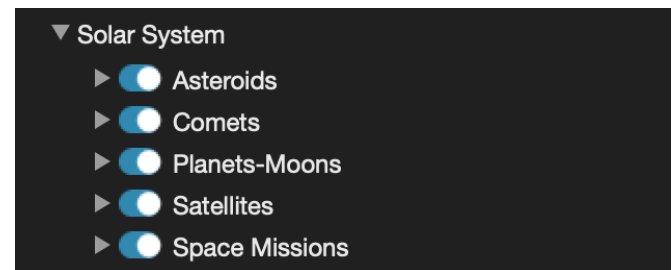
1 Solar System

2 Stars

3 Deep Space

Databases 1 (Solar System)

These databases are for objects that are inside our solar system.



Asteroids: Small, rocky bodies that are too small to be planets. Most asteroids lie in the “asteroid belt”, a region of space between the orbits of Mars and Jupiter. Starry Night includes thousands of asteroids organized by groups and families. Asteroid data needs to be updated regularly. See “Database Updates” on page 66 for information on updating asteroid data.

Comets: These are the small balls of rock and ice that 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 Earth and the sun, picking up speed and getting brighter. Starry Night includes about 150 comets, including some great comets of yesteryear such as Halley and Hale-Bopp. Comet data needs to be updated regularly, so that any bright new comets are added to Starry Night’s database. See “Database Updates” on page 66 for information on updating comet data.

Planets/moons: The sun, the eight major planets that orbit the sun, the dwarf planets, and all of the moons of these planets. In the past few years, many new small moons have been discovered around the outer planets. Starry Night includes all of the moons that were known at the time of release. If any new moons are discovered in the future, data for these moons will be available on our website. Choose **Help>Check For Application Updates** to see if any new data is available.

Satellites: This refers to any man-made body orbiting our Earth. Most satellites fall into two distinct types of orbits: near-Earth orbits or geosynchronous orbits. Satellites in near-Earth orbit move much more rapidly than 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 Earth rotates, so they stay directly above the same point on Earth's surface at all times. Starry Night includes hundreds of satellites. Satellite data needs to be updated regularly. See "Database Updates" on page 66 for information on updating satellite data.

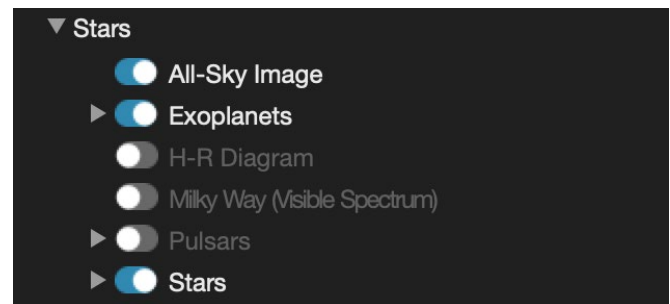
Space Missions: Interplanetary spacecraft and probes. Follow the path of Voyager, Cassini, Pioneer and other space missions.

Meteor Showers: This database is under the "Local View" layer in the **Options** search results pane. It marks the positions of the major meteor shower **radiants**. The radiant is the point in the sky where all meteors from a given meteor shower appear to be coming from. Meteor showers are formed by comets that come close to the sun. Heat from the sun causes dust and rock to break off the comet and gather into a collection of debris that moves along the comet's orbital path. If Earth's orbit crosses this path, there is a meteor shower as the dust particles burn up in Earth's atmosphere. Each meteor shower happens at

about the same time each year. This database uses data from the International Meteor Organization and was created by Stephen Hutson.

Databases 2 (Stars)

This includes not only stars, but also all objects that are outside of our solar system, but still inside our galaxy, the Milky Way.



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AllSky Image: The AllSky image presents the entire sky as a full-color, seamless mosaic, and at several resolution levels. It is simply breathtaking. See "AllSky CCD Mosaic" on page 140 for additional information.

Exoplanets: All known (confirmed) exoplanets as 3D bodies with proper location, size, orbit and planetary texture. You can even land on them.

Milky Way: The band of our Milky Way that stretches across the night sky. The misty band of illumination that we see is actually the combined light of millions of stars. It is possible to adjust the brightness of the Milky Way. Starry Night Pro and Pro Plus users can view the Milky Way in several different wavelengths including infrared and x-ray.

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Pulsars: A catalog of more than 700 pulsars. Pulsars are neutron stars, former supergiants that have been compressed into spheres with diameters of only a few tens of kilometers. Created by Ulf Teras.

Star Clusters: Some 1700 open star clusters and globular clusters. Globular clusters are densely packed balls of stars. Open star clusters are loosely packed collections of stars.

Stars: A star is any body which burns or once burned hydrogen fuel. The energy and light produced in stars comes from the fusion of hydrogen atoms. 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.

In Starry Night, all stars are accurately rendered as 3-dimensional bodies with classification-appropriate color, texture and relative radii.

The star database in Starry Night is actually a compilation of databases: Starry Night Enthusiast uses the Hipparcos catalog, and the Tycho-2 catalog, and Starry Night Pro and Pro Plus also include the USNO-A2 catalog.

The Hipparcos and Tycho-2 catalogs come from a European Space Agency project to determine the distance to our nearest stars. The Hipparcos catalog has about 100,000 stars and the Tycho-2 catalog has about two million. Find out more about these catalogs on their official web page:

<http://astro.estec.esa.nl/SA-general/Projects/Hipparcos/hipparcos.html>

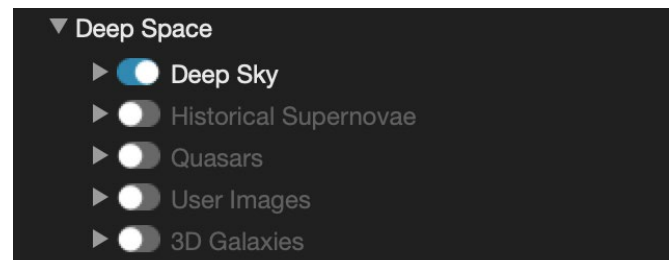
Starry Night Pro and Pro Plus use the USNO-A2 star database for dim stars not included in the Hipparcos or Tycho catalogs.

The entire USNO-A2 star database contains 500 million stars down to magnitude 21! This database is far too large to fit on a CD or DVD, so Starry Night allows you to download portions of this database from the Internet. See “Adding Objects 3 (Stars)” on page 133 for more information.

Tip: Our sun is an ordinary star. However, in Starry Night, it is a member of the “Planets/moons” database, not the “Stars” database.

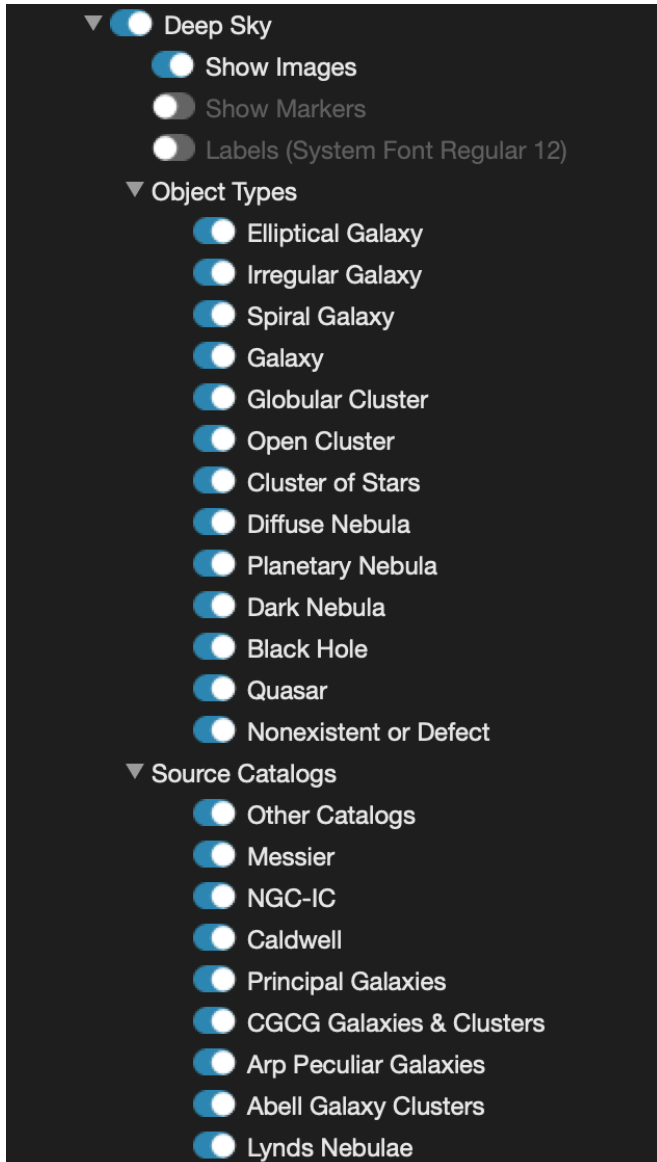
Databases 3 (Deep Space)

This includes all objects outside of our solar system.



Deep Sky Objects: Created using more than a dozen source catalogs, Starry Night staff compiled the best object positions, sizes and types into a single, cross-referenced database. With over 36,000 targets suitable for amateur astronomers, it replaces the majority of Starry Nights previous object databases.

Objects in this database can be filtered by *Object Type* and by their *Source Catalogs*, given you the flexibility to display only the objects you are interested in observing.



Here is a description of some of the source catalogs included in the Deep Sky database.

Messier Objects: This category includes the 110 Messier objects, originally cataloged by French astronomer Charles Messier and colleagues in the late 1700s. Messier was trying to identify all “fuzzy” deep space objects that might be mistaken for comets. The Messier objects are a mixture of star clusters, nebulae, and galaxies (plus a few objects that don't fit into any of these categories). Many of the Messier objects are favorite targets for amateur astronomers. For

each object in the Messier catalog, Starry Night includes a detailed image and a text description with observing tips.

NGC/IC Database: The NGC/IC (New General catalog/Index catalog) is a more extensive listing of star clusters, galaxies and nebulae. It was originally compiled by J.C. Dreyer from 1888-1908 and includes about 13,000 objects. Starry Night uses an updated version of this database.

Caldwell: The Caldwell catalog consists of 109 deep space objects not in the Messier catalog that can be viewed with a small telescope. This catalog was originally compiled by Sir Patrick Moore.

Principal Galaxy Catalog: The Catalogue of Principal Galaxies (PGC) contains coordinates and cross-identifications for thousands of galaxies. It is based on the Lyon- Meudon Extragalactic Database (LEDA), which was originally started in 1983.

CGCG: The Catalogue of Galaxies and of Clusters of Galaxies (CGCG) was compiled by Fritz Zwicky in 1961-68 and contains galaxies and galaxy clusters.

Abell Cluster of Galaxies: The catalog was originally prepared at the Bulgarian Academy of Sciences. The Abell clusters are rich, compact clusters of galaxies identified by Abell (1958). These clusters were identified on the red plates of the Palomar Observatory Sky Survey (POSS). The magnitude, if known, refers to the brightest member.

Arp Peculiar Galaxies: A catalog of peculiar galaxies gathered by Dr. Halton C. Arp in his Atlas of Peculiar Galaxies. The catalog is a selection of unusual or peculiar galaxies, interacting pairs or larger groups. Arp compiled the list with photographs from the Palomar 200-inch telescope in 1966. Magnitude, if known, refers to brightest member. Lynds Nebula: A collection of bright and dark nebulae originally compiled in the 1960s by Beverly Lynds.

Other Catalogs: This category includes the brightest objects from dozens of other minor catalogs.

Quasars: More than 18,000 quasars, BL Lac objects, and active galaxies. All three classes of objects are the extremely luminous nuclei of very distant galaxies. There is probably a supermassive black hole at the center of each of these objects. This database was created by Ulf Teras.

Tully 3D Database: A collection of over 2 million galaxies. The neat thing about this database is that it contains 3-dimensional positions of these galaxies. You can use Starry Night's controls to view the 3-dimensional arrangement of these galaxies.

Choose **Favorites > Deep Space** from the main menu to view some samples that use this database to render some 3-dimensional extragalactic views of our universe.

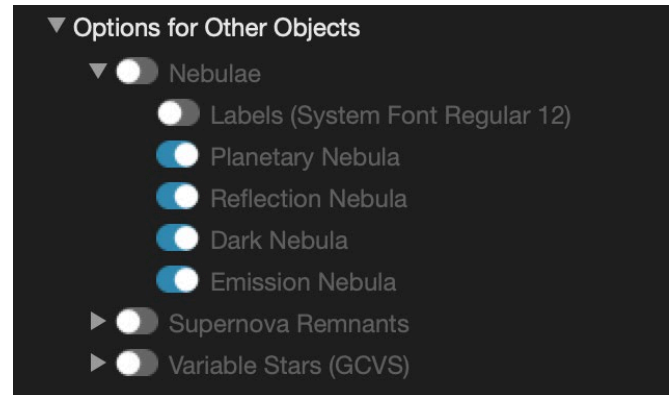
Databases 4 (Other Objects)

Databases fall into this category because they overlap with one or more of the databases described in the first 4 layers. For example, the Other Objects category includes a database of nebulae. However, many of these nebulae are already included in the "Messier Objects", or the "NGC-IC Objects" databases, so Starry Night would show duplicate markings for these objects, if the "Nebulae" database was also turned on.

Tip: Most of the databases in this category were created by Starry Night users. See "Adding Objects 4 (Databases)" on page 135 for information on building your own databases.

Note: The list of databases in your version of Starry Night may not be exactly the same as the following list, as we are continually adding new databases and updating existing ones. If you want to include a database you see described

here, but it is not installed in your version of Starry Night, please visit the Knowledge Base area of our website and do a search for "databases".



Nebulae: This database includes some 2700 Dark, Emission, and Reflection Nebulae.

Variable Stars (GCVS): All 31,000 stars in the GCVS (General Catalog of Variable Stars). Based on data from Kopolev et. al (1988) and NASA/ADC (1997). Converted to Starry Night format by Marion Schmitz.

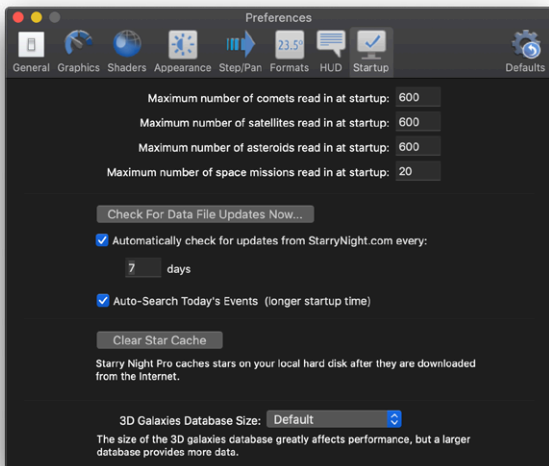
Database Updates

Our view of the universe will change over the next ten years. New moons will be discovered, bright new comets will streak toward the sun, and new satellites will be launched into orbit. To ensure that Starry Night's library of data keeps up with these changes, several update mechanisms are built into the program.

The databases of comets, asteroids and satellites change more frequently than other databases, so Starry Night has a special method of updating these databases. Choose **Help>Update Data Files** and updated satellite, comet and asteroid data files will be downloaded from our website. We update these files several times a week, so you can expect that any new comets, asteroids or satellites will be added as soon as possible. After you have downloaded the new files, you will need

to exit and restart Starry Night before it will read in the new data files.

You can set up Starry Night to automatically update your comet, asteroid & satellite files. The various preferences are in the **Startup** tab in the **Preferences** window.



Click the **Check For Data File Updates Now** button to download the latest comet, satellite, and asteroid data files from the Starry Night website.

Automatically check for updates from StarryNight.com every # days: Checking this option ensures that Starry Night will automatically connect to our website on a regular basis to update the comet, asteroid & satellite files. The updates will be performed when Starry Night is opened. You can control how often Starry Night will attempt to download the files from our website. It is recommended that you update the files at least once every two weeks. This is particularly important for satellites. The position of satellites in Starry Night will become unreliable if your data is more than a few weeks old, due to the effects of atmospheric drag.

Auto-Search Today's Events: If you check this box, Starry Night will always search for any celestial events visible from your home location.

Note: It is also possible to manually modify the comet, asteroid and satellite databases. See “Adding Objects 2 (Multiple Solar System Objects)” on page 132 for more information.

For objects other than comets, asteroids & satellites, the data does not change as frequently.

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Maximum number of objects read in at startup: This field determines how much comet, asteroid, and satellite data Starry Night downloads from our website. The more objects you choose to download, the longer Starry Night will take to load when you start the program. You would only want to modify the default values for these fields if you have manually created larger comet, satellite, or asteroid databases. See “Adding Objects 2 (Multiple Solar System Objects)” on page 129 for information on building these databases.

Clear Star Cache: Empties the stars downloaded from the Internet that were cached on your local hard drive. See “Adding Objects 3 (Stars)” on page 130 for information on downloading star data from the Internet.

However, there will still be changes to existing databases, and occasionally, new databases. You can check to see if any new data is available by choosing **Help>Update Data Files** from the menu. This connects you to the updates page on our website. If any new databases are available, they will be posted on this page, along with instructions for adding them to your copy of Starry Night.

Now that you know all of the different databases in Starry Night, we will look at how to get more information on any of the objects in these databases.

Search Results Pane Info

In “Finding Objects” on page 17, you learned that typing in a search for an object produced a list of items found. For each item in this list, the Search Results pane displays several pieces of information:



☰ This opens the object's contextual menu. See “Object Contextual Menu” on page 68 for information on the fields in this menu.

/ **Select/Deselect:** In Starry Night, checking the box to the left of the object's name in the Search Results pane selects the object and labels it onscreen. See “Labeling Select Objects” on page 29 for more information on selecting objects.

Orbit: Checking the radio button (circle) to the right of the object's name, toggles on its orbit.

Events: Moving your cursor over the objects name will bring up the Events link. Click on the word “Events” (in blue) to view specific upcoming events for that object.

Object Name: Clicking on an object's name will label it onscreen. Double-clicking on the object's name will label and center it onscreen.



Tip: Click the **i** button in the object's label to read a text description of the object. All well-known objects will have unique text descriptions, with historical information, observing tips, and other cool facts about the object. For nondescript objects such as dim stars, the description will be a generic description for the object type (i.e. red giant star).

Altitude: The object's height above the horizon. If the object has a negative altitude, it is currently beneath the horizon. If it has a positive altitude that is close to 0°, the object is just above the horizon. An altitude close to 90° means that the object is high above the horizon.

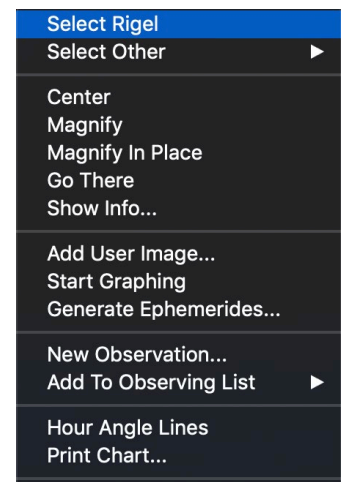
Objects in our solar system also have the following options:

Orbit: Checking this box (to the right of the object name) draws the orbital line of the object. See “Orbits” on page 85 for more information on solar system orbits.

Object Contextual Menu

An object's contextual menu provides a list of actions in Starry Night that can be performed on an object. You open an object's contextual menu by clicking the right mouse button (**Ctrl**-clicking on the Mac) while the cursor is pointing at the object.

All of the items in the menu relate to the object that you clicked on. If you were not pointing the cursor at a specific object, the menu gives you options for the appearance of the sky as a whole and the constellation that you are pointing at. See “Sky Contextual Menu” on page 24 for information on that menu.



Tip: You can also open an object's contextual menu from the Search Results pane by clicking on the contextual menu button to the left of an object's name.

The various options in the contextual menu are described here. Most of these features are discussed in more detail in other sections of the book, so only a brief description of each feature is given in this section. Don't be overwhelmed! The options are just listed here so that you have a quick reference for all the contextual menu options in one place.

Select/Deselect: This selects or deselects the object. If an object is selected, its name and an arrow pointing to the object will appear onscreen. See “Labeling Select Objects” on page 29 for more information on selecting objects.

Center: This adjusts your view so that the object is at the center of the screen and remains locked 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 centered 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 a close-up view. Objects within our solar system and deep space objects in the Messier database all have detailed images. Stars other than our sun are just shown as points of light, and many of the objects from other databases will just have position markers instead of images. **Magnify in Place** zooms in on an object but does not center it on the main window.

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 viewing direction will change, then you will begin to lift off your current body and fly in the direction of the celestial body you have chosen. Your distance from the sun will appear along the bottom of the screen as you fly to the new location. The Heads-Up Display (HUD) will identify any objects that you pass by during your journey. The “Go There” option is only available for objects with accurate 3-dimensional position information. There are many other ways to change your location in Starry Night. See “Changing Your Viewing Location” on page 80 for more information. However, the contextual menu is the **only** way to change your location so that you are viewing from another star or galaxy.

Tip: *If you zoom in for a close-up of a planet and then right-click the mouse (**Ctrl-click** on the Mac) and choose **Go There**, your location on the new planet will be the position on the surface where you clicked the mouse. This can be helpful if you want to watch eclipses on other planets. You can zoom in on Jupiter (for example) until you can see the shadow caused by one of its moons passing in front of the sun. Right-clicking on the shadow and choosing **Go There** will allow you to watch a solar eclipse from Jupiter! **Note:** Not available in Complete Space and Astronomy Pack (CSAP)*

Pronounce: Correctly pronounces the objects name. See “Pronunciation Guide” on page 76 for more information.

Audio Description: Plays an audio guided tour of the selected object if available.

Print Chart: Prints a star chart for the object.

Show Info: On all Starry Night programs, this opens the **Info Window**, which displays much more information on the object. All the fields in the Info Window are explained in “Info Window” on page 71.

Objects in our solar system have a few additional entries in their contextual menu.

New Asteroid / New Comet / New Satellite / Add Moon Orbiting...: All of these options allow you to add a new object using the Orbit Editor. The type of object that you can add depends on the type of object that you open a contextual menu for.

For example, if you open a planet’s contextual menu, the “Add moon Orbiting...” option appears. See “Adding Objects 1 (Individual Solar System Objects)” on page 127 for more information on adding objects with the Orbit Editor.

Surface Image / Model: An option only for solar system bodies with surface images, this allows you to modify the surface image or replace the

image entirely. See “Modifying Images and Models” on page 138 for more information.

Mark On Surface: Places a marker or flag on a planet or moon's surface. Works on rocky solar system bodies where surface data is available. This is handy if you want to mark all the lunar landing sites on the moon or the rover sites on Mars for example. See “Location Markers” on page 35 for more information.

Markers and Outlines...: Opens the Markers and Outlines dialog box. The **Markers** tab contains options that allow you to search for geological features on the surface of a planet or moon and mark their location with a flag. The **Outlines** tab allows you to draw a contoured outline around selected surface features. See “Location Markers and Surface Feature Outlines” on page 35 for more information.

Orbit: Draws the orbital line of the object. See “Orbits” on page 85 for more information on solar system orbits.

Edit Orbital Elements: An option only for objects that you have added with the Orbit Editor, this allows you to edit the object's orbital elements. See “Adding Objects 1 (Individual Solar System Objects)” on page 127 for more information on orbital elements and the Orbit Editor.

Delete: An option only for objects that you have added with the Orbit Editor, this allows you to delete the object entirely from Starry Night's database.

Enlarge Moon Size: By default, the moon's size is enlarged when you are viewing at a large field of view, so that you are able to easily see the moon's phase (the moon is drawn at its correct size when you are zoomed in for a close-up view). By unchecking this option in the moon's contextual menu, the moon will always be drawn at its correct size, but it will be too small to see phase information when you are viewing at a large field of view.

Halo Effects: The sun's halo is an atmospheric

effect that occurs when the sun's light is scattered by our atmosphere. You can turn the sun halo on all the time, off all the time, or on in daylight only. You can also simulate lens flare. If you're viewing a total eclipse of the sun, you will probably wish to leave the sun's halo on, as this halo also serves as the sun's corona.

Tip: To remove the Lens Flare from the sun, open the sun's contextual menu, select Halo Effects and uncheck Lens Flare.

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Start\Stop Graphing: This plots the object's motion with Starry Night's graphing feature (not available in Starry Night Podium). See “Graph” on page 96 for more information.

Generate Ephemerides: This allows you to create a list of printable ephemeris tables for any object in Starry Night. See “Ephemeris Generator” on page 98 for more information.

Add/Edit Image: This allows you to add an image of this object to Starry Night, or edit the image, if the object already has an image. See “User Images” on page 132 and “Modifying Images and Models” on page 138 for more information.

New Observation Entries: Creates a log entry for you to add observing notes about an object. See “Adding Log Entries” on page 104 for more information on log entries.

Note: If you have already added a log entry for an object, the object's contextual menu will list these entries.

CONTINUES NEXT PAGE

Graph Elongation of Moons: Only an option for planets with moons, this plots the elongation of the planet's moon(s) using the graphing feature. See "Graph" on page 96 for more information.

Local/Celestial Path: Turns on the local or celestial path of the object, which shows how the object moves over time. See "Local and Celestial Paths" on page 80 for more information.

Add to Observing List: This adds the object to a new or existing observing list. See "Observing Lists" on page 99 for more information.

Hour Angle Lines: Displays the angular distance that a celestial object is from the observer's local meridian. See "Hour Angle Lines" on page 49 for more information.

Info Window

You were introduced briefly to the floating **Info Window** in "Learning More About Objects" on page 22. Recall that you can double-click on any object onscreen to automatically open the object's **Info Window**. You can also open an object's **Info Window** by typing in a search for the object, then opening the object's contextual menu from the list of items found. Choose **Show Info** from the contextual menu to open the **Info Window**. The **Info Window** provides a great deal of information about any object.

Note: The **Info Window** for an object differs in function from the object's contextual menu. The **Info Window** provides information, while the contextual menu lists possible actions.

Some of the fields in the **Info Window** are common for all objects, while some fields are specific to certain object types.

• General Info

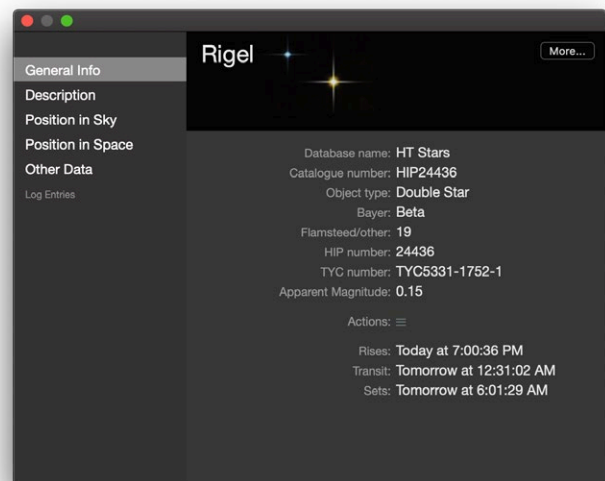
Center: This button center and labels the object onscreen.

More...: Clicking this button will bring up the object's contextual menu of options.

Name: The name of the selected object.

Catalog number:

The object's number in the appropriate astronomical catalog (if applicable).



Object Type: The object's celestial type (star, galaxy, planet, etc.).

Bayer: For stars only, this field 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. Only relatively bright stars have Bayer letters.

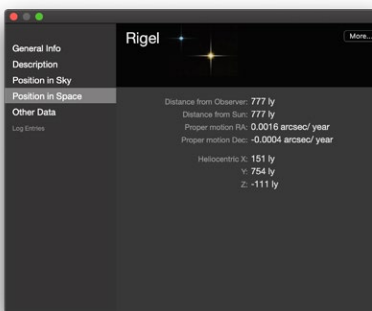
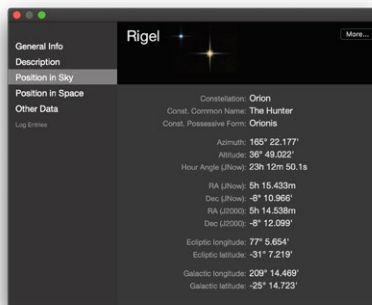
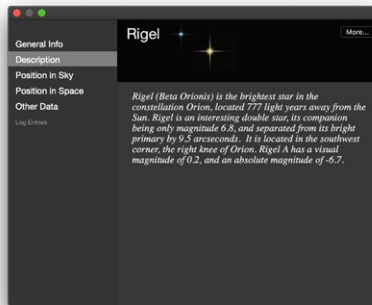
Flamsteed/Other: For stars only, this gives the star's Flamsteed number, if any. The Flamsteed system orders stars not by brightness, but by their position relative to the western boundary of the constellation they are in. The star closest to the western edge is labelled 1. Only relatively bright stars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

HIP Number/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-2 catalog included about two million stars and the HIPPARCOS catalog about 100,000. For stars only, these fields give the catalog numbers of the star in question. Not every star has a HIPPARCOS catalog number.

Rise/Transit/Set: The time at which the object rises above the horizon, transits, and sets below the horizon, as viewed on the date and from the location of the active Starry Night window. An object's transit time is the time at which it is highest in the sky. At its transit time, an object will

be due south in the sky (if you are viewing from the Northern Hemisphere), or due north (if you are viewing from the Southern Hemisphere).

Tip: Clicking on the **rise/set/transit** buttons will change the time in Starry Night to reflect the rise/set/transit times for the object.



Description

A text description of the object. All well-known objects will have unique text descriptions, with historical information, observing tips, and other cool facts about the object. For non-descript objects such as dim stars, the description will be a generic description for the object type (i.e. red giant star).

Position in Sky

This section lists the constellation that the object is currently in, and the object's positional coordinates in many different coordinate systems. The meanings of each of these coordinates are described in "Guides 1 (Coordinate Systems)" on page 43.

Position in Space

This section has information on the object's 3D position in space, if known.

- **Distance from observer:** The object's distance from your current 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 distances are much less accurate for stars farther away than this.

- **Distance from sun:** The object's distance from the sun.

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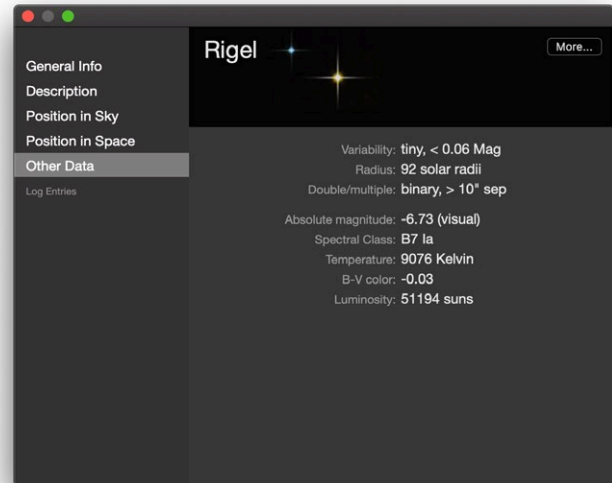
Proper Motion RA/Dec: Stars are not fixed in space, and most are in fact moving quite rapidly. Because of their great distance from us, however, their positions appear constant. Only on a timescale of hundreds or even thousands of years can we actually see the shifting positions. These fields (for stars only) describe how much the star's equatorial coordinates are shifting each year due to the star's motion.

Other Data

The fields that appear in this category depend greatly on the database that the object is from. Different databases will have different information fields.

Star Information Fields:

For stars, the following fields are present:



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

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.

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

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 cataloged 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.

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 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 appear 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 absolute magnitude means a brighter body.

Spectral Class: Spectral classes are groups of stars that have similar characteristic emission lines in their spectra.

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

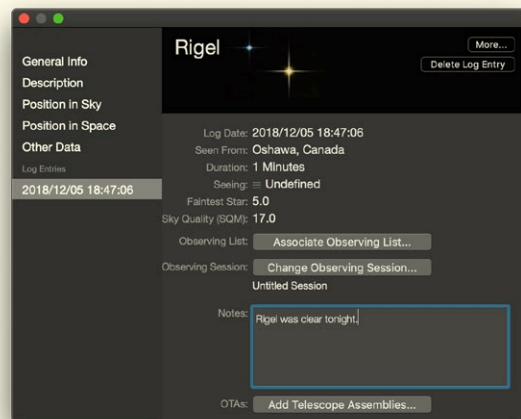
B-V Color: This is a way of measuring a star's color. An average star has a B-V value of around 0. If a star has a negative B-V value it is on the bluish side of the spectrum. If it has a positive B-V value it is on the reddish side of the spectrum. The more negative or positive a star's B-V, the more 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.

Luminosity: Luminosity measures the total light and energy output of a star. It is different from apparent magnitude, because it measures not only visible light, but also the energy released as infrared waves, X-rays, and radio waves.

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Logs: Lists all log entries (if any) that you have created for this object. See “Adding Log Entries” on page 104 for more information on log entries.



Exoplanet Information Fields:

If you use the **Options** search results pane to turn on markers for stars with exoplanets, the Info Window for stars with exoplanets will have additional information fields. This information will also appear in the Heads-Up Display (HUD) when you point the cursor at a star with an exoplanet.

Mass: The mass of the exoplanet, in relation to the mass of Jupiter.

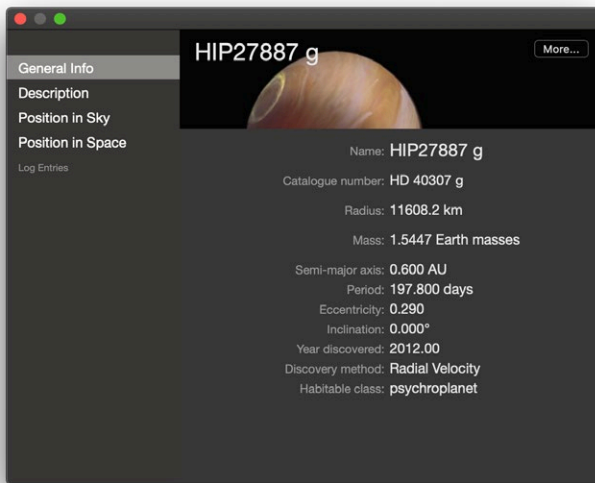
Semi-major axis: A measure of the planet's distance from its central star, in astronomical units (AU). 1 AU is the average distance between Earth and the sun.

Period: The time needed for the planet to make 1 complete revolution around its central star.

Eccentricity:

A measure of the shape of the exoplanet's orbit. The larger a planet's eccentricity, the more that its distance from its parent star (and also its surface temperature) will vary throughout its orbit.

Inclination: The tilt of the planet's orbit, relative to our viewing position on Earth.



Note: This is a different definition of inclination than is used for objects within our solar system (e.g. comets, asteroids, satellites, moons) because the tilt is measured relative to our viewing position, not to the central body's equator. See "Orbital Elements" on page 127 for the definition of inclination for objects within our solar system.

Radius: The radius of the exoplanet.

Solar System Object Information Fields:

For objects within our solar system, the following information fields are present:

Radius: The object's radius (if known).

Apparent magnitude:

The object's apparent magnitude, a measure of its brightness in the sky. See "Magnitude" on page 74 for more information on apparent magnitude.

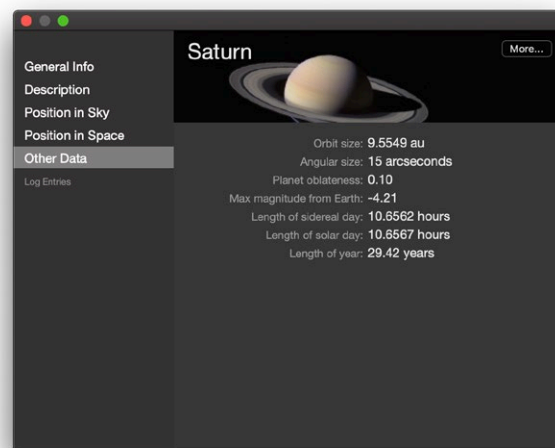
Age: Only an option for the moon, this gives the moon's current phase, and the number of days that have passed since the moon was last new.

Orbit Size: The radius of the orbit that the object makes around its parent body.

Angular Size: This measures the angular width of the object (the field of view that it occupies in the sky).

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

Planet oblateness: This measures how much an object is "squished", in other words, how much it deviates from a perfect sphere. A perfect sphere would have an oblateness of 0. The larger an object's oblateness, the more "squished" it is.



Mass: The object's mass (if known).

Max. Mag. From Earth: The apparent brightness of planets and other objects in the solar system changes as the object moves in its orbit, due to the object's changing distance from Earth and the object's disc illumination. This field gives the apparent magnitude of the object when it is at its brightest.

Length of Sidereal/Solar Day: An object's sidereal day is the time that it takes to rotate once, relative to the fixed stars. An object's solar day is the time that it takes to rotate once, relative to the sun. This is also the average time between sunrises on the planet's surface. These two time periods differ by a large amount only when the length of a planet's sidereal day is a significant fraction of the length of the planet's year. On Earth, the time periods are almost identical, with the 24-hour solar day being only four minutes longer than the sidereal day.

Length of Year: For objects that orbit the sun, a year is the amount of time that it takes for the object to complete one full orbit.

Other Object Information Fields:

The information fields for objects other than stars and solar system objects will vary. Often the only pieces of information are the object's magnitude and angular size.

Pronunciation Guide

Some astronomical names can be a little difficult to pronounce. For example, the constellation Boötes is pronounced "booOH-tees" not "Boots" or "Booties". In some cases careful pronunciation may be necessary to avoid embarrassment as in the case of Uranus, which is pronounced "Yoor-anus", not "Your-anus".

The pronunciation guide in Starry Night will help you learn how to correctly pronounce the names of hundreds of celestial objects from different categories such as stars, constellations and planets.

To listen to the proper pronunciation of an object's name, right click (**Ctrl**-click on the Mac) and select **Pronounce** from the objects contextual menu. The **Pronounce** menu item will only be visible if a pronunciation file for the selected object exists in Starry Night.

The Starry Night pronunciation guide is a handy reference to help you win some friendly arguments at your next astronomical gathering.

Note: *The correct pronunciation of names (even those with historical and mythological roots) can always be debatable.*

Chapter 6

Bending Space & Time

This chapter will show you how to take full advantage of Starry Night's planetarium capabilities. You will learn how to start, stop, speed up and slow down the flow of time, and change your location to view from anywhere on or off the surface of Earth — you'll even fly a spaceship! Several examples will help you master the control of time & space in Starry Night.

Time Flow


By default, time in Starry Night advances at the same rate as real time. If you run Starry Night for one hour, the time on-screen will also advance by one hour. As the time in Starry Night changes, the screen continuously updates to reflect the changing sky.

Note: *This means that the rate of time flow is the same as real time, but the time itself may not be the same. For example, let's say you open Starry Night at 8 p.m. You then change the time on-screen to 1 p.m. and run the program for one hour. At the end of the hour, the actual time will be 9 p.m., but the time that Starry Night shows will be 2 p.m.*

Changing Time Flow Rate: One of the nice things about Starry Night is that you can change the rate at which time flows. Just like nature programs use time-lapse photography to show processes that take place too slowly to see in real time, you can speed up or slow down time to get the best possible views of an astronomical event.



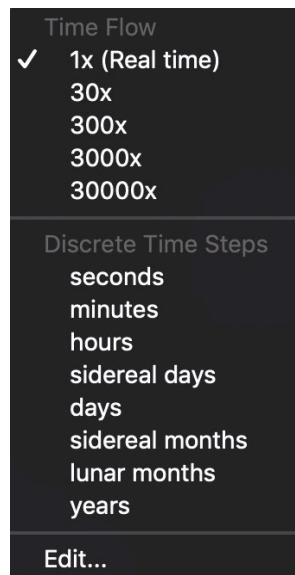
The rate of time flow is shown immediately to the right of the date and time in the toolbar.

Clicking the **Contextual Menu** button  opens a pulldown menu that displays a list of possible time steps. The steps fall into two categories: multiples of real time, and **discrete time steps**. Time steps that are multiples of real time (i.e. 30x) simply advance the time in Starry Night at a rate equal to a multiple of the real rate of time flow. For example, a time step of 30x would cause the time in Starry Night to advance at 30 times the real rate of time flow. Obviously, the larger the multiple, the faster time would advance onscreen. Discrete time steps update the time by a specific increment. For example, a time step of 3 minutes means that every time the screen updates, the time in Starry Night is advanced by 3 minutes.

Discrete time steps are often useful when simulating astronomical events. For example, assume you wanted to see how Jupiter's position in the sky changes over the next few months. You could set the time to sometime in the evening (for example, 9 p.m.) and then set the time step to 1 day. Starry Night would run time forward, showing the sky at 9 p.m. each night. If you had chosen a multiple of real time instead of a discrete time step, you would see an alternating cycle of day and night, instead of seeing the sky at the same time each night.

A few of the discrete time steps listed in the pull-down menu 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 Earth around the sun.



Sidereal month: This is the time it takes for the moon to rotate once around Earth, approximately 27.3 days. This is shorter than the month we are familiar with (the lunar month), again due to the revolution of Earth around the sun.

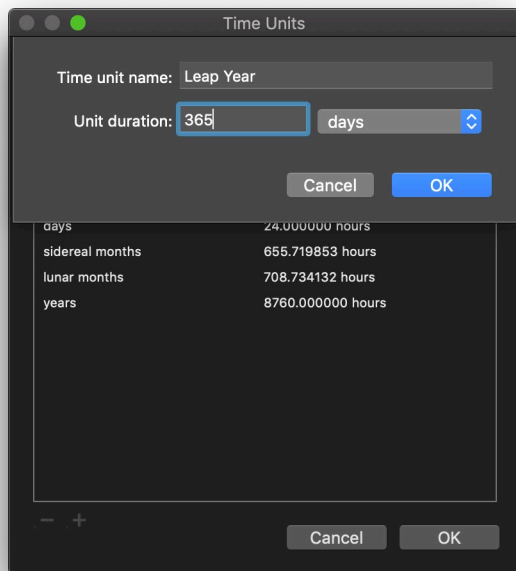
Lunar month: This is the time interval between two full moons, as seen on Earth. It is about 29 1/2 days.

Customizing Time Steps:



You are not limited to the choice of time steps that appear in the time step pull-down menu. If you click on the numerical part of the current time step, it will light up and you can type in a numerical value. This will let you change the time step from 1 day to 7 days, for example.

In Starry Night Pro and Pro Plus, you can also create entirely new discrete time steps. To do this, choose **Edit** from the bottom of the time flow pull-down menu. This opens a new dialog box,



which lists the existing time steps and their values. Double-click on any of the existing time steps to change their values, or click the **(+)** sign in the bottom left corner of this dialog box to define a new time step. For example, you could create a “Martian day”, the average time between sunrise and sunset as seen from Mars!

Time Flow Modes

In the previous section, you learned how to change the rate of time flow, but not the mode of time flow. Time simply flowed forward continuously, advancing every time the screen updated. This is known as the “Forward” mode and is one of 5 different time flow modes in Starry Night. You change the time mode using the controls in the toolbar.



Single Step Backward: Moves the time backward by one time step and then freezes time.

Backward: Runs time backward continuously. Each time the screen is updated, the time moves backward one time step.

Stop: Freezes time at the current value.

Forward (Play): Runs time forward continuously. Each time the screen is updated, time moves forward one time step. This is the default time flow mode.

Single Step Forward: Moves the time forward by one time step and then freezes time.

Tip: If you want to view the sky at a precise time, first press the **Stop** button, and then type in the viewing time. If you type in the viewing time first, the time shown onscreen may update before you can press the **Stop** button.

PRODUCT SPECIFIC FEATURE

PRO PLUS ✓ **PRO** ✓ **ENTHUSIAST** —

Local and Celestial Paths

Objects in our solar system move over time, relative to the background stars and galaxies. Several options in Starry Night allow you to display this motion. Right-click (**Ctrl**-click on the Mac) on any object in the solar system to open the object's contextual menu. You will see options named "Local Path" and "Celestial Path". Selecting one of these options begins to plot the appropriate path for the object in question. As time advances, this path will grow. You can turn off the path by opening the object's contextual menu and selecting the path option again.

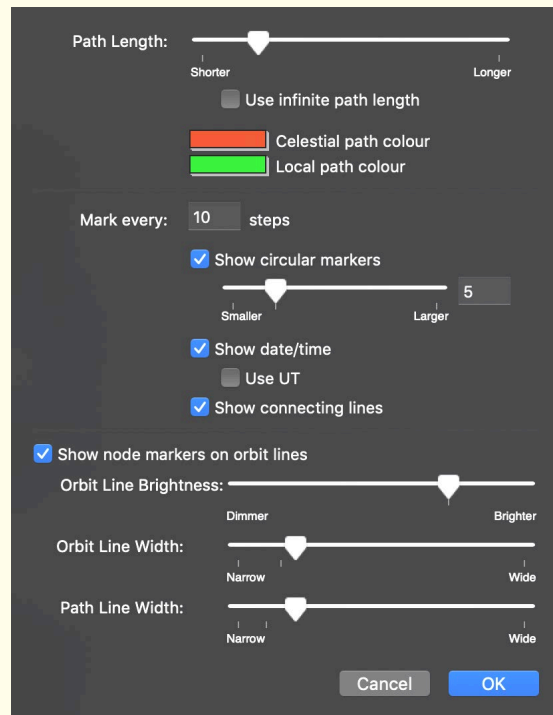
Note: A path is the trail an object makes over a period of time. Therefore, if time is stopped in Starry Night, a path cannot be displayed.

Local Path: A local path is the apparent trail an object would make over time, as seen from your location. The local path of an object incorporates the object's actual motion and the effects of Earth's rotation (assuming you are located on Earth).

Celestial Path: A celestial path is the apparent path an object makes on the celestial sphere — the trail an object leaves over time, in relation to the fixed stars. The celestial path incorporates only the object's actual motion and ignores the effects of Earth's rotation.

Note: There is no local or celestial path for an object that you are located on, since that object doesn't move in relation to you.

Path Options: By choosing **Options>Orbit/Path Options** from the main menu, you can customize the way Starry Night displays local and celestial paths.



Path Length: As Starry Night draws the local or celestial path for an object, and time runs forward, eventually Starry Night starts to erase the oldest parts of the path (if it did not do this, the entire screen would eventually be covered with path lines!). The "path length" slider lets you control how long time runs forward before Starry Night begins erasing the oldest part of the path.

Other Path Options: You can choose whether paths are marked with discrete circular dots, connecting lines, or both. You can choose how often the path should be marked. You can also choose to show date markers for each dot on the path. Finally, you can set the color for the path lines.

Example: The Retrograde Motion of Mars

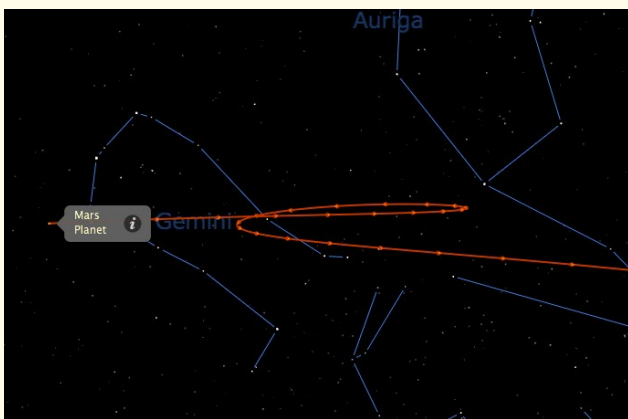
In this example we'll display the celestial path of Mars over a few months as seen from Earth. This path is famous because Mars appears to

CONTINUES NEXT PAGE

move backward partway through its cycle, a phenomenon known as **retrograde motion**. This exercise will also give you practice in switching time modes.

- 1 Open the **Options** search results pane, expand the “Local View” layer, and uncheck the “Local Horizon” and “Daylight” options.
- 2 Type in a search for Mars, and double-click on the entry for Mars in the list of items found. This will center on Mars.
- 3 Press the **Stop** button in the time mode controls in the toolbar.
- 4 Point the cursor at Mars, and right-click (**Ctrl**-click on the Mac) to open the contextual menu for Mars. Select **Celestial Path** from this menu.
- 5 In the time mode controls, set the time step to a discrete step of 1 days.
- 6 Press the **Forward** button in the time mode controls.

Mars should now begin to move against the background stars. Partway through its motion, it will slow down, appear to pause, and briefly reverse direction, making a short loop before starting to move again in the direction of its original motion.



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, you can travel around the Earth, the solar system, the stars, and even out to the galaxies!

☰ ∨ ^ Minneapolis, United States

The toolbar displays your current viewing location. To change this location in Starry Night, click on it to open a pull-down menu. Select the option **View From...** from the menu. This opens the Viewing Location dialog box, which looks similar to the window where you entered your home location the first time that you used Starry Night. The difference this time is that you are just setting your current viewing location, not your permanent home location. The three tabs offer different ways of choosing a new location.

Tip: You can also open the Viewing Location dialog box by choosing **Options>Viewing Location** from the main menu.

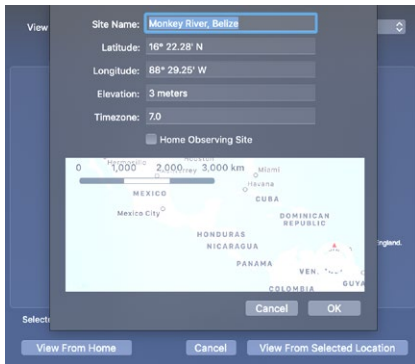
List: Click on a location from the large list of cities, then press **View From Selected Location**.

Map: Click anywhere on the world map to make this area your new viewing location.

Latitude/Longitude: Manually type in the latitude, longitude and time zone of your new location. Click the **Lookup Lat/Long On Internet** button if you don't know the latitude and longitude of your desired location.

Adding/deleting locations: If you have a favorite observing location(s) that you will be using frequently in Starry Night (but is not your home

location), and it is not in the Viewing Location dialog box's list of cities, you can add it to the list. To do this, click the Latitude/Longitude tab of the Viewing Location dialog box, enter the viewing coordinates, then press the **Save As New Observing Site** button. Press the **OK** button to save your location.

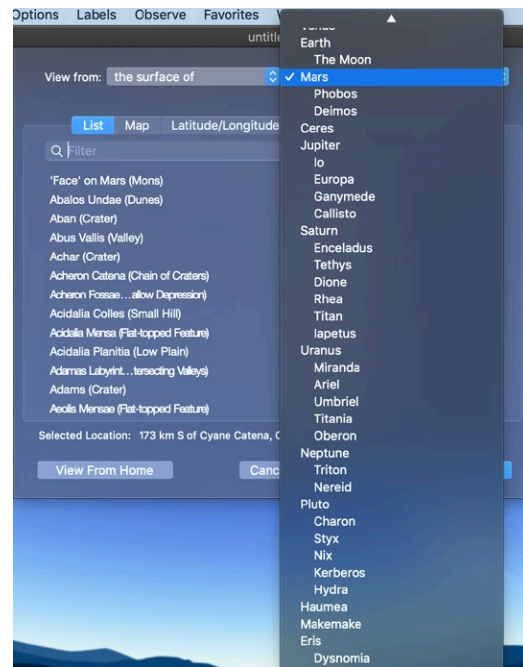


To view from this location in the future, just click on the My Sites tab of the Viewing Location dialog box, and select your location from the list of cities. To delete a location from this list, just click on the city name, then press the Delete key (Windows) or the Backspace key (Macintosh).

Animating Location Changes: By default, when you change your viewing location, Starry Night will simulate a flight that blasts you off from your current location, and sets you down at your new location. You can turn this feature off by choosing **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh), selecting **Step/Pan** from the top of this dialog box, and unchecking the option “Animate changes in location”. You can also change the speed of animated location changes by adjusting this slider. Finally, you can choose to animate only location changes where you move between planets. The next section describes how to change your viewing location to another planet.

Viewing From Other Planets: To view from another planet or moon, open the Viewing Location window and click the **List** tab. Near the top of this window is a dropdown menu that reads “Earth”. You can open this dropdown menu

and select any of the other celestial bodies in this list.



Once you have selected a new body (for example, Mars), the three tabs in the Viewing Location window behave the same as before, but in relation to your new body. The **List** tab will have a list of craters, volcanoes and other prominent features on Mars, the **Map** tab will show a surface map of Mars, and the **Latitude/Longitude** tab will allow you to type in a new latitude and longitude on the surface of Mars.

Click **View From Selected Location** when you are finished selecting your new location. Starry Night will fly you off the surface of Earth, travel through the solar system, and set you down gently on the surface of your chosen planet.

Tip: The list of locations for the moon includes not only craters and other prominent geological features, but also the sites of all the Apollo landings!

Viewing From Stars or Galaxies: You can also view the sky from nearby stars with Starry Night, but you can't do this from the Viewing Location

window. See “Go There” on page 70 for information on visiting other stars and galaxies.

Returning Home: To return to your home location at any time, press the **Home** button on the toolbar, or choose **Options** from the main menu and click on the name of your home city in this menu.

You will see two options: one with “Default Options” in the name, and one without. Choosing the “Default Options” option will also restore all settings to their default values, while choosing the other option will return you to your home location but leave all other settings unchanged.

Changing Elevation

Viewing Locations

View from Oshawa, Canada (with Default Options)
View From...

All of the options described in the last section leave you on the surface of a planet. You may also want to place yourself at some distance above a planet's surface. You can change your Elevation above a planet's surface in Starry Night with the **Elevation** buttons in the toolbar, immediately to the left of your location information.



This button decreases your elevation.



This button increases your elevation.

As you change elevation, the location information in the toolbar will update to show how high above the planet's surface you are.

Test out the **Elevation** buttons by shifting your

☰ ↓ ↑ Minneapolis, United States

gaze down so that you are looking at the horizon, and then pressing the **Increase Elevation** button repeatedly to rise off Earth. You will see the horizon drop away beneath you and the planet's outline will begin to appear as you get high

enough above the surface. Your changing elevation will be shown in the toolbar. To return to and “land” at your original location, hold down the **Decrease Elevation** button.

You can use the Elevation buttons while located on any object (the sun, planets, moons, etc.), thereby achieving some extraordinary views of the solar system.

Note: *When you change elevation, you are still attached to your original location on the planet's surface by a long, invisible pole. Over time, as Earth (or whichever planet you are over) rotates, you also rotate in space. You can tell that you are rotating due to the apparent motion of the sky and stars. See “Position Hovering Over” on page 85 to learn how to hover over a planet, instead of rotating with it.*

Changing the Elevation Step: You can change the rate at which Starry Night increases and decreases your elevation when you use the **Elevation** buttons. Choose **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh) and choose **Step/Pan** from the top of the Preferences dialog box. The “Elevation Step” slider controls the sensitivity of the **Elevation** buttons. By moving this slider farther to the right, you can change your elevation at a faster rate, because each elevation step will be larger.

Preset Elevations: In Starry Night Pro and Pro Plus, if you click on your location in the toolbar, the pull-down menu opens. This menu has several automatic elevation options (“distance from surface”), specific to the planet or moon that you are located on. Selecting any of these options places you at the new elevation.



Location Scroller: The Location Scroller offers another way of changing your location. Your cursor icon will automatically change to the Location Scroller once you are elevated high over an object. See “Tool Selection Control” on page 22 for more information on choosing tools in Starry Night Pro and Pro Plus.

Tip: Hold down the **Shift** key on the keyboard to change to the *Location Scroller* tool.

If you are using the *Location Scroller* tool and you click and drag the cursor, your latitude or longitude will change, instead of your viewing direction. Dragging up or down adjusts your latitude, while dragging left or right adjusts your longitude.

Recall that when you use the **Elevation** buttons to blast off a planet's surface, you are still attached to the planet by an invisible pole. Imagine that this pole originates at the planet's center. Using the *Location Scroller* to change your location is like changing the direction of this pole, so that it now protrudes from the planet's surface in a different spot. You are still at the same elevation, but looking down on a different part of the planet's surface. The planet appears to turn beneath you. This allows you to achieve fantastic views of the planets and solar system. For instance, you can hover a few thousand miles off the surface of Saturn, then use the *Location Scroller* tool to turn the planet and view the rings from every angle. The *Location Scroller* can help you gain a real sense of the three-dimensional relationships between the objects in our solar system.

Example: Viewing The Surface of Earth

- 1 Use the **Increase Elevation** button to blast off Earth's surface until the entire globe can be seen onscreen (an elevation of between 6,000 and 10,000 km).
 - 2 Right-click (**Ctrl**-click on the Mac) on Earth and choose **Center** from the contextual menu that pops up.
 - 3 Click and drag the cursor from the center of the screen to the left side. This will move you eastward across Earth's surface.
 - 4 Continue clicking and dragging the cursor from the center of the screen to the left side.
- Eventually you will pass over the entire surface of the planet. You can see which parts of Earth are in sunlight, and which parts are in shadow.
- 5 Now click and drag the cursor from the center of the screen to the top of the screen. This will move you southward across Earth's surface, eventually allowing you to see Antarctica. You can also click and drag the cursor from the center of the screen to the bottom to eventually see the Arctic.
 - 6 Return home by pressing the **Home** button on the tool bar, opening the **Options** menu and clicking on the name of your home city.

Location Mode

So far, you have learned how to view from anywhere on a planet's surface, and how to view from any height above a planet's surface. In these situations, you are "tied" to the planet, rotating in space as the planet does. *Starry Night* also offers several location modes where you are not tied to a planet's rotation. You can access these modes by opening the *Viewing Location* dialog box.

The "View From" dropdown menu in the top left corner of this dialog box offers five options. The first is the familiar "Surface Of" option. The other four options are described here. These options are quite specialized and you may not ever need to use them.

The Center Of: This puts you at the center of the planet or moon in question. It is handy when you want to watch the motion of a celestial object while ignoring the rotation of the planet you are based on. For example, assume you want to see how a comet will move relative to the fixed stars over a night. Placing yourself at Earth's center allows you to watch the comet's actual motion and ignore the effects of Earth's rotation during the night.

Position Hovering Over: If you are positioned at a high enough elevation above a planet's surface,



you can “hover” at that location. Hovering allows you to stay at a constant position above any object and, as time passes, watch as it rotates beneath your feet.

Note: *Hovering is only useful if you are relatively high above a planet's surface. Therefore, if you select “Position Hovering Over” when you are on the surface of a planet or at a low elevation, Starry Night will automatically increase your elevation to a height that is suitable for hovering. This height will vary depending on the size of the planet. For moons and small planets, you can hover at a lower elevation than you can for large planets such as Saturn and Jupiter.*

Position Moving With: This option allows you to travel together with a planet as it moves through its orbit, but at a fixed distance from the planet (this fixed distance is your elevation). The “Position Moving With” option differs from “Position Hovering Over” because it always keeps you in the same orientation with respect to Earth and the sun, whereas “Position Hovering Over” keeps you in the same orientation with respect to the background stars. Assume you choose “Position Hovering Over” and set yourself high above Earth looking at the bright (sunlit) side of Earth. If you play time forward for six months, you will end up viewing the dark side of Earth, because Earth has

moved 180° around the sun, but you are still facing in the same direction, relative to the background stars. If you instead set your location choosing “Position Moving With” and select the “Beside (sun side)” option, you will always view the bright side of Earth, no matter how long you play time forward.

Stationary Location: This option places you at a fixed location in space, relative to the sun. Stationary locations can be entered as heliocentric ecliptic Cartesian coordinates or heliocentric ecliptic spherical coordinates. For Cartesian coordinates, the position on the ecliptic plane is given by X and Y coordinates. The Z coordinate takes the location out of the plane of the ecliptic. For spherical coordinates, “radius” is the distance from the sun’s center, “theta” is the position angle from the ecliptic plane, and “phi” is the position angle along the ecliptic plane. Heliocentric means that the sun is the center of the coordinate system, so the point (0,0,0) is at the center of the sun, using either Cartesian or spherical coordinates.

Note: *When you switch from a location on Earth to a stationary location, the initial coordinates listed are the current heliocentric coordinates of your current Earth location. If you select these coordinates and advance time forward, you'll quickly be left behind as Earth continues on in its orbit, while you remain at the same position in space.*

Planet Flybys: There are times when you may want to watch a celestial event from a fixed point in space. Using the elevation controls, rise above a planet and then switch to a fixed heliocentric location. Increase the rate at which time flows and you can watch a planet fly past in its orbit. If you have elevated from the planet’s surface in the direction that it is traveling, you pass directly through the planet as it moves forward in its orbit!

Tip: Noon or midnight is a good time to try flybys, since you are lifting off in a direction that is perpendicular to the direction of the planet's orbit.

Orientation

Now that you know how to change your viewing location, there may be times when you also wish to change your orientation. Orientation refers to the way you align yourself—which direction is “up” and which direction is “down”. When referring to a computer program, the question becomes which direction in space points to the top of the screen, and which direction points to the bottom.

Local (Standard)
 ✓ Equatorial
 Ecliptic
 Galactic
 Super Galactic

You can change your orientation in Starry Night by choosing **Options>Orientation** from the menu. The most familiar and intuitive orientation is the local orientation, which Starry Night uses by default. Local orientation orients you relative to the horizon, with the point directly above you in the sky at the top of the screen, and the point directly beneath your feet at the bottom.

Now, imagine you are on the space shuttle. Because you are floating freely in space, your orientation is no longer obvious—the points directly above and below you are not fixed. You could mimic the local orientation by pointing your feet at your backyard on Earth, but you could just as easily align yourself with the axis of Earth's rotation. Starry Night refers to that alignment as the equatorial orientation.

In local orientation, Starry Night keeps your feet pointed directly toward the center of the Earth. In the equatorial orientation, Starry Night keeps the North Celestial Pole directly overhead and the South Celestial pole beneath your feet.

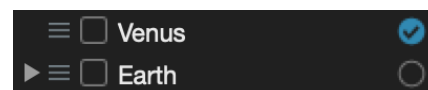
If you set your orientation to ecliptic, Starry Night gives you a view as though you were standing on the ecliptic plane, on which all of the planets in our solar system revolve. If you choose a galactic orientation, your view of the sky is the one you would see if you were standing on the same plane as our galaxy, the Milky Way. A supergalactic orientation aligns you with the plane of the band of nearby galaxies that surrounds the Milky Way.

In all orientation options except for local, the horizon is automatically turned off.

Tip: There may be times when you want to use a non-local orientation even though your location is on Earth's surface. Most star charts that you will find in astronomy books use an equatorial orientation. You could switch to an equatorial orientation in Starry Night to match your onscreen view to these charts.

Orbits

For any body in the solar system, Starry Night allows you to draw the orbit of this body on-screen. This is of limited value when your location is on the surface of Earth. However, now that you know how to change location, the ability to show planet orbits can come in very handy. Object orbits are most useful when you are at an elevation high above the north pole of the parent body of the orbiting object. For example, to view the orbits of the planets, an ideal viewing location would be at an elevation high above the north pole of the sun. To view the orbit of the moon or the orbits of artificial satellites, an ideal viewing location is high above Earth's north pole.



To display the orbit of any object in our solar system, open the **Planets** search results pane by typing “Planets” in the search field of the toolbar. This will display the list of solar system objects.

The Orbit column is the first column to the **right** of the object name. Checking this circle for a particular object turns on the orbit for this object, and unchecking the circle turns the orbit off. You can turn on orbits for more than one object at the same time.

Tip: You can also turn on the orbit of a solar system body by right-clicking (**Ctrl**-click on the Mac) on the object and choosing **Orbit** from its contextual menu.

This image shows the orbit of Jupiter. Key points in the orbit are marked with special indicators.



Orbit Markers: The **ascending node** of the orbit—the point at which the planet crosses up through the ecliptic plane—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.

Orbit brightness: You can adjust the brightness of object orbits by choosing **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh), and selecting **Appearance** from the top of the Preferences dialog box. This dialog box has a slider which lets you make orbits brighter or dimmer.

Orbit Colors: You can choose the color in which you want to display the orbits of comets, asteroids, and satellites. See “Comet, Asteroid & Satellite Display Options” on page 40 for more information. You cannot modify the orbit colors for planets.

Example: Viewing The Solar System From Above

This example combines many of the different techniques in Starry Night for changing your viewing location.

- 1 Click on your current location in the toolbar and choose **View From...** to open the Viewing Location dialog box. Click the **List** tab.
- 2 From the dropdown menus along the top of the dialog box, select View From “The Surface Of” “sun”.
- 3 Click the **Latitude/Longitude** tab and change your latitude to 90° N. Press the **View From Selected Location** button. This will change your location to the north pole of the sun.
- 4 Use the **Increase Elevation** button to increase your elevation until you are 60 AU above the north pole of the sun. As you move higher, you will see several of the “stars” in the sky move away. These “stars” are actually planets, as you will see in a minute.
- 5 Right-click on the sun (**Ctrl**-click on the Mac) and choose **Center** from the contextual menu.
- 6 Open the **Options** search results pane by typing “Options” in the toolbar’s search field and expand the “Solar System” layer. Check the box for “Planets/moons”. Click on the words “Planets/moons” to open the Planets/moons Options dialog box. In this dialog box, check the “Labels” box. You should now be able to see labels for all the planets.

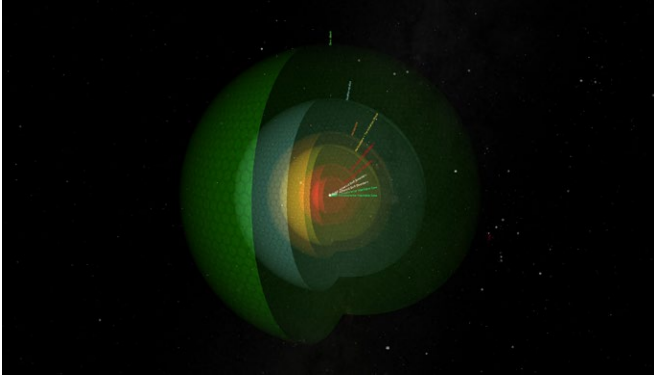
- 7 Open the **Planets** search results pane by typing "Planets" in the toolbar's search field and check the orbit column for all planets. You do not need to turn on the orbits of moons, asteroids, or comets. You should now be able to see a view of the entire solar system onscreen.
- 8 Change your time step in the toolbar to a discrete value of 20 days, then press the **Forward** button to start time moving forward. You can see the planets moving around the sun.
- 9 The innermost planets will be too close to the sun to really see. Use the **Decrease Elevation** button to reduce your elevation to about 10 AU (so that the orbit of Saturn approximately fills the screen). You can see that the inner planets move much more rapidly. Change the time step to a discrete value of 3 days to slow down the motion of the planets.
- 10 Press the **Stop** button in the time controls to stop the motion of the planets. Click and drag the mouse (while holding down the **Shift**-key) to shift your view of the solar system. You should be able to adjust your view so that all of the planet orbits fall into a straight line. You are now viewing along the plane of the ecliptic.

Example: Viewing the Tully Collection

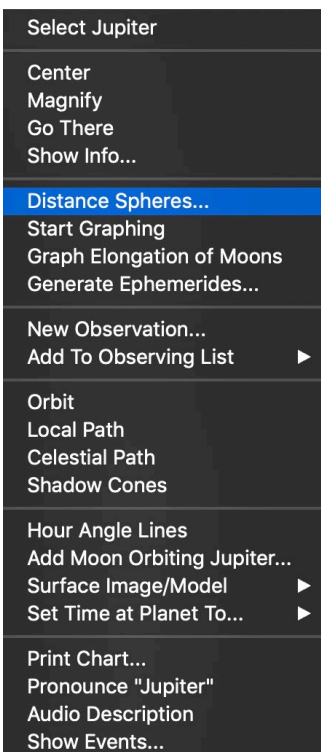
- 1 Press the **Home** button.
- 2 Use the **Increase Elevation** button to blast off until you are about 100,000 light-year from the sun. The Milky Way galaxy will be in view at this distance.
- 3 Use the Location Scroller tool (hold down the **Shift**-key and drag the mouse cursor) to rotate your view of the Milky Way galaxy.
- 4 Use the **Increase Elevation** button to go way out to 800 MLY from the sun. You should see the dataset begin to collapse into a box-like shape. This is the edge of the Tully collection.
- 5 Use the Location Scroller tool to rotate your view of the Tully collection. You should see a slice through the middle of the box-like shape that contains very few galaxies. This is the plane of the Milky Way, where we have been unable to identify many galaxies due to obscuration of the distant galaxies by dust.
- 6 Freely navigate through the galaxies in the Tully Collection. There are thousands of them to explore!

Distance Spheres

Starry Night's Distance Spheres feature allows you to display translucent spheres at custom distance milestones from a selected object.



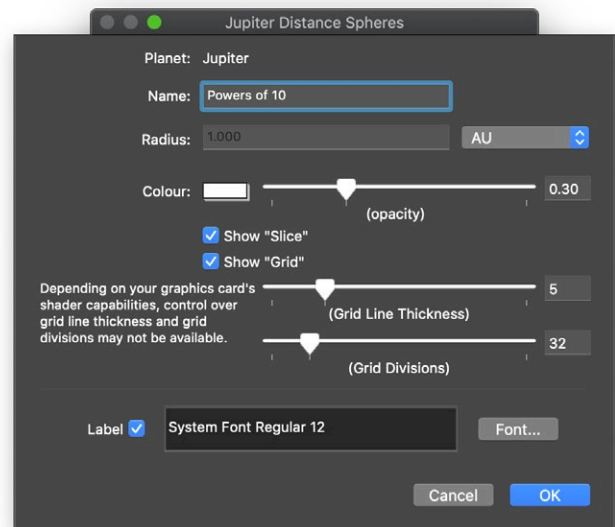
Adding a distance sphere: To add a new distance sphere, right-click (**Ctrl**-click on the Mac) on a solar system object and select **Distance Spheres...** from the contextual menu that pops up. Alternatively, you can open the **Planets** search results pane by typing "Planets" in the toolbar's search field and click on an object's **Contextual Menu** button (first button located on the left of the object's name) to view the contextual menu.



Click the **(+)** button in the dialog window that opens to add a new distance sphere.

Naming a distance sphere: Name your distance sphere and set the radius of the sphere. In the example following, Jupiter will be at the center of the distance sphere. Press the **OK** button when finished.

To display the distance sphere, make sure the box to the left of the sphere's name is checked.



Viewing a distance sphere: To view the distance sphere, use the **Increase Elevation** button to increase your distance from the Earth. In this example, we added a distance light sphere with a radius of 1 light-year and would have to increase the elevation to at least 1 light-year to view the sphere.

Spaceship Mode

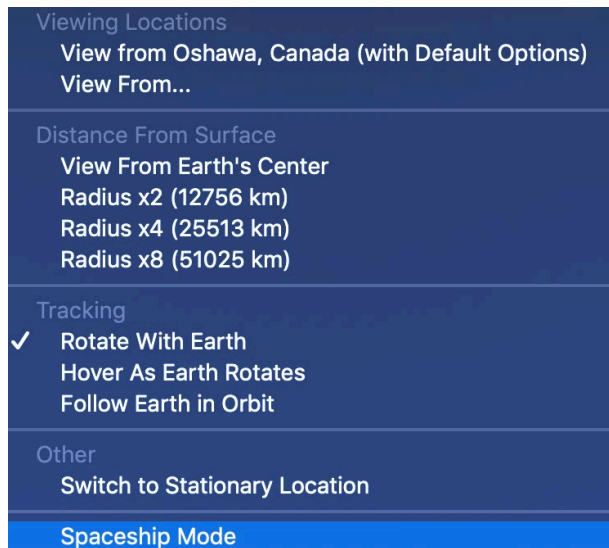
PRODUCT SPECIFIC FEATURE

PRO PLUS ✓ **PRO** ✓ **ENTHUSIAST** —

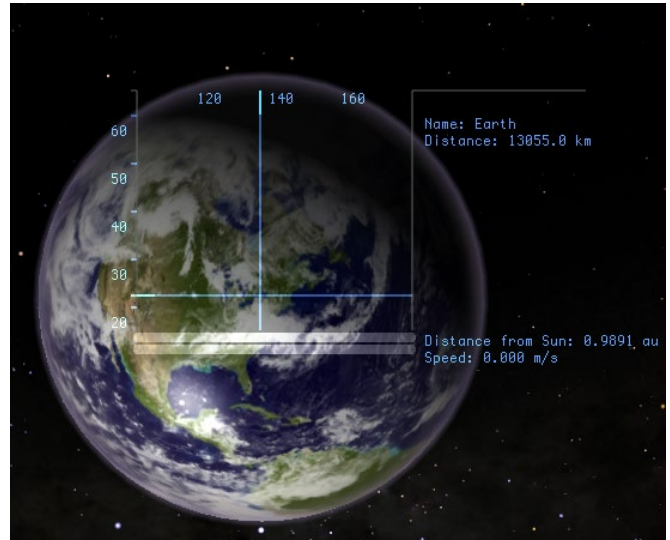
Plug-in your joystick — or use your keyboard controls — to fly an intergalactic spaceship anywhere within a virtual cube of real space objects, over 2 billion light-years on a side!

Spaceship mode (Pro and Pro Plus only) lets you change your location in a completely different way than using the Go There option. It lets you interactively drive through the universe.

To enter Spaceship mode, click on the **Viewing Location** control in the toolbar and select **Spaceship Mode** from the pull-down menu.



Entering Spaceship mode lifts you above the Earth's surface and calls a heads-up display similar to the ones fighter pilots use. The area inside the blue rectangle is called the *viewport*, and the motion of the spaceship is always towards the area of sky at the center of the viewport. To turn off spaceship mode, select **Spaceship mode** again from the **Viewing Location** pull-down menu.



Speed: Two gauges beneath the main display measure the motion of your spaceship. The top gauge measures your velocity or speed. In order of increasing speed, the markers are green, yellow, orange and red. If you are in the green range, you are traveling beneath the speed of light, while yellow, orange and red are all-greater than the speed of light. Your speed is also shown in a numerical format beneath the two gauges. It is given in km/s for sublight speeds or units of 'c', which is the speed of light. Values greater than 1c are greater than the speed of light. The lower gauge indicates how fast you are accelerating or decelerating (i.e. changing your speed). If your speed is increasing, this gauge will be green, while if your speed is decreasing, the gauge will be red.

Closest Object: The position of the closest object inside the viewport is marked by crosshairs on the display screen. The name and distance to the object are shown just to the right of the display. You may also see a second object marked by crosshairs, which is outside the viewport. If so, then this object is even closer than the object marked inside the viewport. If no second object is marked by crosshairs, then the object inside the viewport is the absolute closest object.

Direction of Spaceship: The numbers along the top and left sides of the viewport indicate your direction relative to the sun. If you use the pitch

and yaw keys so that these numbers are both equal to 0, then your spaceship will be travelling directly towards the sun. If the number along the left side is 0 but the number along the top is 180, then you are moving directly away from the sun.

Piloting the Spaceship: Hook up your joystick and give spaceship mode a try, or you can control the spaceship using keyboard commands. These keys and their functions are listed in the legend at the top left corner of the screen. Once you become familiar with the keys, you can hide the legend by pressing the S key.

```
Show/Hide Legend: S
Show/Hide HUD:   H
Accelerate:      A
Decelerate:      Z
Stop:            [Spacebar]
Presets:         [1..9]
Roll Left:       Keypad-7
Roll Right:      Keypad-9
Pitch Up:        Keypad-2
Pitch Down:      Keypad-8
Yaw Left:        Keypad-4
Yaw Right:       Keypad-6
Joystick:        not detected
```

If your keyboard does not have a numeric keypad, you can use the following alternative commands:

Accelerate: A
Decelerate: Z
Roll left: Q
Roll right: W
Pitch up: Up arrow
Pitch down: Down arrow
Yaw left: Left arrow
Yaw right: Right arrow
Pause/restart: P

Accelerate/Decelerate:

Speed up/slow down the spaceship.

Pause/Restart:

Instantly stop the spaceship. You might need to do this if you are flying towards an interesting object and are moving so fast that the object will disappear from view before you can slow down using the deceleration key. If the spaceship is already paused, pressing this key again will unpause the spaceship.

Roll, Pitch, Yaw:

All of these keys change the direction of your spaceship. Roll rotates the spaceship, pitch shifts the spaceship up or down, and yaw shifts the spaceship left or right.

Joystick:

Lets you know if a joystick is plugged in.

Spaceship tips for the rookie pilot:

- 1 Practice your flying skills in the vicinity of Earth first. Once you feel comfortable with the controls, venture out to other space objects.
- 2 If you want to fly towards a specific space object, first use **Search** to centre on that object. You can then turn spaceship mode on and fly directly towards the object.
- 3 Slow down! As soon as an interesting object comes into view, begin decelerating. Otherwise, it'll quickly pass you by.
- 4 When flying outside the Milky Way galaxy, point your spaceship towards areas that are densely populated. Soon you'll be moving through a crowded region of space, one of the galaxy clusters the universe seems to enjoy building. As you move even closer, each of these points will resolve into a separate galaxy.

Chapter 7

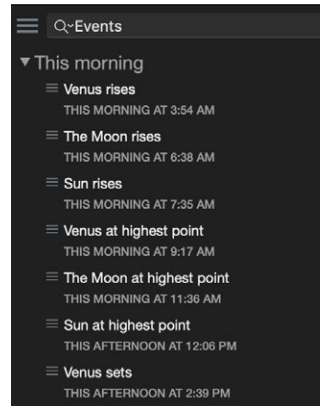
Observation Tools

This chapter covers the many observational tools and features in Starry Night Pro and Pro Plus that go beyond the planetarium aspects of the program. These features are designed to help you plan, view and log your astronomical observations. You will learn about the following features:

- 1 Event Finder
- 2 Graph Tool
- 3 Ephemeris Generator
- 4 LiveSky
- 5 Observation Lists
- 6 Log Book (Observations)
- 7 Observing Sessions
- 8 Observing Sites
- 9 Equipment
- 10 Field of View Indicators Indicators
- 11 Telescope Control
- 12 Focuser Control
- 13 Imaging Plug-in
- 14 Satellite Tracking
- 15 Wireless Telescope Control
- 16 Flip
- 17 Printing
- 18 White Sky Mode
- 19 Night Vision Mode

Event Finder

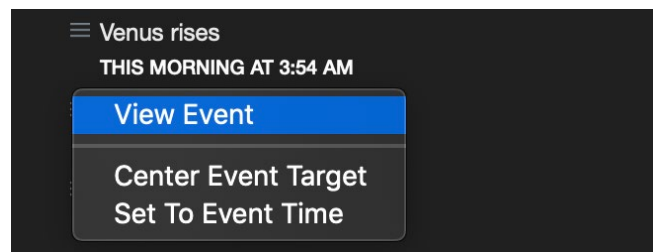
The Event Finder is a powerful search engine that finds astronomical events visible tonight and far into the future. The finder dynamically generates a listing of moon phases, eclipses, Jupiter satellite events, meteor showers and planetary phenomenon such as conjunctions, elongations and oppositions to name but a few of the events that can be displayed.



You open the Event Finder by selecting **Events** from the **Pane Shortcuts** menu or by typing “Events” in the search box.

Viewing Events: Click the contextual menu button to the left of an event name, and choose **View Event**

from the **Contextual Menu** to simulate the event in Starry Night. To place the event target in the center of the screen without changing the current time choose **Center Event Target**. To set the time in Starry Night to the time of the event choose **Set to Event Time**.

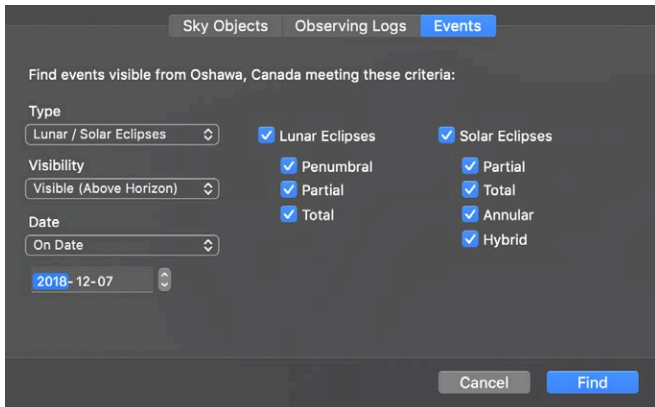


Tip: You can double-click on an event name to place the event target in the center of the screen at the correct time.

Object Events: Moving your cursor over an objects name in the Search pane will bring up the Events link. Click on the word **Events** to view specific upcoming events for that object if available. You can also right-click (**Ctrl**-click on Mac) and select **Events** from the objects contextual menu.



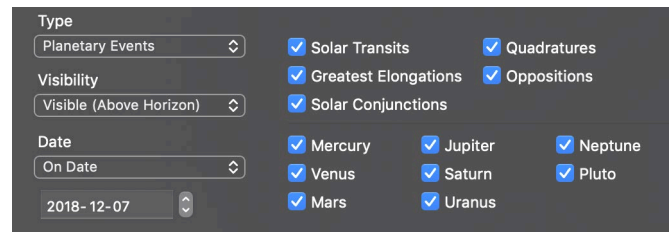
Advanced Event Search: Click the **Pane Shortcuts** button in the toolbar and select **Advanced Find**. In the dialog window that opens, click on the **Events** tab for additional event filters. The “Event Filters” allow you to select what type of astronomical events to search for and display.



Event Type: Most of the event types listed in the **Events** tab have special options associated with them. Selecting an event type name from the drop down menu will display the options for that event type. For example, selecting “Lunar Phases” will display options for selecting the type of lunar phases to include in your search.

Some of the event types might not be familiar to you:

Lunar Phase Events: *New Moon* is the Moon as it appears on Earth when it is positioned between Earth and the Sun at the beginning of a cycle of lunar phases.



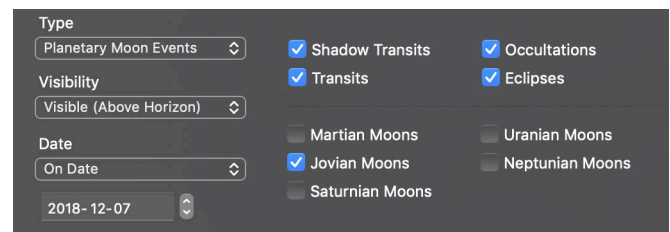
The new moon rises and sets with the Sun.

During *First Quarter Moon* and *Last Quarter Moon* half of the Moon’s disc is illuminated.

Full Moon is the Moon’s appearance from Earth when it is positioned directly opposite the Sun. The Moon is full two weeks after new moon. The full moon rises at sunset and sets at sunrise when Earth is between the Moon and the Sun.

Planetary Moon Events: A *Shadow Transit* is the passage of a moon’s shadow across the face of its parent planet.

Shadow transits are a favourite event among planetary observers.



A *Transit* is the passage of a moon over the face of its parent planet.

An *Occultation* is the disappearance—eclipse—of one moon behind its parent planet.

An *Eclipse* occurs when a moon passes through the shadow of its parent planet.

Lunar and Solar Eclipse Events: A *Total Lunar Eclipse* is an eclipse of the Moon where Earth crosses between the Sun and Moon, blocking sunlight from reaching any of the Moon's surface. During a total eclipse, the Moon darkens slightly and takes on a reddish colour.

A *Partial Lunar Eclipse* is an eclipse of the Moon where Earth crosses between the Sun and Moon, blocking sunlight from reaching only part of the Moon's surface. This part will appear darker than the rest of the Moon.

A *Penumbral Solar Eclipse* is an eclipse of the Moon where Earth crosses between the Sun and Moon, but only partially blocks the Sun's light. Because some light still reaches all parts of the Moon, the Moon does not darken noticeably during a penumbral eclipse.

A *Partial Solar Eclipse* is an eclipse of the Sun where the Moon covers only part of noticeably during a partial eclipse.

A *Total Solar Eclipse* is an eclipse of the Sun where the Moon completely covers the Sun.

An *Annular Solar Eclipse* is an eclipse of the Sun where the Moon passes directly in front of the Sun, but does not completely cover it. At the eclipse's peak, a ring of sunlight still shines around the Moon's edges.

A *Hybrid Solar Eclipse* is an eclipse that starts as an annular solar eclipse, then becomes a total solar eclipse and at the end returns to an annular solar eclipse. The total eclipse phase of a hybrid eclipse tends to be short in duration.

Meteor Shower Events: When the Earth's orbit crosses the path of debris left behind by a comet, there is a meteor shower as the dust particles burn up in Earth's atmosphere. You can select to display all meteor showers or only the major meteor shower that average more than 10 meteors per hour.

Planetary Events: A *Solar Transit* is the passage of one planet across the face of the Sun. These rare events require the use of a safe solar filter designed specifically for viewing the Sun.

Greatest Elongation is the greatest angular distance to the east or west of the Sun reached by a planet, usually Mercury and Venus. When a planet is at its eastern elongation, it sets after the Sun and is at its best visibility in the evening sky. When a planet is at its western elongation, it sets before the Sun and is at its best visibility in the morning sky.

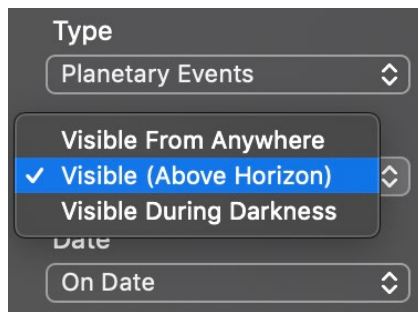
There are two types of *Solar Conjunctions*. An *Inferior Conjunction* is the passage of Mercury or Venus between Earth and the Sun. The outer

planets cannot pass between Earth and the Sun and therefore cannot come to inferior conjunction. A *Superior Conjunction* is the position of a planet when it is on the far side of the Sun (and in conjunction with the Sun).

A *Quadrature* occurs when the angle between the Sun and a planet is 90 degrees or a quarter of a circle. Eastern Quadrature is defined when a the planet is 90 degrees to the east of the Sun, and Western Quadrature when a planet is 90 degrees to the west of the Sun.

Solar Opposition is the position of a planet when it is opposite the Sun in the sky.

Event Visibility: Visible (Above Horizon) is selected by default and displays only those events that are visible from your current location.



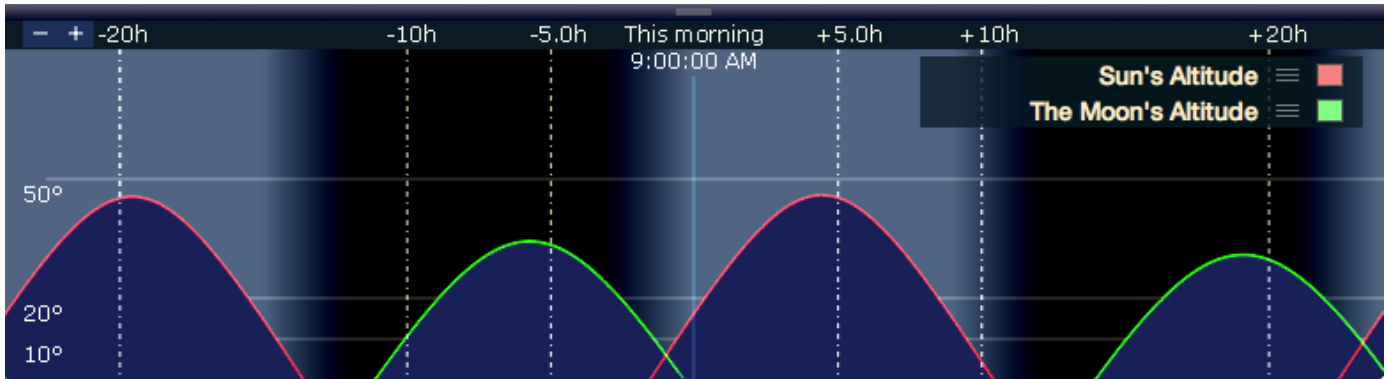
Visible From Anywhere lists all events, including those not visible from your current location.

Visible During Darkness lists events visible

from your current location and suppresses events that are only visible during daylight.

Events by Date: By default, the list of events is created for today's date. From the **Date** drop down menu, you can search for astronomical events on a specific date (**On Date**) or enter a start and end search date (**Between**). When the desired date range is selected, press the **Find** button to dynamically generate a list of events.

Note: Creating a list of events for a long date range requires a greater amount of time to calculate. For faster searches limit the date range to a few months. Knowing what specific objects you are interested in will also speed up searches.



Graph Tool

The Graph offers a way of examining changes in an object's qualities over time. The horizontal axis of the Graph always plots time, while the vertical axis can plot one of several different qualities (magnitude, altitude in sky, distance, etc.). It is possible to plot more than one object on the Graph at one time.

Opening the Graph: You open the Graph by clicking and dragging up the area under the main sky window. As you drag up, a graph is revealed. By default, the moon and sun are plotted when you open the Graph.

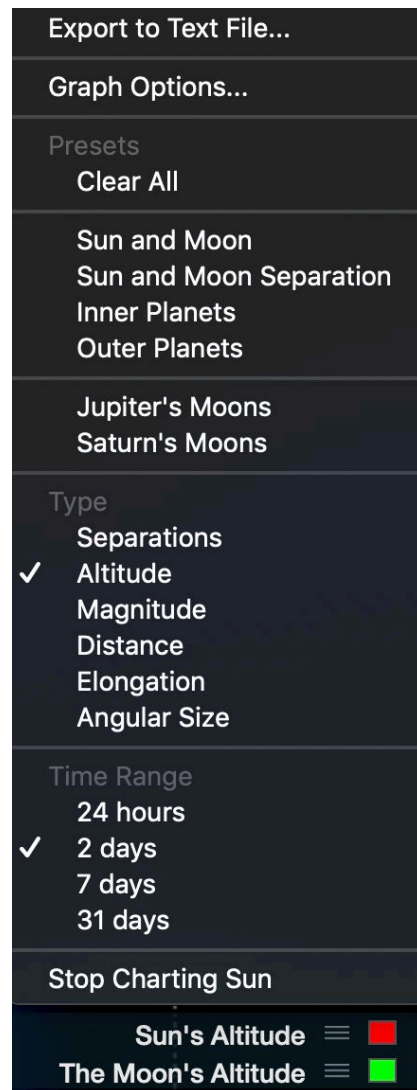
Tip: You can also open/close the graph by pressing **Ctrl-G** (Windows) or **Cmd-G** (Macintosh) or by selecting the graph tool toggle button in the toolbar.



Adding Objects to the Graph: Right-click (**Ctrl**-click on the Mac) on any object and choose **Start Graphing** from its contextual menu to plot this object on the Graph.

Changing Time On the Graph: The horizontal axis plots time, with the current time at the Graph's center. If you click in the graph and drag an area of the Graph onto the center line, time in the main Starry Night window adjusts so that this time becomes the current time.

Graph Menu: Clicking on the graph's **Contextual Menu** button opens the Graph menu. Listed are several preset options for objects that you may wish to graph (e.g. "Inner Planets" and several time ranges). Also listed are the six variables that you can plot on the vertical axis of the graph.



Separations: This plots the angular separation between two objects, therefore it is only valid when you have two objects plotted on the graph. You could use this feature to find planetary conjunctions, for example. By plotting Mars and Jupiter on the Graph, you could quickly see when these planets come closest together in the sky.

Altitude: This plots the height of one or more objects in relation to the horizon, so you can quickly see when these objects are visible. For example, if you wanted to view 5 planets over the course of a night, you could plot the altitude of these planets to see when each planet will be highest in the sky.

Magnitude: Plots the apparent magnitude (brightness) of an object(s) over time. For stars and deep space objects, apparent magnitude is approximately constant. However, the apparent magnitude of objects in our solar system varies considerably, due to their changing distance from Earth. You could plot the magnitude of an asteroid or comet to determine when it will be at its brightest.

Distance: Plots the object's distance from your current position.

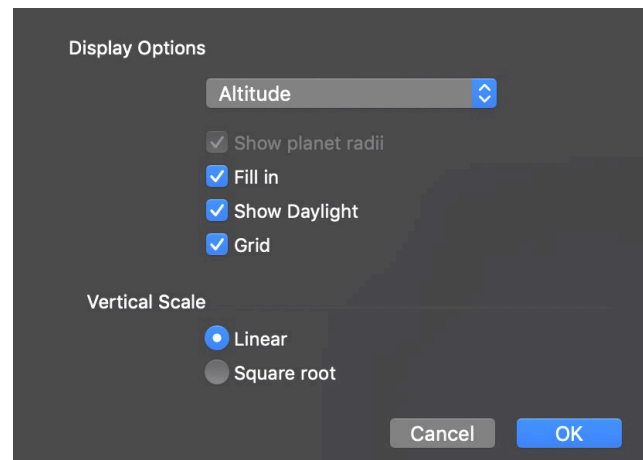
Elongation: Elongation plots the apparent separation in the sky between an object in our solar system and its parent body. It is similar to angular separation, except elongation has positive and negative values, depending on which side of the parent body the object is on. A small elongation value means that the object's apparent position in the sky is very close to its parent body, while a large elongation value indicates that the two objects are far apart. Planets are best viewed when they are at fairly large elongations. In fact, this is the only time when Mercury can be viewed. You could also use elongation to find the apparent position of a planet's moons.

Tip: You can automatically graph the elongation of a planet's moons, by choosing *Graph Elongation Of moons from the planet's contextual menu*.

Angular Size: Plots the angular size of the object in the sky. This will vary considerably for objects in our solar system. For example, Venus appears much larger when it is on the same side of the sun as Earth is.

Time Range: You can change the horizontal time scale of the Graph by selecting any of the time range options in the Graph's **Contextual Menu** or by using the time increment buttons in the upper left corner of the Graph. A scale of 24 hours is helpful when planning a night of observing, while a larger time scale is useful to see phenomena such as the change in an object's apparent magnitude.

Graph Options: Clicking this option in the Graph contextual menu opens a dialog box with several more options.



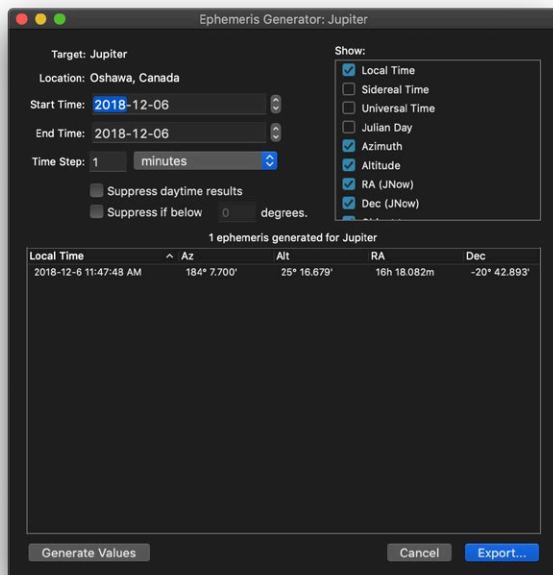
You can shade the area underneath an object's line on the Graph by checking "Fill in". You can turn daylight on/off on the Graph. Turning daylight on makes it easier to find the best time to view an object. You can also choose to turn off the grid that marks the vertical divisions on the Graph.

Removing Objects: The list of objects being graphed are shown to the right of the Graph. To remove an object from the graph, right click on the object's contextual menu button and select Stop Charting.

Ephemeris Generator

You'll always know where and when to look with Starry Night's built-in ephemeris generator. It's a handy observational aid that creates a table of positional data for any object over a specified time span and interval. You can then export the generated values to a text file and print them out.

To generate an ephemeris table for any object, right-click on it (**Ctrl**-click on a Macintosh) and select **Generate Ephemerides** from the objects contextual menu.



Ephemeris values are handy for knowing where an object will be in the sky at a particular time. If you are using manual or digital setting circles, for instance, you can dial in the generated positional data to locate an object quickly. For example, if you are tracking the path of a fast-moving asteroid as it makes its closest approach to Earth, your

ephemeris table will let you know exactly where the asteroid will be during the time period you'll be observing it.

The ephemeris generator window has the following set of controls.

Start/End Time: This allows you to enter a start and stop date/time for the ephemeris table.

Time Step: Allows you to specify the time interval between ephemeride values.

Suppress daytime results: By checking this box, ephemeris data will only be generated when the sun is below the horizon.

Suppress results if below horizon: By checking this box, ephemeris data will only be generated when the target object is above the horizon.

Show: This list allows you to select the information to include in your ephemeris table. By default, Local Time, Azimuth/Altitude, RA/Dec, Object type and Constellation are selected.

Exporting values: Pressing the **Export** button will open a dialog window which will allow you to save the ephemeris table to a text file.

Note: The ephemeris generator outputs values specific to your current home location. If you wish to generate an ephemeris table for an object at a different location, you first have to change your viewing location in Starry Night.

Example: Generating an Ephemeris for Saturn

First find Saturn.

- 1 Type "Saturn" in the search text box located on the far right side of the toolbar.
- 2 Double-click on Saturn's name in the list to center on Saturn. If a dialog box shows that Saturn is beneath the horizon, choose **View>Hide Horizon**.

Then generate the ephemeris.

- 3 To generate a new ephemeris for Saturn, right-click on it (**Ctrl**-click on Mac) and select **Generate Ephemerides** from the contextual menu.
- 4 The Ephemeris Generator window will open. Enter a start time and end time (a range of one week will provide a good example) and select a time step of one day.
- 5 Uncheck the boxes “Suppress Daytime Results” and “Suppress Results if Below Horizon”.
- 6 Press the **Generate Values** button at the bottom of the window. To export your data to a text file, press the **Export** button.

LiveSky

The next few sections in this chapter explain a number of tools to help you record your observing journey, and you might come across the word “LiveSky”. LiveSky is a feature built into Starry Night that helps you backup your observing data, sync it across devices, and even manage it from the convenience of a web-browser.

LiveSky Cloud Backup

Your Starry Night observing data is backed up automatically by storing it on your computer and synchronizing it with our LiveSky Cloud server.

When you first launch Starry Night, you are assigned an automatically generated and anonymous username and password. The app uses this login information to backup your data on our server. The username and password combination is stored in your computers Keychain (Mac) or Credential Manager (Windows), allowing you to restore your data if Starry Night is reinstalled.

The data backed up to the LiveSky server includes observing lists, logs, sessions, equipment, observing sites, and field of view indicators.

LiveSky Registration

Register for a new LiveSky account for free to access and sync your observing data with your mobile device using SkySafari (iOS, Android), another computer using Starry Night (macOS, Windows), or a web-browser at www.LiveSky.com.

Setup an account by selecting **Observe-LiveSky Account**. After you sign up, the LiveSky window becomes a view of your account. From here you can request another verification email, or switch to another account.

Starry Night includes a free Basic Subscription to www.LiveSky.com, providing you with access to your data on a web-browser. An optional Premium subscription allows you to edit and manage your data, in addition to providing you with access to an online version of Starry Night that can be accessed from any browser on any device.

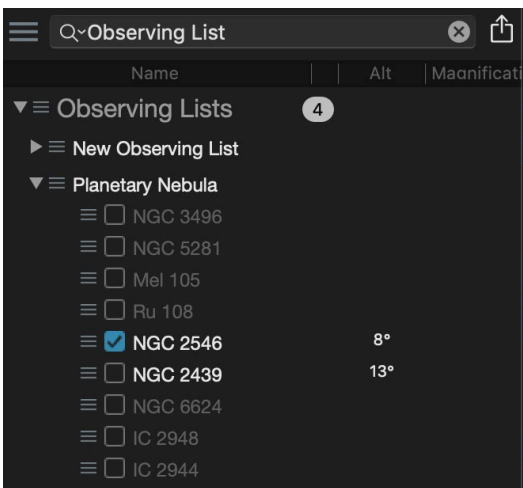
You can launch LiveSky.com by selecting **LiveSky Web** from the **Observe** menu.

Observation Lists

The Observation List is a tool that you can use to help create a list of astronomical objects that you wish to observe. You can make a list of targets for a particular night or create a list of targets that you want to observe over a period of time. For example, you can create a list of open clusters that are visible tonight in your 8inch telescope from your backyard between 9 p.m. and 11 p.m. Or you may want to observe all galaxies brighter than 9th magnitude over the course of a year. On any given night, Starry Night will let you know what galaxies are visible.

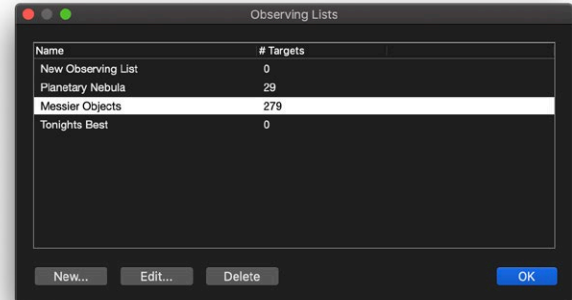
After you have created the list, you have the option of saving the observing list. It is possible to create and save observing lists not only for you but also for sharing with other Starry Night users!

You open the Observation Lists by selecting **Observing Lists** from the **Pane Shortcuts** menu or by typing "Lists" in the search text box. The "Observing Lists" layer displays the observing lists that are available. Click on an observing list name and expand the layer to view the objects that make up that list.

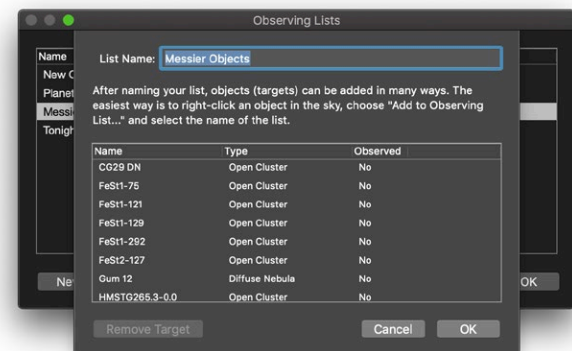


Tip: If you wish to create an observing list for a different location, first change the location in Starry Night, then open the **Observing Lists** pane.

Select **Observe>Observing Lists...** from the main menu to open a new window which lets you add a new observing list.

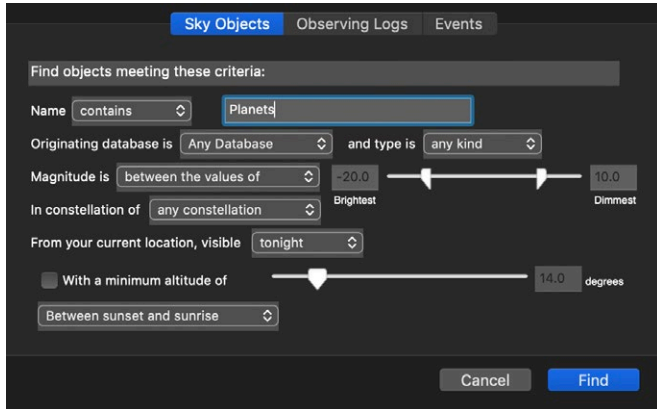


Click the **New** button to name your new observing list. After the Observing List is created, you can add objects to it in a variety of different ways.



Before adding objects to your observing list, decide on whether you wish to create an observing list for a specific night or a list of objects that are visible from your location but not tied to a particular date. To start, open a window with object filtering options by selecting **Advanced Find** from the **Pane Shortcuts** menu.

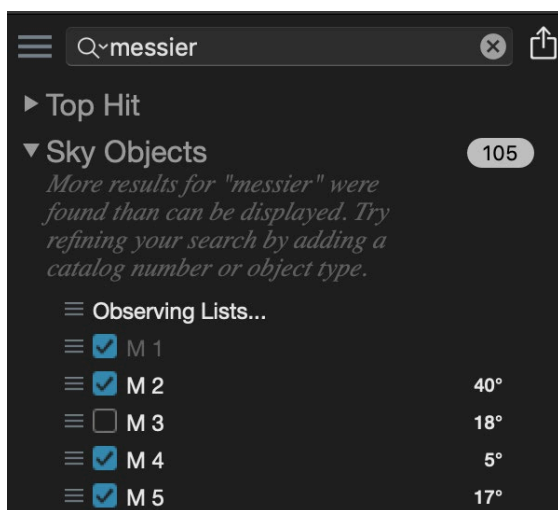
Date specific observing list: To create a list of objects for a specific night choose **on specific night** from the "From your current location, visible..." dropdown menu. This will allow you to enter the date you plan to observe.



The “Minimum Altitude for Visibility” and “Visible Between” dropdown menus allow you to search only for those objects that are visible above a specific height above the horizon and during a particular time window.

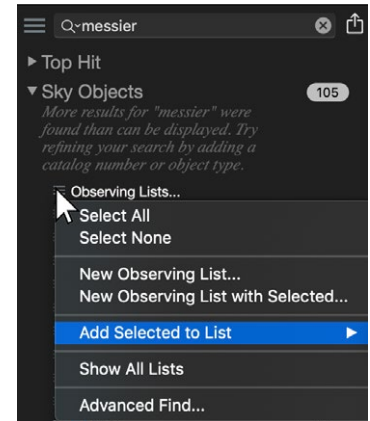
Date independent observing list: Choose **on any date** from the “From your current location, visible...” dropdown menu to create a date independent observing list.

Adding a specific object to a list: If you are interested in viewing a specific object, type the object’s name (or the first few letters in the name) in the “Name” text box, then press the **Find** button. Starry Night will display a list of objects that match this name.

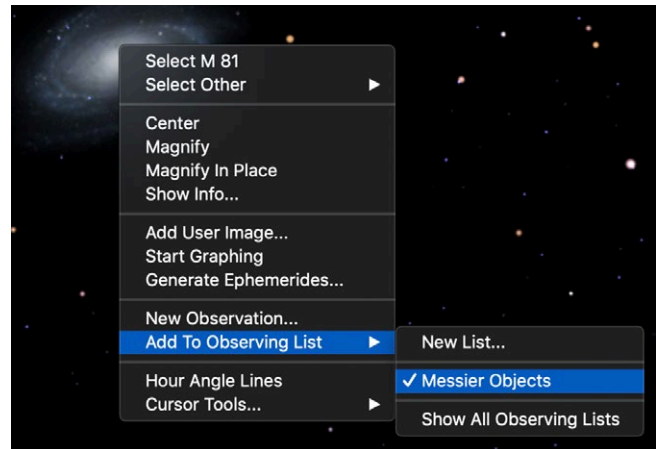


To add an object to your list, check the select box of the object(s) and then press the **Observing Lists Contextual Menu** button at the top of the

list of found objects. Select “Add Selected to List” to add the select object(s) to your current observing list.



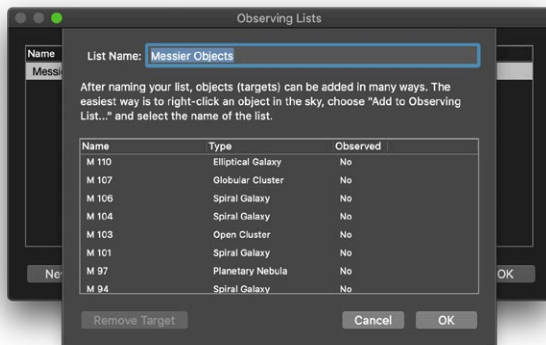
An object can also be added to your current observing list by right-clicking (**Ctrl**-click on the Mac) on its name and choosing **Add to Observing List** from the contextual menu. You can add the object to a “New List...” or add it to an existing list.



You can repeat these steps as many times as you want to build up your list of objects.

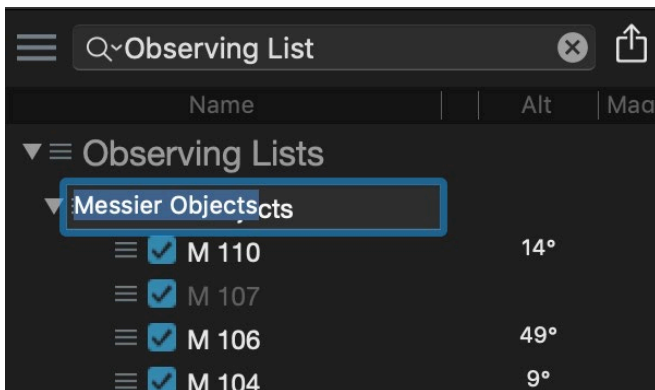
Removing objects and deleting lists: To remove an object from your current observing list check its selection box and then press the **Observing Lists Contextual Menu** and choose “Remove Selections from”. To delete the entire observing list, choose “Delete Entire”.

You can also edit your observing lists by selecting **Observe>Observing Lists...** from the main menu, then highlighting your list in the dialog window that opens, and pressing the **Edit** button.

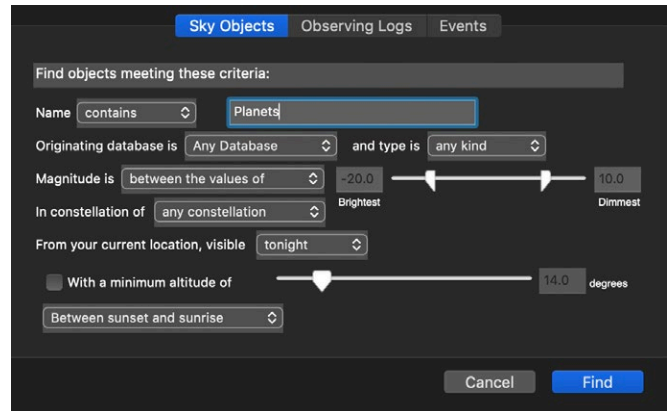


Click on the name of the object you want to delete from your list and then press the **Remove Target** button.

Naming an observing list: By default, Starry Night gives your observing list a generic name but you can enter a custom “Observing List Name” by clicking on a list name and typing a new one.



Browsing for interesting objects: Another way to build an observation list is to use Starry Night to help you find interesting objects. In Advanced Find, the fields named (“Database”, “Type”, “Constellation”, “Magnitude”) are filters that you can use to build a list of interesting objects.



Modify these filters, leave the “Name” field blank, and press the **Find** button to generate a list of objects. Here are a few examples:

- 1 All of the planets (set the “Type” filter to “Planets”).
- 2 All Messier objects within the constellation Scorpius (set the “Database” filter to “Deep Sky”, “Name” filter to “Messier”, and the “Constellation” filter to “Scorpius”).
- 3 All planetary nebulae in the Messier catalog (set the “Database” filter to “Deep Sky”, “Name” filter to “Messier” and the “Type” filter to “Planetary nebula”).

Tip: If you have created an Equipment List, you can use the Magnitude filter so that only objects bright enough to be seen through your telescope are listed. See “Field of View Indicators 1 (Creating an Equipment List)” on page 106 for information on creating an equipment list.

Press the **Find** button. Once Starry Night has generated a list of all the objects that meet your criteria, select each of the objects you are interested in adding to your observation list.

Using your completed list: Once your observation list is complete, open the **Observing Lists** pane to view your completed observation list.

If you right-click (**Ctrl**-click on the Mac) on any of the objects in your list, a contextual menu appears. See “Object Contextual Menu” on page 68 for information on object contextual menus.

Determining if an object will be visible: Once you have built up an observation list of objects, you can select to list only those objects Visible Tonight from the observing list contextual menu.

Tip: Targets in your observing list that are below the horizon will be greyed out and their altitude above the horizon will not appear.

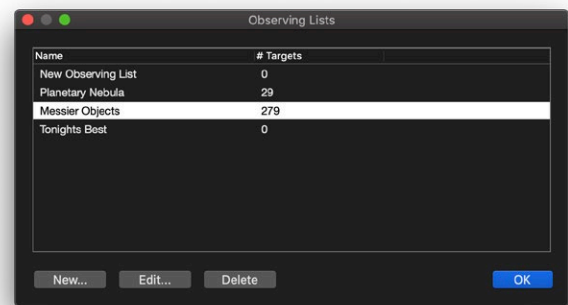
To find out the best time to view a specific object, right click (**Ctrl**-click on the Mac) on the object, and choose **Start Graphing** from the contextual menu. The object is added to the graph that runs along the top of the window.

This graph plots the altitude of the sun (in red), the moon (in green), and your selected object (in blue), over the course of the night. See “Graph Tool” on page 95 for more information on using the graph.

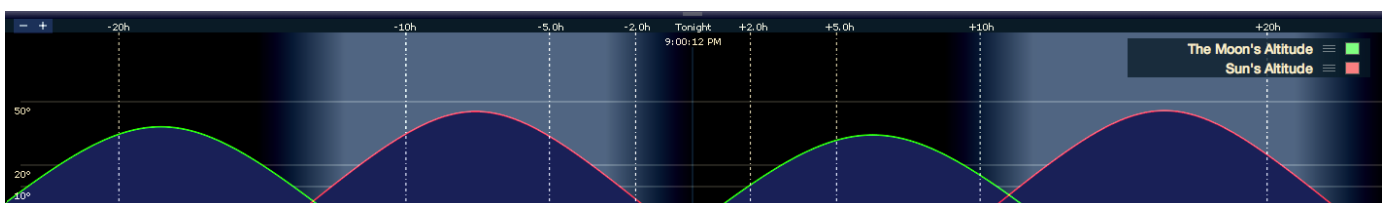
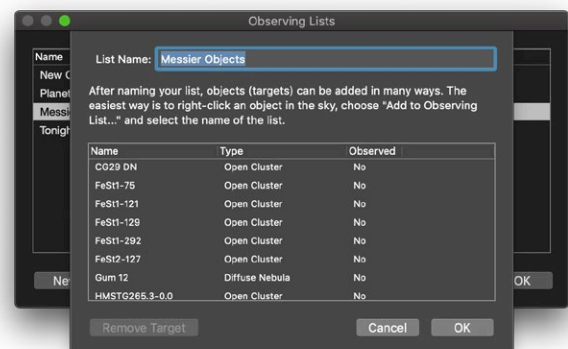
You can use the graph's plot to help you find the best time to view your object. Ideally, you will be able to find a time when your object has a high altitude, while the sun and moon are beneath the horizon (have altitudes less than 0). Sometimes, this is not possible. If you find that conditions are not suitable for viewing an object in your list, you can try to observe the object on a different day or remove it from your list.

Sharing observing lists: Whenever you create an observing list it is automatically saved to the LiveSky Cloud. If you create a free LiveSky account, you can view and share your observing lists at LiveSky.com. See “LiveSky” on page 98 for more information.”

Observe menu: You can also create and manage observing lists from the **Observe - Observing Lists...** menu.



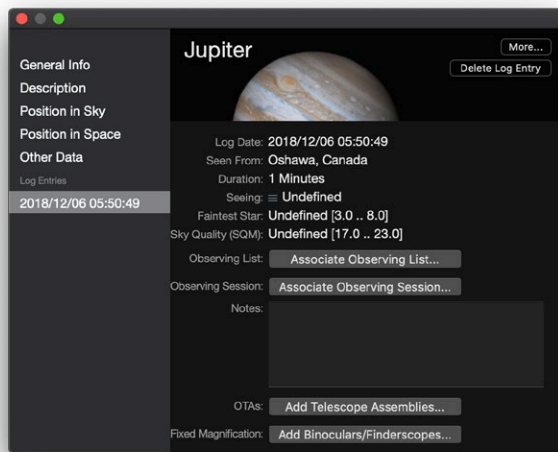
Press the **New...** button to create a new observing list or the **Delete** button to remove an existing list. The **Edit...** button allows you to rename your observing list and remove objects from the list.



Log Book

Many astronomers like to keep a record of their observations of celestial objects. You might wish to keep records for several reasons:

- 1 to compare how celestial objects appear through different telescopes and eyepieces, or from different observing sites
- 2 to keep track of your progress in observing a set of objects (for example, the 110 Messier objects)
- 3 to record how the appearance of an object (such as a planet or comet) changes over time



Starry Night has a built-in logging feature which makes it easy to record your observations and review your notes at a later date.

Creating a new log entry: To add a new log entry for an object, use Starry Night to bring the object onscreen, then right-click on it (**Ctrl**-click on the Mac), and choose **New Observation...** from the object's contextual menu. The **Log** window will open, with space for you to add your new log entry.

Note: Log entries are referenced by the date and time of your observation. Starry Night assumes that you will be adding these log entry's while you are observing, so the log entry's date, time, and

viewing location are automatically set to the date, time and location in the active Starry Night window. If you will be adding log entries sometime after your observing session, first set the date, time and location in Starry Night to the date, time and location of your observation. This will ensure that your log entries are filed correctly.

The **Log Date** is the date and time when you actually observed the object.

Seen From is the location the observation was made from.

The **Duration** field allows you to enter the duration of the observation in minutes.

The **Seeing** is a measure of how steady the air was when you observed the object using the Antoniadi scale. Use the slider to choose from I (Perfect seeing) to V (very bad seeing).

Faintest Star is a measure of the faintest stars (apparent magnitude) that can be detected with the unaided eye near the zenith. Choose from magnitude 3 to 8.

Sky Quality is a measure of the brightness of the sky in magnitudes per square arcsecond (Mpsa). Choose from a Mpsa of 17 (sky is brilliantly lit) to 23 (excellent dark skies).

Observing List is the list the observation is associated with. Each observation can only be associated with one observing list. If "None" of your observing lists contains the object you are creating an observation for, you will not be able to choose a list. See "Observing Lists" on page 99 for more information.

A **Session** is a period devoted to a particular observing time. A Session can be associated with multiple observations. For example, you might want to organize a single night's object observations into a Session. New Sessions can be created selecting **Sessions** from the **Observe** menu.

The **Notes** section has space for you to enter any particular notes about the object that you want to save. For example, “Jupiter’s Great Red Spot was unusually red tonight.”

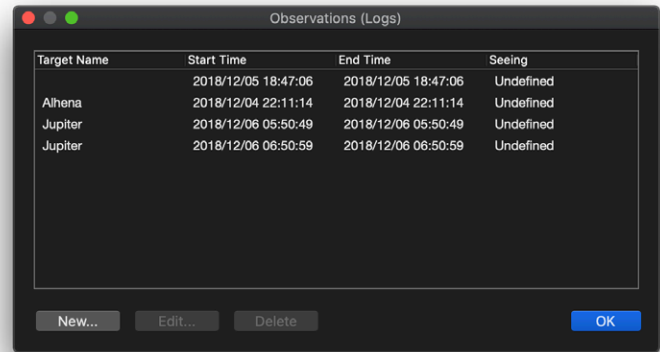
OTAs and **Fixed Magnification** allow you to add the combination of equipment you used to observe the object (telescope, eyepiece, binoculars, etc.) See “Equipment” on page 106 for information on creating an equipment list.

Tip: You can go back and edit your observations of an object at any time.

Viewing old log entries:

To view previously created log entries for an object, right-click on the object (Ctrl-click on the Mac) and choose **Show Info**. This will display a list of all previous entries for this object. Click on the entry that you wish to look at.

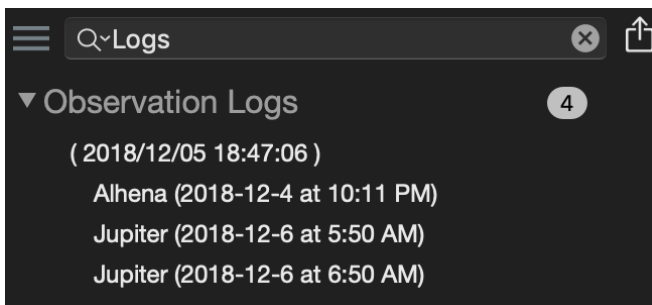
To view **all** recorded log entries select **Observations (Logs)** from the **Observe** menu or type “Logs” in the search field of the toolbar to bring up the Logs search results pane.



Target Name	Start Time	End Time	Seeing
	2018/12/05 18:47:06	2018/12/05 18:47:06	Undefined
Alhena	2018/12/04 22:11:14	2018/12/04 22:11:14	Undefined
Jupiter	2018/12/06 05:50:49	2018/12/06 05:50:49	Undefined
Jupiter	2018/12/06 06:50:59	2018/12/06 06:50:59	Undefined

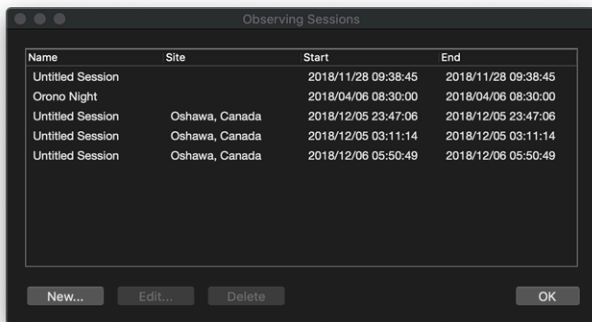
Deleting log entries: To delete a log entry for an object, click on the log entry in the object’s Log window, then press the **Delete Log Entry** button at the top right of the window.

Exporting log entries: choose **Logs->Export**

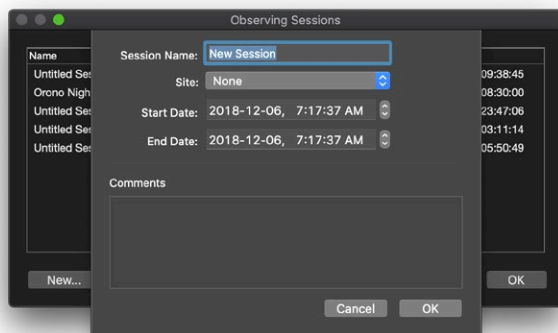


Observing Sessions

A Session lets you collect your observations into groups that span a few hours, or a few nights. For example, you might want to organize a single night's observations from your favorite dark sky site into a session. Sessions can be viewed and created by clicking the **Observe** menu and selecting **Sessions**.



Creating A New Observing Session: To create a new session, open the Sessions window by selecting **Sessions...** from the **Observe** menu. Then press the **New...** button and fill out the information.



Session Name lets you add a title to your session.

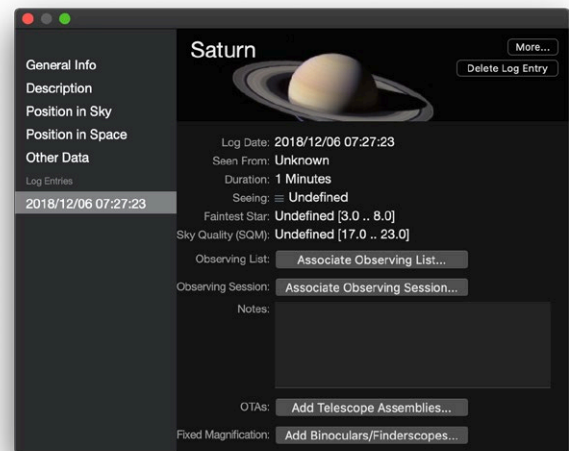
Site provides a choice of locations to choose from, including your current location.

Start Date lets you set the start time of your session. By default the time is set to when the session was created.

End Date sets the end time of your session.

Add any particular notes about the site that you want to save in the **Comments**. For example, "Astronomers and mosquitos don't mix at this site."

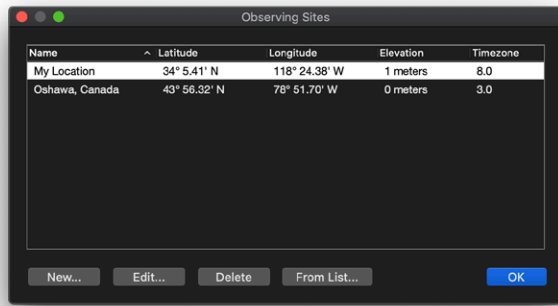
Associating Observations to Sessions: To associate an observation (log entry) to a session you created, select **Observations (Logs)** from the **Observe** menu. Highlight the observation by clicking on it and then press the **Edit...** button. In the Object Info window, click the **Associate Observing Session...** button and select your session.



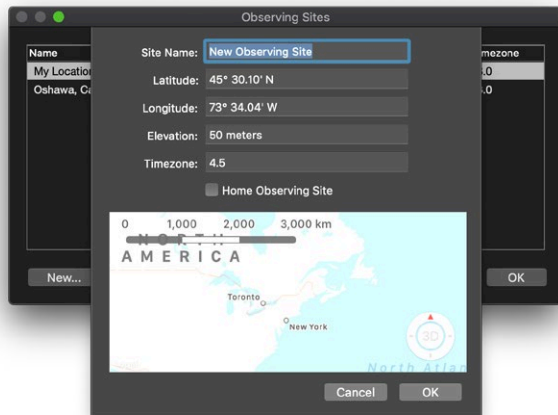
Deleting An Observing Session: You can delete Observing Sessions if the session is not referenced by observations. Select **Sessions...** from the **Observe** menu, click on a session and then press the **Delete** button.

Observing Sites

You can add your own favorite observing sites to Starry Night and then associate them with your observation entries. Sites can be created in the Observing Sites window view by selecting **Sites...** from the **Observe** menu.



Creating A New Observing Site: To enter a new site, click the **New** button at the bottom of the Observing Sites window. You can set the new site to your current location or from the map at the bottom of the view. To create a custom location, fill out the information.



Name - lets you add a title to your site.

Latitude - the geographic latitude of your observing site on the Earth's surface.

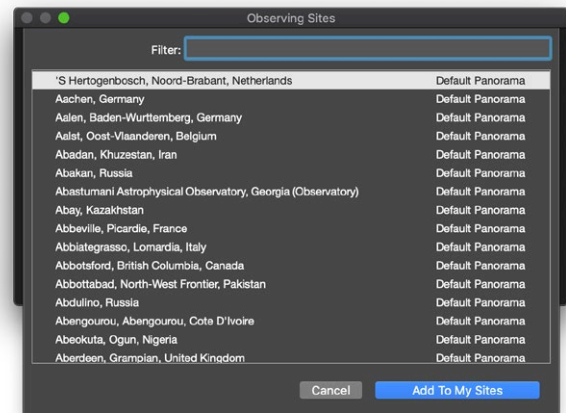
Longitude - the geographic longitude of your observing site on the Earth's surface.

Elevation - the elevation of your observing site above sea level in meters.

Time Zone - the time offset in hours from Greenwich Mean Time (GMT).

Click **OK** when finished.

Selecting From The Location List: Click the **From List...** button at the bottom of the Observing Sites window and select a location name. Click **Add To My Sites** when done.

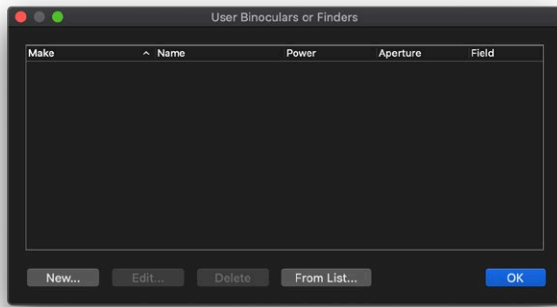


Deleting An Observing Site: You can delete Observing Sites if the site is not referenced by an Observing Session by selecting the **Delete** button at the bottom of the Observing Sites window.

Equipment

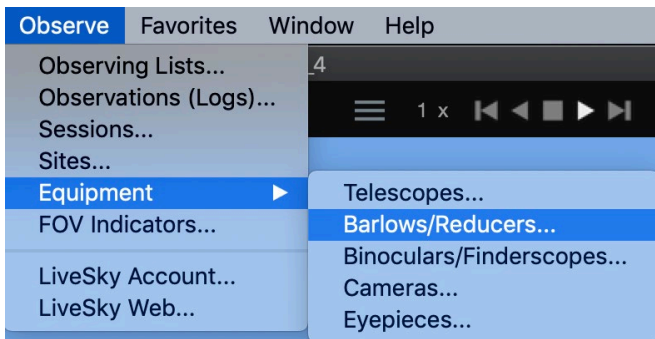
Use the Equipment window to enter information about your telescopes, eyepieces, finder scope, binoculars, and/or camera(s). Starry Night uses this information to display the field of view of your equipment. And you can select this equipment when logging observations of objects.

Opening the Equipment List: Choose **Observe>Equipment>(Type)** from the main menu to open your equipment list. Initially, this list will be blank.



Starry Night comes with an extensive built-in list of equipment. You can use these, and/or add your own equipment.

Types of Equipment: The **Observe>Equipment>** menu displays the different types of astronomical equipment. Some of these pieces of equipment may be unfamiliar to you.



Eyepiece. For any given telescope, you may have several eyepieces. When viewing the same object through the same telescope, the image that you see will vary, depending on the eyepiece properties. The most important property of an eyepiece is its focal length, which affects the image magnification. Eyepieces with large focal lengths (low magnification) are good for viewing faint deep-space objects. Eyepieces with small focal lengths (high magnification) are good for viewing details on bright objects, such as the moon or planets.

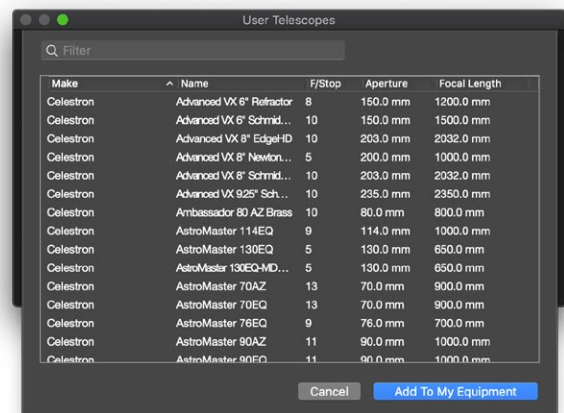
Barlow. A Barlow lens is a device that sits between your telescope's focuser and eyepiece. It is used to increase the magnification of an eyepiece.

Focal Reducer. A focal reducer is essentially the opposite of a Barlow lens. It reduces the focal length of your telescope, decreasing the magnification of an eyepiece.

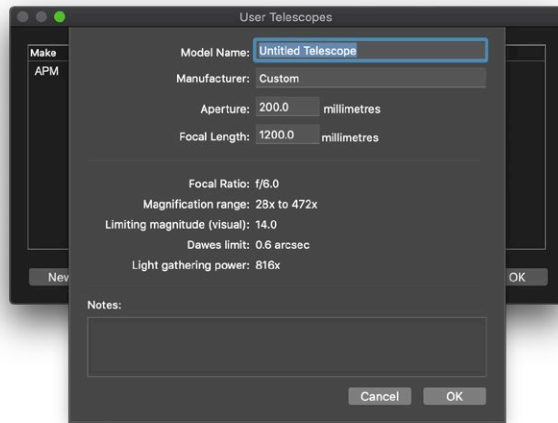
Finderscope. A Finderscope is a secondary telescope that attaches onto your main telescope. It has a lower magnification and a larger field of view than the main scope, and is used to locate objects in the sky, which you will then view using the main scope.

Camera. A CCD is a camera that is attached to your telescope and used to take digital astronomical photographs.

Adding items to the equipment list: To add your pieces of observing equipment to the equipment list, choose the appropriate equipment category (e.g. "telescopes") from the **Observe>Equipment** menu. In the Equipment List dialog box, press the **From List** button. A dialog box will open with a list of equipment available under that category.



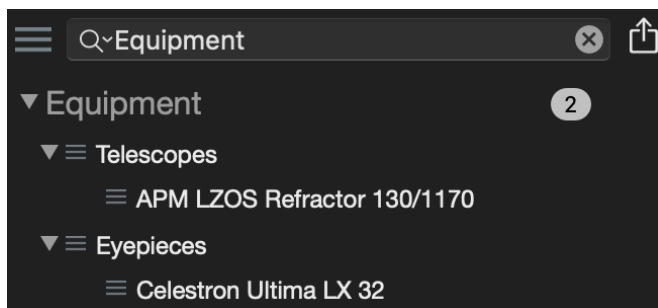
If your equipment is not listed, press the **New** button in the lower left corner. A dialog box will open, which allows you to name your piece of equipment, and enter its relevant information. Once you have entered all of the necessary information, press the **OK** button to save this piece of equipment in your equipment list.



The information that can be entered depends on the type of observing equipment. All of the necessary information should be available in the documentation that came with your equipment. Some of this information is used by Starry Night when it calculates how field of view indicators will look when drawn onscreen.

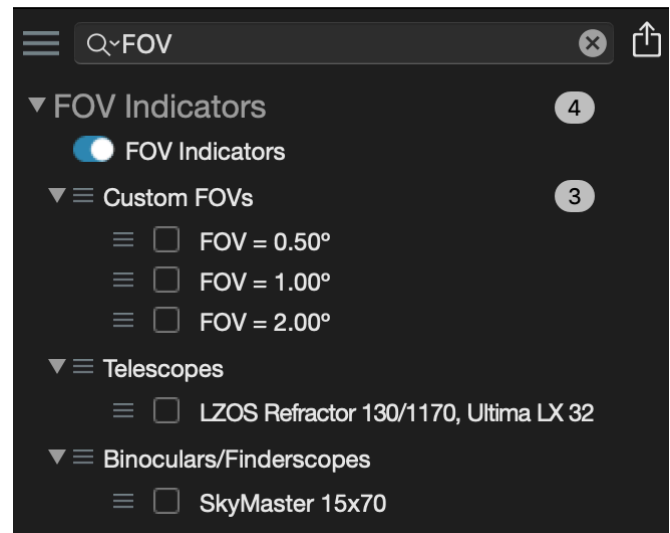
Editing Equipment Lists: You can edit (custom equipment only) or delete items in an equipment list by pressing the **Edit** or **Delete** button in the Equipment List window.

Equipment Pane: You can also view, add, and edit all of your equipment in the **Equipment** pane by typing "Equipment" in the main toolbar search field.



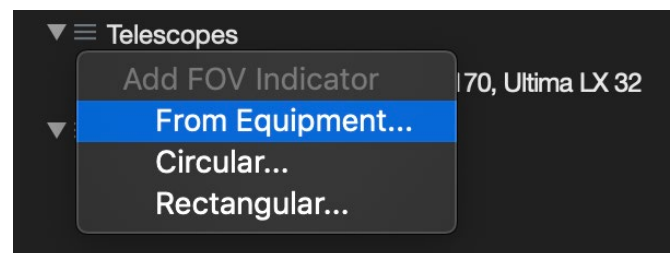
Field Of View (FOV) Indicators

The **FOV Indicators** pane allows you to display an outline onscreen that shows the shape and field of view (FOV) of any of your astronomical instruments.



Indicator List: To see the list of FOV Indicators, open the FOV pane. You will see a list of indicators, divided into Custom FOVs, Telescopes, and Binoculars/Finderscopes.

Adding FOV Indicators: The list of FOVs will be empty by default. Click on the contextual menu of the equipment type and select **From Equipment** to add a new FOV indicator.



You need to have previously created your equipment list (see "Equipment" on page xxx for information on creating an equipment list) in order to have it available for selection.

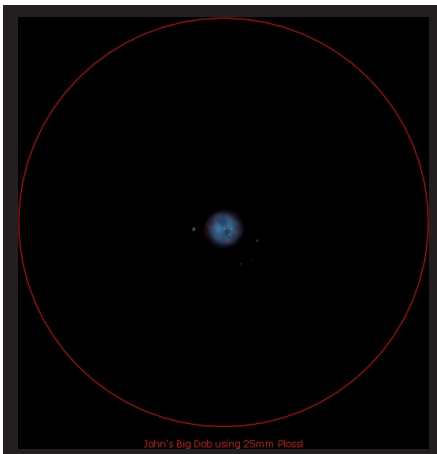


The name of the indicator and its field of view will then be shown.



Turning indicators on/off: Checking/unchecking the box to the left of the indicator name turns on/off the outline for that indicator.

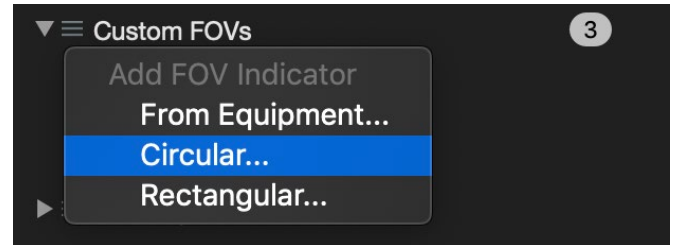
After you have turned an indicator on, you should see the indicator in the main Starry Night sky view at the center of the screen.



Multiple Indicators: You can turn on more than one FOV indicator at a time. One situation where you might wish to display indicators is if you are using a primary telescope and a finderscope.

FOV Indicators Window: You can also add, edit and manage your FOV Indicators in the FOV Indicators window by selecting **FOV Indicators...** from the **Observe** Menu.

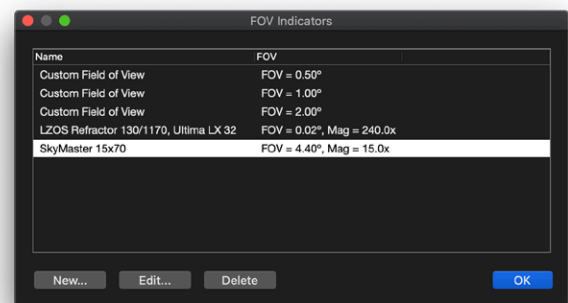
Adding other indicators: It is possible to display FOV indicators that do not correspond to any of the items in your equipment list.



To add one of these indicators, click the “Custom FOVs” Contextual Menu button and select **Circular...** or **Rectangular...**

Deleting indicators: You can delete any of your Field of View indicators by clicking on the indicator’s **Contextual Menu** button in the **FOV** pane, then selecting “Delete” in the menu that opens.

FOV Indicators Window: You can also add, edit and manage your FOV Indicators in the FOV Indicators window by selecting **FOV Indicators...** from the **Observe** Menu.



Telescope Control

If you have an automated “go-to” telescope, you can probably use Starry Night to control your telescope. The list of telescopes supported by Starry Night is slightly different on Macintosh and Windows:

Windows: On Windows computers, Starry Night controls telescopes with the aid of the ASCOM telescope driver.

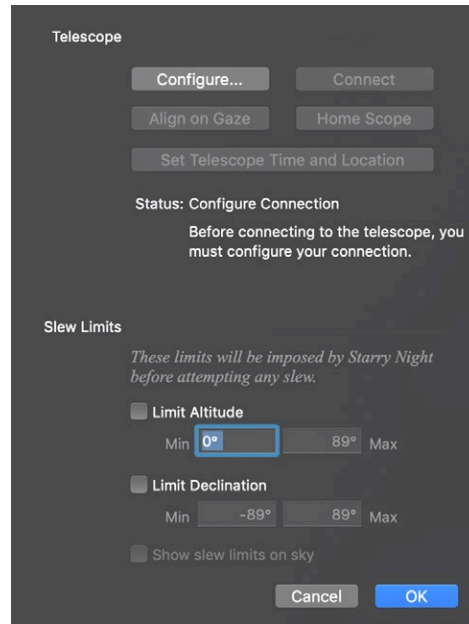
ASCOM is an open source programming initiative designed “to provide software technology that will help bring about a rebirth of science in amateur astronomy”. You can learn more about ASCOM by visiting the ASCOM website: <http://ascom-standards.org>.



Macintosh: On the Macintosh, Starry Night controls telescopes with its own telescope plug-in.

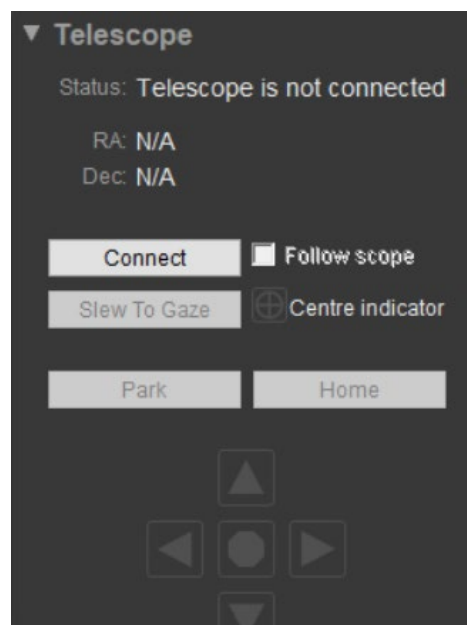
Telescopes Supported: The list of telescopes that can be controlled with Starry Night is constantly changing, and new telescope models are added on a regular basis. Drivers are also updated occasionally for supported telescopes, to account for any changes in the telescope software. See “Telescope Configuration” on page 111 to determine which telescopes can be controlled with Starry Night. If your telescope model does not appear to be supported, check our website: www.starrynight.com to see if support for your telescope model has been added.

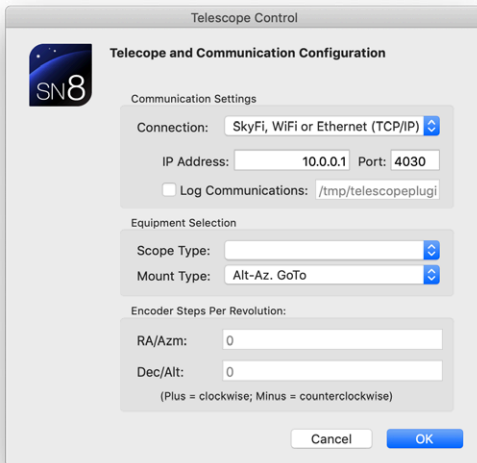
Installing Telescope Control: To control your telescope on a Windows computer, you need to install the ASCOM driver by selecting to install telescope support during the installation of Starry Night. Macintosh users do not need to install a separate driver, as telescope control is packaged into the main Starry Night installer.



Telescope Controls: All of the telescope controls in Starry Night can be accessed in the Telescope Control floating window by selecting **Show Telescope Panel** from the **View** menu.

Telescope Configuration: To configure your telescope, open the Telescope Setup pane by selecting **Show Telescope Setup** from the **View** menu. Then press the **Configure** button in the Setup layer. You will see a list of all supported telescopes.





Mac Telescope Configuration window

Communication Settings

Connection: Allows you to select how you are connecting your computer to your telescope. If *WiFi* is selected, Starry Night will only attempt to communicate with your telescope using a Wi-Fi adapter like SkyFi. The adapter must be turned on, and physically connected to your telescope's serial port.

If you are using Wi-Fi, then the following settings must be correct. These are only used with Wi-Fi telescope communication. They will be disabled if you are communicating via bluetooth.

IP Address - If your SkyFi's IP address is not auto-detect, you can enter it here manually instead. Your computer must be on the same Wi-Fi network as the SkyFi, and must have an IP address on the same subnet. Check your Wi-Fi network settings to make sure this is correct. The default IP address used by SkyFi is 10.0.0.1.

Port Number - The TCP port number to be used for communication with the adapter. Make sure this is the same TCP port that the telescope adapter or server is listening on. The default port number used by SkyFi is 4030.

Save Log File - If turned on, Starry Night saves a log of its communication with the telescope on your computer. Starry Night creates a new log file every time you connect to the telescope. The log file records every command that Starry Night sends to the telescope, and every response from the telescope. The log file name is:

telescopeplugin.log

This log file can be emailed to Simulation Curriculum for troubleshooting telescope communication problems.

Equipment Selection

Scope Type - selects the type of telescope you want to control. Starry Night can control any of the telescopes in the list. Starry Night supports many encoder systems that can read out the telescope position but not actually move the telescope. The Celestron AstroMaster and JMI NGC-MAX are examples of such encoder systems.

Mount Type - selects your telescope's type of mounting:

Equatorial Push-To - a non-motorized mount whose right ascension axis is pointed at the celestial pole. The mount must be manually turned around this axis to follow the diurnal motion of the sky.

Equatorial GoTo (Fork) - a motorized equatorial mount that automatically follows the diurnal motion of, and can automatically slew to, targets in any part of the sky. Has one or two fork arms that suspend the telescope between them. The

Meade LX-200 and Celestron NexStar (when used with an equatorial wedge) are examples.

Equatorial GoTo (German) - a motorized, polar-aligned mount that requires reversing the telescope tube to the east or west side of the mount when the telescope passes through the meridian. Examples include the Losmandy and Takahashi mounts.

Alt-Az. Push-To on Equ. Platform - a non-motorized mount that must be manually pushed to targets in different parts of the sky. However, it sits on a motorized platform that is aligned with the Earth's polar axis, so the mount follows the diurnal motion of the sky when it is not being pushed.

Alt-Az. Push-To - a non-motorized alt-azimuth platform with fork arms that suspend the telescope between them. It is moved manually by pushing the telescope tube. It sits flat on the ground, so its "up-down" and "left-right" axes of motion align to the local horizon and zenith. This includes most Dobsonian telescopes.

Alt-Az. GoTo - a motorized alt-azimuth platform with fork arms that suspend the telescope between them, and can slew to any set of coordinates in the sky on command. Includes the Meade LX-200 and Celestron NexStar when used in the alt-azimuth configuration.

If your telescope mount has encoders which provide a digital readout of the scope's position, additional text fields apply in the **Encoder Steps Per Revolution** section. These let you specify the encoder resolution.

RA/Azm - The number of steps per revolution for the encoder attached to the telescope's Right Ascension axis (or Azimuth axis, if you have an alt-azimuth mount).

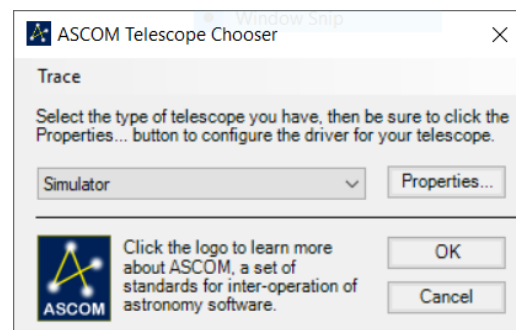
Dec/Alt - The number of steps per revolution for the encoder attached to the telescope's Declination axis (or Altitude axis, if you have an alt-azimuth mount).

Depending how your encoders are installed, their position readouts may increase when they are turned clockwise, or increase when they are turned counterclockwise. If the encoder position readouts increase when they are turned counterclockwise, enter a negative value for the number of steps per revolution. You may need to determine the correct + or - sign by trial-and-error. If you push your telescope left (or

up), but the telescope field-of-view indicator on the sky chart moves right (or down), the sign is probably wrong.

Windows Telescope Configuration window

Choose your telescope model from the list, press the **Properties** button, and select the serial port that your telescope is connected to.



Note: If you have any Meade telescope with an Autostar controller that is not specifically listed (e.g. an ETX), choose the "Meade LX200 and Autostar" option.

Press the **OK** button to close the Configure dialog box.

Connecting Your Telescope: The first step in controlling your telescope with Starry Night is turning your telescope on and aligning it properly. Your telescope needs to be aligned before you begin using it with Starry Night! Once your telescope is aligned, plug it into your computer. You will need an RS-232 cable that connects the telescope (or the telescope handbox, depending on the telescope model) to the serial port on your computer. Different models of telescopes require different cables. If your computer does not have a serial port, you may also need an adapter that converts your computer's serial port to a USB port.

Connect/Disconnect: Once your telescope is aligned and plugged in to your computer, press the **Connect** button in the Telescope Pane

(View>Show Telescope Panel). This begins communication between your telescope and Starry Night. To end communication, press the Disconnect button.

Telescope Setup: Once you have pressed the **Connect** button and your telescope is connected to Starry Night, an onscreen marker will indicate where your telescope is pointing. Your telescope's right ascension and declination will also be shown in the Status section of the Telescope Panel. At first, these values may not be accurate. One possible reason for this is that the time and location in Starry Night are not the same as the time and location that your telescope is using.

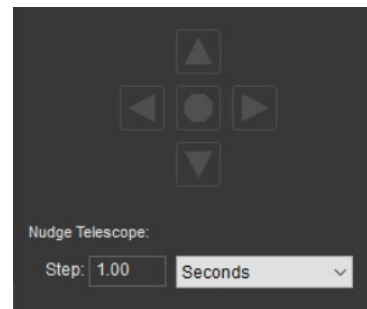
Check the electronic controller for your telescope and make sure that the time and location that your telescope is using match the values in Starry Night. If the view through your telescope still does not match what Starry Night is showing onscreen, use Starry Night to slew to an object that is easy to recognize, such as a bright star (see the next section for information on slewing your telescope to objects using Starry Night). Next, guide the telescope using its built-in control devices (a handbox or controls on the telescope itself), so that the bright star is at the center of your view when you look through the telescope eyepiece (i.e. the view in Starry Night will now match what you see through the eyepiece). Finally, open the Telescope Setup Pane by selecting **View>Show Telescope Setup** and press the Align on Gaze button.

Telescope Control: Once your telescope is pointing in the right direction, you can click the **Slew To Gaze** button in the Telescope Panel and your telescope will slew to the coordinates of Starry Night's screen center. You can also right-click (**Ctrl**-click on the Mac) on any object and choose **Slew To** from the object's contextual menu. Your telescope will then slew to and center on the object you selected. If you check the box marked "Follow scope" in the **Telescope** pane, Starry Night will keep the sky view centered in the direction that your telescope is pointing. Press

the **Center Indicator** button to immediately center the Starry Night view on the onscreen telescope position marker. (Windows only)

Handbox simulator: simulates your telescope handbox by allowing you to push the direction arrows in the Starry Night interface to move your telescope.

For an altazimuth mounted telescope, the direction keys move the telescope in Altitude and Azimuth. In an equatorial configuration, the direction keys move the telescope in Right Ascension and Declination.



Tip: Holding down a direction key will continuously slew the telescope. The **Stop** button will stop any slew that is in progress.

The **Nudge Telescope** options, allow you to set the slew increment for each nudge.

Enhanced telescope control: These controls can be found in the Telescope Setup window. The **Home Scope** button moves your telescope to its home position. This allows for easier computer to star alignment. The home position for altazimuth mounted telescopes usually involves setting the telescope tube facing north and horizontally leveled. For equatorial mounted telescopes, the telescope must be set to the polar configuration. Your telescope manual will provide instructions on these options.

The **Slew Limits** check boxes prevent the telescope from slewing outside a user-defined horizon in both altazimuth and equatorial configura-

tions. This feature is handy to prevent damage to imaging equipment that would otherwise hit the mount or tripod of the telescope.

You can display your slew 'horizon' in the sky by checking the "Show slew limits on sky" box.

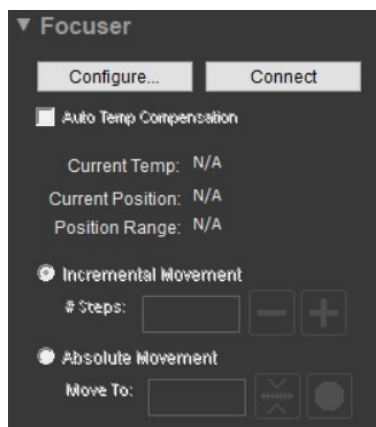
Tip: *Not all telescopes support the enhanced telescope controls. Features that are not supported by your telescope will be disabled automatically.*

Focuser control (Windows only)

Control your robotic focuser through Starry Night. Allows for incremental and absolute positioning for applications where precise focusing is required. Not all focusers support all the features available in the "Focuser" section of the Telescope Control Panel. If a selected focuser model does not support a feature, that option will not be available.

Supported focusers include:

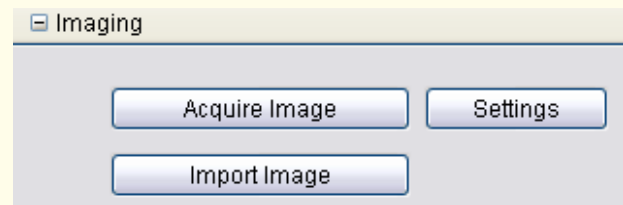
- AstroOptik telescopes
- Astrophysics GTO mount
- Finger Lakes focusers
- Gemini equipped mount
- JMI Smart Focus
- Meade LX200 and Autostar
- Optec TCF-S
- PCFocus
- Imaging Plug-in (Windows only)



PRODUCT SPECIFIC FEATURE

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Capture images using the plug-in to MaxIm DL imaging software (sold separately). This innovative integration lets you find your target, take and process pictures with MaxIm DL and then import these pictures back into Starry Night.



The MaxIm DL plug-in is included with Starry Night Pro Plus. If you own Starry Night Pro you can purchase the MaximDL plug-in separately from <http://www.starrynight.com>.

Capturing an image: Press the **Acquire Image** button to tell Maxim DL to take an image of the area currently centered on the main Starry Night window. Then press the **Import Image** button to bring the image taken by Maxim DL into Starry Night.

See "MaxIm DL Plug-In (Windows only)" on page 147 for more information on Maxim DL and its integration with Starry Night.

Satellite Tracking

Track the International Space Station, the Space Shuttle and hundreds of other satellites with your robotic telescope.

Satellite tracking: Right-click (**Ctrl**-click on the Mac) on any satellite in the main window and choose **Track** from the satellite's contextual menu. Your telescope will then slew to, center on and track the satellite you selected.

The satellite will only be tracked if your telescope is capable of slewing at the rate the satellite is traveling.

Note: *Satellite tracking is currently only available for Macintosh users using the Meade LX200/RCX400 series of telescopes. If your telescope type or operating system is not currently supported, please visit <http://www.starrynight.com> for update announcements.*

Wireless Telescope Control

The *SkyFi-USB Wireless Telescope Adapter* (or the Orion StarSeek WiFi Telescope Adapter) allows you to command your computerized telescope from your computer wirelessly. The device uses integrated wireless technology to give you enhanced range and freedom of movement in the field.

It works with most major brands of computerized telescopes, allowing complete wireless control while using your favorite astronomy planetarium software.

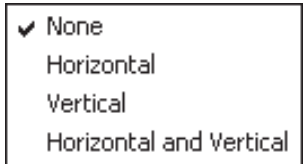
For added convenience, the Wireless Telescope Adapter doubles as a USB adapter in wired configurations, eliminating the need for a USB to serial port adapter.



Visit <http://www.starrynight.com> to learn more about the freedom of wireless telescope control.

Flip

Another way of modifying Starry Night's screen appearance to match your telescope is to flip your view. You can flip your view horizontally, vertically, or in both directions, to match what you see through your telescope. You flip your view by choosing **Options>Flip** from the menu.



You can then print out charts that match the telescope's view and use those charts during observing sessions. If you observe the sky with binoculars or the naked eye, you will not need to use this option.

Printing

Starry Night allows you to create finder charts in a variety of layouts. From naked eye charts that help you become familiar with the pattern of the constellations to finder charts that accurately simulate what you can see in your telescope, finderscope or binoculars. The finder charts are designed for use in the field and will help guide you to the most challenging of objects.

Center on the area of sky you are interested in and use the **Field of View** buttons in the **Zoom** control in the main sky window to set the correct field of view for your printed chart. For example, if you want a chart that shows the northern part of the sky, press the **N** keyboard key to face north and set your field of view to 100 degrees.

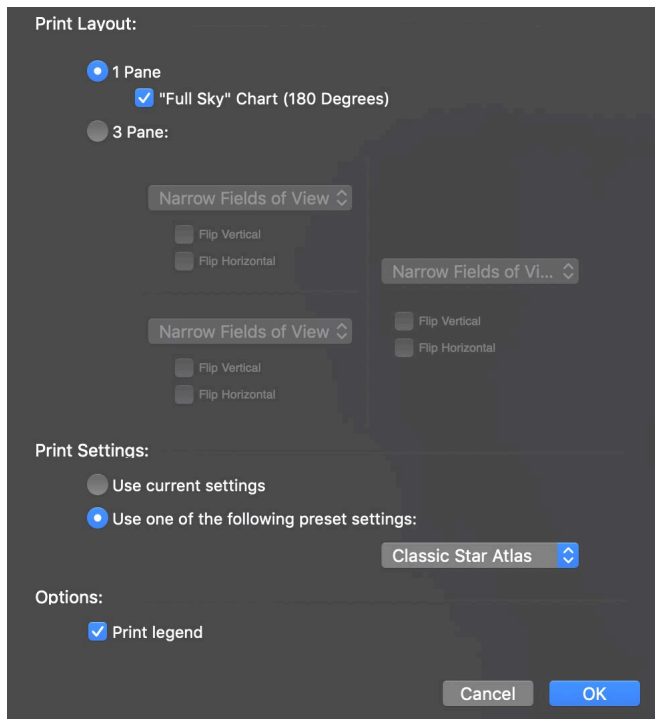
Remember that the appearance of the sky is time-sensitive; so make sure to set the time in Starry Night to the time you plan to go outside to observe!

Once you have set the time, viewing direction and field of view, select **File>Print** from the menu. Alternatively, if you wish to print a chart centered on a specific object, right-click (**Ctrl**-click on the Mac) on the object and select **Print Chart** from the contextual menu.

Tip: If you are interested in viewing a dim object, and it is not labeled on the printed chart you make, select it on the screen by pointing the cursor at the object and clicking on it. Its name should then appear on screen with an arrow pointing to the object. This is known as “selecting” an object. See “Labeling Select Objects” on page 29 for more information on selecting objects. If you print a new chart, the selected object will now be labeled.

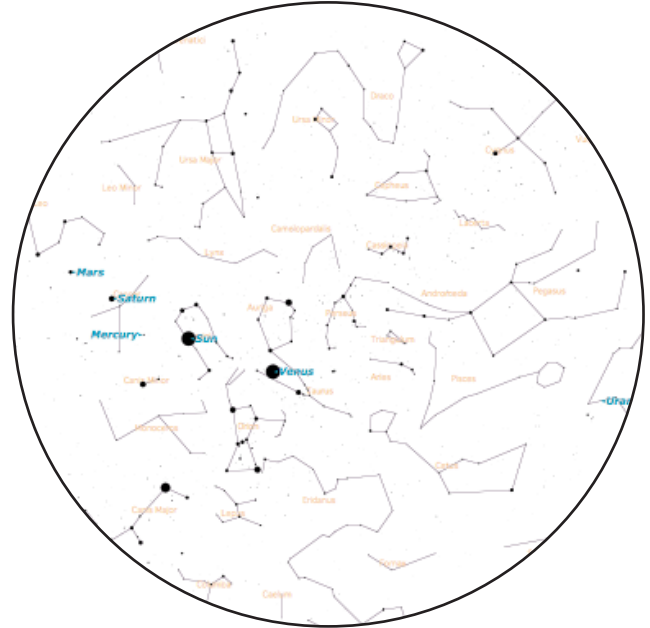
Selecting **Print** will open a dialog box with options for controlling the appearance of your printed chart.

One pane star charts: Produces a full-page printout of the area shown onscreen. When checked, the “Fill page when printing” box prints a star chart that covers a larger area than shown onscreen.



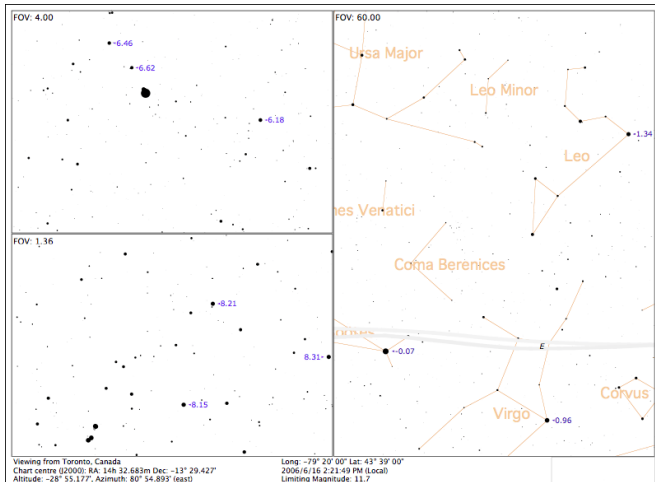
Full sky star charts: Checking the “Full Sky Chart” box will print a circular star chart that covers the entire sky from horizon to horizon. These charts are centered on the zenith and show you what

the sky looks like above the horizon in all directions. Full sky charts are handy for identifying the constellations or locating the brighter stars and planets visible with the naked eye.



Tip: To use a full sky star chart hold it in front of you and turn it around so the label for the cardinal direction you're facing (such as north (N) or southwest (SW)) is right-side up. For example, if you are looking north, the bottom of your full sky printout should be labeled north. The circle around the full sky map is the horizon. The center of the map is the zenith, the point in the sky directly above the observer.

Three pane star charts: Prints a three-view star-hopping chart customized to the field of view and orientation of your telescope, finder or binoculars. A three pane star chart effortlessly guides novices to challenging objects and allows experts to manage their time more efficiently.



Each pane can be tailored to fit your needs. For example, you might set the larger pane to 90 degrees to help you locate the constellation the object is in. The smaller panes can then be set to display the field of view of your finderscope and eyepiece. Each pane is centered on the selected object and is designed to progressively guide you closer to your target.

The field of view drop down menu in each pane can be set to the field of view of the equipment you've entered in your equipment database. See "Field of View Indicators 1 (Creating an Equipment List)" on page 106 for more information.

Use the "Flip Vertical" and "Flip Horizontal" checkboxes in each pane to match the view seen through your telescope, finderscope or binoculars.

Print Legend: Prints the time and date, limiting magnitude, location plus a symbol key for object types such as double stars, galaxies and nebulae. Without the legend, the star chart might cover a larger area.

The following options control the appearance of your printed chart.

Use current settings: Prints star charts using the same settings (how many stars are shown, what objects are labeled, etc.) that you currently have onscreen.

Use one of the following preset settings: Prints star charts using Starry Night's special print setting files. Preset files include:

Classic Star Atlas labels bright stars by name and dimmer stars with Flamsteed numbers. Displays the outlines of deep sky objects and overlays the equatorial grid lines. Variable and binary stars are marked.

Constellation displays the constellation stick figures and labels.

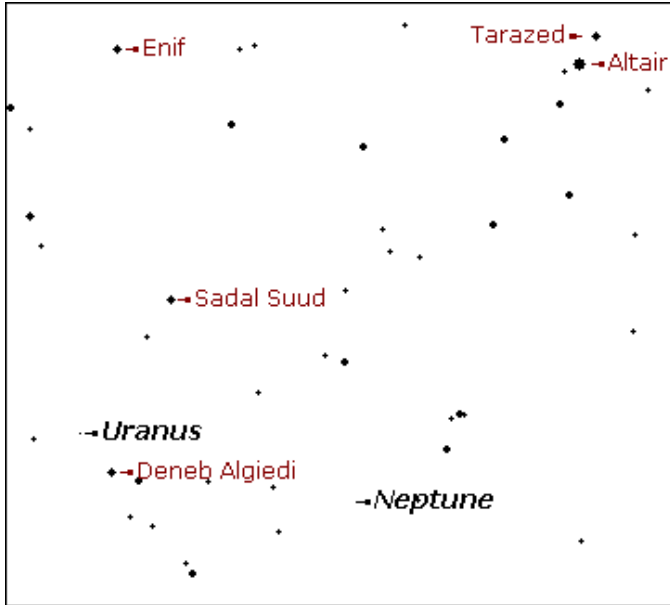
Solar System labels the planets and the brighter asteroids and comets. The ecliptic line is also drawn.

Tip: Preset settings can be viewed before printing by selecting **Options>Presets** from the menu.

See "Adding Print Presets" on page 54 for more information on adding your own preset print settings.

White Sky Mode

You learned how to print star charts in "Printing Star Charts" on page 22. Starry Night also allows you to simulate printed star charts on your screen, by choosing **View>White Sky** from the menu. This displays a negative image of your Starry Night view, reversing the colors of objects and labels. Stars are represented by dark circles on a white background.



Note: **View>White Sky** differs from **Options>Presets>Print Settings** because it does not use *Starry Night's* special print settings, it just displays a negative image using your existing settings.

Night Vision Mode

Selecting **Night Vision** from the **View** menu instructs your monitor to dim its display red. Night Vision mode is suitable for outdoor, night-time viewing, as it helps to preserve dark adaptation when you look into your computer's display.

Because of the control Night Vision must exert over your computer display, not all computers will support it.

Adjusting brightness: You can adjust the brightness of night vision mode by choosing **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh), selecting **Appearance** from the top of the Preferences dialog box, and adjusting the Night Vision slider in this dialog box.

Turning night vision off: If you are in Night Vision mode, choose **View>Night Vision** from the menu to turn off Night Vision mode.

Chapter 8

Working With Files

In this chapter you will learn about the different types of files you can create with Starry Night. We'll look at several types of files:

Starry Night files: Dynamic files that you open with Starry Night to recreate a particular view or celestial event.

Image files: Static color images of a particular view in Starry Night.

Movie files: Animation sequences showing an astronomical event such as an eclipse.

Exported text files: Plain text documents with information about every celestial object shown onscreen in a particular Starry Night window.

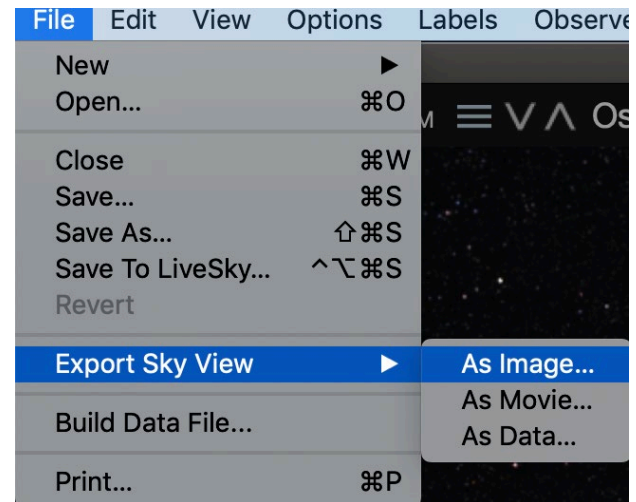
What Is a Starry Night File?

A Starry Night file allows you to recreate all the conditions you used in the program to see a particular celestial event. When you open a file again, it will restore you to the same time, viewing location and viewing direction as when you saved the file. It will also restore the time mode you were using when you saved the file. For example, if you had time playing continuously forward in discrete time steps of one day when you saved the file, time will again move forward one day at a time when you reopen it. Finally, all of your label, guide and sky settings will be restored.

Note: *Starry Night files are saved with the file extension “.snf” at the end of their name.*

Some events for which you may wish to make a Starry Night file include an eclipse, a planetary alignment, or a close-up of a galaxy or star cluster. Premade files are also very useful for teaching situations. See “The Favorites Menu” on page 118 to see a sample of pre-made files.

What is a Starry Night file **not**? It is not a pre-made animation sequence which shows you blasting off from Earth, for example. All a Starry Night file does is establish the initial screen conditions— from then on you have complete control over how the screen view will evolve. If you want to make replayable animation sequences, read the section on “Making Movies” on page 124.



File Features

Most of the features for working with files are in the **File** menu. These features work similarly to those found in most file-based applications.

Note: *The File menu on the Macintosh looks slightly different, as some of the menu items are in the Starry Night menu.*

New>New Viewer: This opens a new Starry Night window with the default settings. The original Starry Night window is not closed, so this feature allows you to open as many different windows as you want.

Open: This allows you to open a previously saved Starry Night file. A dialog box will open that prompts you to select a file from your hard drive.

Close: This closes the window that is currently active. On Windows computers, this will also exit the application, if you only have one Starry Night window open.

Save: Saves your current view as a Starry Night file (“ .snf”). A dialog box will open that allows you to choose where on your hard drive to save the file. Make sure you save these files to a location that you will easily remember.

Save As: If you are already running a file that was previously saved, this saves the file under a different name and changes the active window to this file.

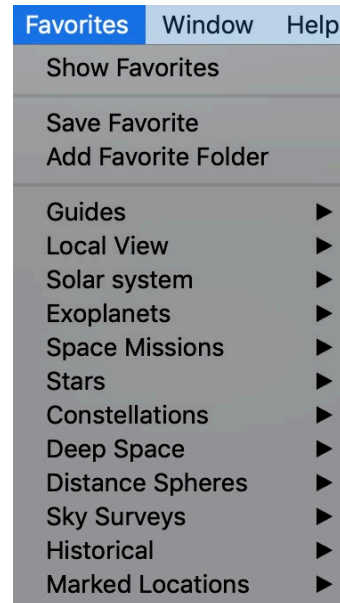
Save To LiveSky: This saves the file and associates it with your LiveSky account. Files saved using this option will be accessible across all your installations of Starry Night and SkySafari that use same LiveSky account.

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

Tip: 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** from the main menu, you can reverse up to the last 50 actions you have performed using Starry Night. Choosing **Edit>Redo** from the menu performs the actions again.

Exit: Exits Starry Night, shutting down all open windows (on the Mac, this command is **Quit Starry Night**, and it is in the **Starry Night** menu). If you have not saved changes made to any open documents, you are asked whether you want to save to a file. Usually, when you exit Starry Night, you will not want to save a file, but occasionally you will. You can eliminate the document save warnings by choosing **Preferences** from the **File** menu (Windows) or the **Starry Night** menu (Macintosh), choosing **General** from the top of the Preferences dialog box, and unchecking the “Show document save warnings” checkbox.

The Favorites Menu



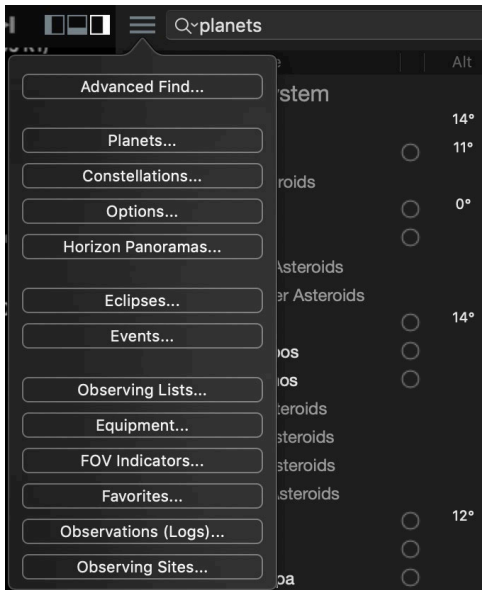
The **Favorites** option in the main menu provides a nice sample of what can be done with Starry Night files.

The bottom half of this menu is subdivided into layers that match the layers in the **Options** search results pane. Selecting any entry opens a pre-made Starry Night file that shows off some aspect of astronomy.

Tip: Take some time to look at the entries in the **Favorites** menu. Remember that the entries are not static images, they are regular Starry Night files which you can then modify using any of Starry Night's controls.

Favorites search results pane: You can also open any of the **Favorites** files by opening the **Favorites** search results pane and double-clicking on the file that you are interested in.

You can open the **Favorites** search results pane by clicking the **Pane Shortcuts** button and selecting it from the menu or typing “Favorites” in the toolbar's search text box.



Customizing the Favorites Menu: It is possible to customize the **Favorites** menu by adding your own files or modifying the existing files. See “Customizing the Favorites Menu” on page 139 for instructions.

Adding notes to Starry Night Files

See “Adding notes to files” on page 127 for more information on adding descriptive notes to your Starry Night files.

Example: Creating Files

This example teaches you how to use the **File** menu to save, open and modify files. You will create a file of the August 21, 2017 solar eclipse.

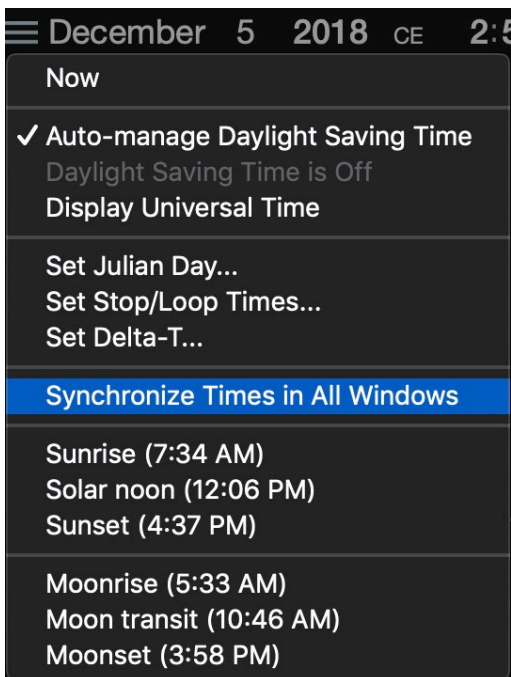
- 1 Restore Starry Night’s default settings by choosing **Options>Presets>Default**.
- 2 Open the Viewing Location dialog box by choosing **Options>Viewing Location** from the menu.
- 3 Click the **List** tab and select Salem, Oregon, from the list of cities. Click the **View From Selected Location** button to close the Viewing Location dialog box. The toolbar should now list Salem as your current location.
- 4 Set the time to 10:12:00 AM, and the date to August 21, 2017, then stop time flow.
- 5 Clear the search field in the toolbar to reveal the list of solar system objects.
- 6 Double-click on the sun’s name in the **Search Results** pane to center and lock on it. 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 had previously turned daylight off, turn it back on now).
- 7 Set your time step to a discrete value of 3 seconds in the toolbar. You now have Starry Night set up perfectly to watch the solar eclipse.
- 8 To save your work, select **File>Save**. In the save dialog that opens, select **Save As File**. Name the file `Eclipse from Salem` and save it in the directory of your choice. Once you have saved the file, the main Starry Night window should now be called `Eclipse from Salem`, not `Untitled`.

You will now watch the eclipse.
- 9 Press the **Forward** button in the time mode controls in the toolbar. As time flows forward, the sky will gradually begin to get darker. At about 10:18, the sky will go completely dark and all the stars will come out. This lasts only a couple of minutes before the sky gradually becomes light again. At about 10:20, stop the flow of time by pressing the **Stop** button on the toolbar.
- 10 Close the file by selecting **File>Close**. Select `Don’t Save` in the window that asks if you want to save changes. On Windows, this will also exit Starry Night.
- 11 Restart Starry Night. After it opens, you should be at your home location at the current time.
- 12 Select **File>Open** and choose `Eclipse from Salem` from the dialog box that opens and

prompts you to select a file. Again you are in Salem, Oregon at 10:12, looking at the sun, in a good spot to watch the eclipse. You can press the **Forward** button on the toolbar to watch it again, if you like.

Multiple Windows

One of the most useful features of Starry Night 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 same object at several different times. Choose **File>New>New Viewer** from the menu to open a new window.



Synching Time in Multiple Windows: You can synchronize the time and the rate of time flow between multiple windows, by clicking the **Date and Time** contextual menu button in the toolbar, and choosing **Synchronize Times In All Windows**. The next example will show you the power of this feature.

Example: Simultaneously Viewing a Solar Eclipse from Earth, the Moon, and the Sun

Multiple windows are an excellent way to view the geometry of our solar system that is responsible for eclipses. In this exercise, we will examine a total solar eclipse simultaneously from three viewpoints: Earth, the moon, and the sun.

- 1 Open the file you made earlier called *Eclipse from Salem* using the **File>Open** command. After you have opened this file, don't start time moving forward, but leave it at 10:12.
- 2 Open a new window by choosing **File>New>New Viewer**, then choose **File>Save** and name the file *Eclipse from moon*.
- 3 Adjust this window's size and position onscreen so that you can see it and the "Eclipse from Salem" window that you previously created.
- 4 In the *Eclipse from moon* window type in a search for the moon. Open the contextual menu for the moon and select **Go There**. You should now be hovering above the moon. Open the contextual menu for the moon by right-clicking (**Ctrl**-click on the Mac) on it and select **Go There (Surface latitude...)**. Your viewing location is now the surface of the moon.
- 5 Do a search for Earth, then double-click on the entry for Earth to center on it.
- 6 Choose **File>New>New Viewer** to open a new window. Choose **File>Save** to save this file as *Eclipse from sun*.
- 7 Adjust this window's size and position so that you can see all three Starry Night windows.
- 8 In the *Eclipse From sun* window type in a search for the sun. Open the contextual menu for the sun and select **Go There**.

Open the contextual menu for the sun by right-clicking (**Ctrl**-click on the Mac) on it and select **Go There (Surface latitude...)**. Your viewing location is now the surface of the sun.

- 9 Still in this window, do a search for Earth, then double-click on the entry for Earth to center on it.
- 10 Now return to the “Eclipse From Salem” window and synchronize time in all three windows by choosing **Synchronize Times In All Windows** from the the date and time contextual menu in the toolbar. All three windows are now showing the sky at exactly the same time.
- 11 In the window “Eclipse From moon”, you should see the moon’s shadow projected on Earth’s surface. Use the **Zoom** buttons in the main sky window to zoom in to a field of view of about 1°. Adjust your view so that Europe is near the center of the screen. You should see a tiny black spot in the center of the shadow. This is the umbra, marking the area on Earth that is experiencing a total solar eclipse. The umbra should be close to Salem.
- 12 In the “Eclipse From sun” window, use the **Zoom** buttons to zoom in on Earth until you reach a field of view of about 17”. This should give you a nice view of the moon in front of Earth.
- 13 Start time running forward by pressing the **Forward** button in the time mode controls in any window. Time moves at the same rate in all three windows, and you can watch this eclipse simultaneously from all three locations.

Exporting Images

You may wish to capture a static image from Starry Night, for example, one of the spectacular eclipse images you viewed in the exercise in the previous section. To save a view from Starry Night



as an image, use Starry Night to set up the view you want, then select **File>Export Sky View>As Image** from the menu. This will bring up a familiar Save dialog box. A dropdown menu near the bottom of this dialog box allows you to choose the format for your new image. You can choose from jpeg, bitmap, pict, and many other popular image formats.

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

Export Images To Social Media

searchicon.png You can also share images directly to social media sites, such as Twitter and Facebook, by clicking on the Share button located to the right of the Search box in the toolbar.

Printing Color Images: Recall that the **File>Print** option in Starry Night prints negative images—black stars on a white background. If you want to print a color image, you can do this by using the **File>Export Sky View>As Image** command to save your color image. Then open this image with a program such as Internet Explorer and print the image using the **File>Print** command in the Internet Explorer menu.

Movies

You can make spectacular movies using Starry Night. You can record a graphically intensive event (such as a planet flyby) and play it back as a smooth animated sequence.

Movies are played back using your operating systems default movie viewer, so you can send them to your friends and colleagues. They need not have Starry Night to view the movies.

To make a movie, choose **File->Export Sky View->As Movie...** A dialog box will open that allows you to name your movie file and choose where to save it.

After you have named your file, a **Record** button (red circle) and **Stop** button (red square) appear on the bottom centre of the screen, along with instructions for recording your movie.

Movie Controls: There are three Movie controls: the Pause button, the Stop button, and the Record button.

The **Record** button starts recording a movie.

The **Stop** button completes the recording process.

The **Pause** button pauses the recording of the movie. This enables you to adjust your view "offscreen" between frames.

A new frame is added to the movie every time the screen is redrawn. Most changes you make in Starry Night cause the screen to be redrawn. Switching daylight on or off, changing the labels, and zooming in or out are just a few changes which will cause a new frame to be recorded.

Tip: Use the Pause button in the movie controls to make changes to your view "offscreen" without adding frames to your movie.

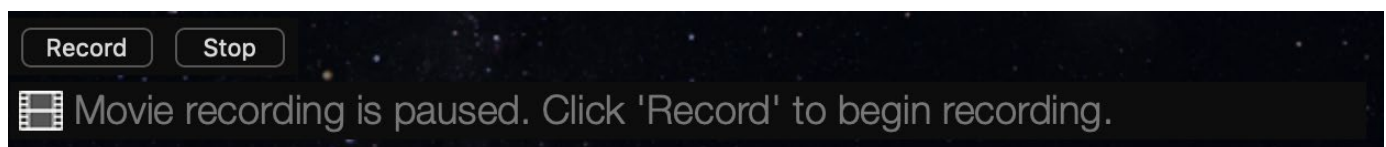
The screen is also redrawn whenever the time in Starry Night changes, causing new frames to be added to your movie. Therefore, if you have time running forward continuously before you begin making a movie, new frames will be added continuously every time the time changes. For this reason, it is often best to stop time flow before you make a movie. Once your view is set up properly, you can turn the flow of time back on.

When you are finished recording your movie, hit the Stop button along the bottom of the screen.

Note: Starry Night doesn't record cursors, so you don't have to worry about getting a "hand" in the shot.

Playing Back Movies

To play back a movie, double-click the file in the folder where you saved it. Starry Night does not need to be open when you play back the movie.



Copyright and Images

Screenshots: You have permission to use screenshots from Starry Night for noncommercial purposes, as long as you include the following credit:

*Graphics courtesy of Starry Night®
(Product Name) (Version Number) / Simulation Curriculum Corp.*

It is preferable to have the permissions credit included either in the image itself or in close proximity to it.

Movies: You have permission to use movies you have made with the Starry Night software for non-commercial purposes. Include the following credit:

*Graphics courtesy of Starry Night®
(Product Name) (Version Number) / Simulation Curriculum Corp.*

Publishing Star Charts Generated by Starry Night:

Individuals may use star charts generated by Starry Night in publications (books, periodicals, newsletters, etc.) provided a suitable copyright statement accompanies the chart(s).

*Star charts generated by Starry Night (Title of Program and Version Number) © Copyright Simulation Curriculum Corp. All rights reserved.
www.starrynight.com*

Note: Some of the photographs supplied with Starry Night are copyrighted and are redistributed by Simulation Curriculum with permission from the author or publisher.

AllSky CCD Image: Users of Starry Night Pro Plus should be aware that the AllSky CCD Image and Associated Data is © Main Sequence Software Inc. All rights reserved.

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Exporting Sky Data

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Selecting **File>Export Sky View>As Data** from the main menu creates a text file that contains data for all of the objects visible on the screen in Starry Night. You will be asked to name the file and choose a directory to save the file in.

The new text file only contains data for those objects displayed on screen, so you can use Starry Night's database controls and filters to create datasets for almost anything you can think of. A few examples:

- 1 All stars within 100 light-years of Earth.
- 2 All satellites above the horizon from your current location.
- 3 All open clusters in the NGC/IC catalog.

The key to creating any dataset is first to use the database controls to ensure that only the objects you are interested in appear onscreen (for example, if you want to create a dataset of bright stars, turn off all other databases).

In the text file that is exported, each type of object has different data fields.

For stars:

- 1 Tycho-2 catalog number
- 2 Hipparcos catalog number
- 3 Star name (may be a proper name, Bayer letter, Flamsteed number, or just the HIP or TYC number again)
- 4 Right ascension, in degrees (J2000 coordinates)

CONTINUES NEXT PAGE

- 5 Declination, in degrees (J2000 coordinates)
- 6 Apparent Magnitude
- 7 Parallax (milliarc seconds)
- 8 B-V color
- 9 Proper motion in the declination direction (milliarcseconds/year)
- 10 Proper motion in the right ascension direction (milliarc seconds/year)
- 11 Star variability (0 means the star is not variable, 1 means that the star varies by less than 0.06 magnitudes, 2 means that the star varies by between 0.06 and 0.6 magnitudes, and 3 means that the star varies by more than 0.6 magnitudes)
- 12 Proximity Flag (0 means that no other object in the Hipparcos/Tycho catalog is within 10 arc seconds of the object, while 1 means that there is at least one other object in the catalog within 10 arc seconds).

For planets, moons, comets, asteroids and artificial satellites:

- 1 Name
- 2 Right ascension (J2000 coordinates)
- 3 Declination (J2000 coordinates)
- 4 Distance (astronomical units)
- 5 Apparent magnitude
- 6 Angular size (arc minutes)
- 7 Percentage illumination
- 8 X coordinate in the heliocentric ecliptic coordinate system (astronomical units)
- 9 Y coordinate in the heliocentric ecliptic coordinate system (astronomical units)
- 10 Z coordinate in the heliocentric ecliptic coordinate system (astronomical units)

For objects in the “Messier” database, “Bright NGC Objects” database, or custom images:

- 1 Catalog number
- 2 Name
- 3 Right ascension (J2000 coordinates)
- 4 Declination (J2000 coordinates)
- 5 Type of object
- 6 Apparent magnitude
- 7 Diameter (arc minutes)
- 8 First alternate name or catalog number
- 9 Second alternate name or catalog number

For other objects:

- 1 Catalog ID (not the number of the object in the catalog, but the number of the catalog in Starry Night's list of catalogs!)
- 2 Catalog number (number of the object in the catalog)
- 3 Type of object
- 4 Name
- 5 Right ascension (J2000 coordinates)
- 6 Declination (J2000 coordinates)
- 7 Apparent Magnitude
- 8 Diameter (arc minutes)
- 9 Minor Axis (arc minutes)
- 10 Position Angle (radians)

Chapter 9

Adding Your Own Data

This chapter describes how you can expand the vast library of data that is built into Starry Night by adding your own data, or data from other sources, such as the Internet.

Adding Log Entries

See “Log Book” on page 103 for more information on adding log entries to objects.

Adding Objects 1 (Individual Solar System Objects)

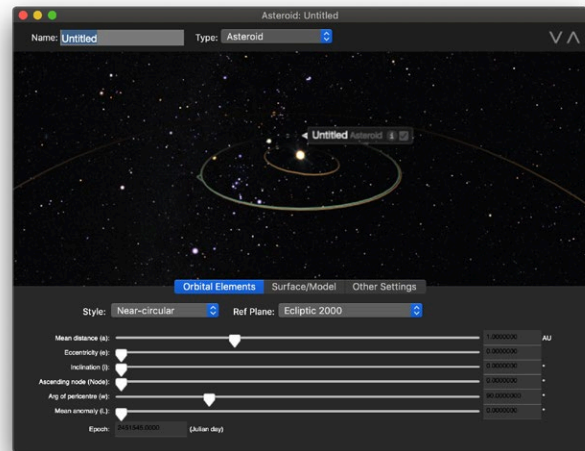
Starry Night makes it easy to add new objects within our solar system. You can add new comets, asteroids, satellites, planetary moons, and even imaginary new planets! You can also add surface maps and 3D modules to your new objects.

Tip: Any major new objects (comets, asteroids, satellites, planetary moons) will be automatically added to Starry Night via our automatic data update feature. You only need to add your own objects if they are not automatically added (or if you wish to create imaginary objects). See “Database Updates” on page 66 for more information about automatic data updates.

Adding your own objects to the solar system is a great way to learn about celestial mechanics. You can view the shape, size, and orientation of your new object's orbit, and use sliders to adjust all aspects of the orbit. This feature makes it clear what each particular orbital element means, and how the orbit is affected when adjustments are made.

To add a new object, first locate the parent body of your new object, either onscreen or using the **Search** Results pane. The parent body is the

celestial object that your new object will revolve around. If you are adding a new planet, comet or asteroid, the parent body is the sun. If you are adding a new moon, the parent body is the planet that this moon will revolve around. If you are adding an artificial satellite, Earth is the parent body. Once you have located the parent body, right-click on it (**Ctrl**-click on the Mac) to open its contextual menu. This menu will have options for adding new objects (**New Asteroid** and **New**

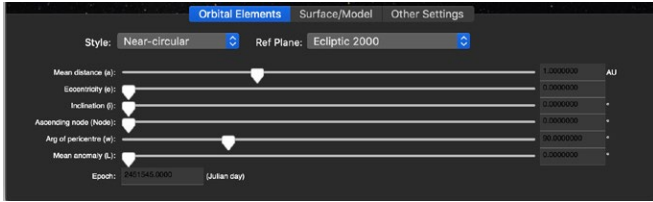


Comet in the sun's contextual menu, **New Satellite** in Earth's contextual menu, and **Add Moon Orbiting...** in the contextual menu of each planet). Clicking any of these options opens the Orbit Editor dialog box.

Tip: Not every option for adding new objects appears in an object's contextual menu. For example, the sun's contextual menu has no option to add a new planet. However, the Orbit Editor lets you change the type of object being added, so just choose **New Asteroid** from the contextual menu, and then change the type of object being added by using the Orbit Editor.

Orbit Editor: The Orbit Editor dialog box opens with a default view of your new object's orbit. Along the top of the dialog box is a dropdown

menu that allows you to choose the type of object (planet, comet, moon, artificial satellite, asteroid or planetoid) and a box where you can type in the new object's name.



Beneath these boxes is an image of your new object's orbit. This is actually not a static image, but a functional and resizable Starry Night window. By clicking and dragging the bottom right corner of this dialog box, you can enlarge the Orbit Editor dialog box, making your object's orbit easier to see. You can use the **Elevation** buttons in this dialog box to move closer or farther from your object, and use the Location Scroller to rotate your view of the object's orbit. As you change your object's orbit by adjusting its orbital elements (described in the following section), these changes will be reflected in the image.

Orbital Elements: The **Orbital Elements** tab controls the attributes of your new object's orbit.

A set of orbital elements provides enough information to specify an object's exact orbit about its parent body, and places the object at a specific point on this orbit at one moment in time. Kepler's laws of motion allow Starry Night to calculate the new object's position in its orbit at any other time. There are several different ways to specify a complete set of orbital elements. You can select one of these using the "Style" dropdown menu in the Orbit Editor dialog box.

Tip: The next few sections explain the meaning of each orbital element. However, another way to learn what each element means is to play around with the orbital element sliders. You'll quickly see how these changes affect the orbit of your new object.

Element Style (Pericentric): The pericentric style is usually used to specify the orbital elements of comets.

- **Eccentricity (e):** Eccentricity describes the shape of an object's orbit. The eccentricity of an object in a fixed orbit has a value between 0 and 1. The larger an object's eccentricity, the more its distance from its parent body varies throughout its orbit. Pluto has the largest eccentricity of any planet in our solar system. Objects in relatively circular orbits have eccentricities near 0, while objects in extremely elliptical orbits (such as many comets), have eccentricities close to 1.
- **Pericenter distance (q):** The distance between the object and its parent body at the point in the object's orbit where it is closest to the parent. Taken together, pericenter distance and eccentricity specify the distance between an object and its parent body at any point in the object's orbit. Pericenter distance is given in units of AU (astronomical units). For objects in orbit about the sun, such as comets, pericenter distance is also called perihelion distance.
- **Ascending Node:** This angular measurement specifies the point at which the orbit crosses northward through the orbit's reference plane (reference planes are described in "Reference Plane" on page 127), relative to the Prime Meridian of the parent body.
- **Argument of Pericenter:** Recall that the pericenter is the point in an object's orbit when the object is closest to the parent body. The Argument of Pericenter specifies the angular location of the pericenter, measured in degrees.

This value is determined by measuring the angle between the ascending node and the pericenter, as measured from the center of the parent body. For example, when the Argument of Pericenter is 0° , the pericenter occurs at the same place in an object's orbit

as the ascending node. That means that the object would be closest to its parent body just as it rises up through the reference plane. Likewise, when the Argument of Pericenter is 180° , the object, as it rises up through the reference plane, is at its farthest from its parent.

- **Inclination (i):** The orbit's elliptical shape lies in a plane known as the orbital plane. Inclination is the angle between the orbital plane and the reference plane, measured between 0° and 180° . Assume the reference plane is the parent body's equatorial plane. In this case, if the object's orbit lies in this plane, the inclination is 0° , and the object circles the parent body's equator. At an inclination of 90° , the orbit is perpendicular to the parent body's equator, and the object passes over the parent body's north and south poles. An inclination of greater than 90° describes a retrograde orbit.

Cool fact: *Spy satellites often have orbits with inclinations close to 90° . From this inclination, they can examine all parts of Earth as it rotates beneath them.*

- **Pericenter Time:** The preceding five orbital elements are sufficient to describe the orbit of a new object. However, a value for pericenter time is needed to determine an object's place on this orbital path at any time. The pericenter time is the time (expressed as a Julian day) when the object is at pericenter. Recall that Kepler's laws of motion then allow Starry Night to calculate the new object's position in its orbit at any other time.
- **Elements Epoch:** The date (expressed as a Julian day) for which this set of orbital elements will be most accurate. As you move farther away from this date, the accuracy of the object's position will decline, although the change in position is often too small to be noticeable. Nevertheless, for precise work, it is advisable to use a set of orbital ele-

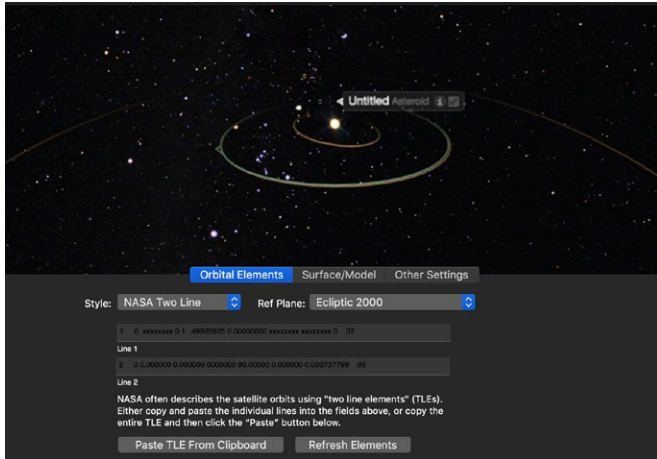
ments with an epoch relatively close to the date you are interested in.

Element Style (Near-Circular): The near-circular style is usually used to specify the orbital elements of planets, asteroids, and planetoids. Only those fields different from the pericentric style are described below.

- **Mean Distance:** Objects in circular orbits would travel at a constant distance from their parent body, but since most planetary orbits are slightly elliptical, the distance between an object and its parent is constantly changing. The common practice is to average this distance, and record it as Mean Distance. It is usually measured in AU's.
- **Mean Anomaly (M) and Epoch:** Together, these fields describe exactly where in its orbit a new object is located at the specified time. The "specified time" is the epoch (given as a Julian Day) and the position is the mean anomaly, the angle between the object's position and the pericenter of the object's orbit, as measured from the center of the parent body.

Tip: Notice that "epoch" has a different meaning in the pericentric and near-circular formats. In the pericentric format, changing the epoch will not change an object's position, but in the near-circular format, it will.

Element Style (NASA Two Line): NASA Two Line Elements (TLE's) are often used to describe the orbit of Earth-orbiting artificial satellites. Describing the TLE format is beyond the scope of this User's Guide. However, you do not need to understand TLE's to use them! If you find the TLE for a satellite, simply copy the element to your clipboard, then press the **Paste TLE From Clipboard** button. Starry Night will paste in the new elements. Not all of the fields in a TLE are used by Starry Night. Fields that are not used will be marked with 'xxx'.



Element Style (AMSAT): This is another style used to describe the orbit of Earth-orbiting artificial satellites. Again, describing this format is beyond the scope of this User's Guide.

Reference Plane: A set of orbital elements is not enough to describe an object's orbit without a reference plane. You can select a reference plane using the dropdown menu in the Orbit Editor dialog box.

For objects orbiting the sun (asteroids, comets, planets), the most useful reference plane is the ecliptic plane. For objects orbiting other planets (such as moons and artificial satellites), the most useful reference plane is the equatorial plane of the object's parent body. An astronomical reference plane is dependent upon the time of the observations. Starry Night allows you to choose any of the following reference planes:

- **Ecliptic:** An ecliptic reference plane based on the time of your current Starry Night window.
- **Ecliptic 1950:** An ecliptic reference plane based on the position of the ecliptic plane in the year 1950.
- **Ecliptic 2000:** An ecliptic reference plane based on the position of the ecliptic plane in the year 2000.

- **Equatorial:** An Earth equatorial reference plane based on the time of your current Starry Night window.
- **Equatorial 1950:** An Earth equatorial reference plane based on the position of Earth's equatorial plane in the year 1950.
- **Equatorial 2000:** An Earth equatorial reference plane based on the position of Earth's equatorial plane in the year 2000.
- **Planet Equatorial:** A reference plane based on the equatorial plane of the object's parent body and the time of your current Starry Night window.

Surface/Model Tab: On this tab, you can import a 3D model (supports .3ds models only) or create a surface for your new object by importing an image file. Click **Add Model** to select a .3ds model from your hard drive or **Download** to visit a website that contains additional .3ds models. Click the **Add Image** button to select an image file from your hard drive. The **Delete** buttons remove your custom model or image. This button will be greyed out if you have not yet added a custom model or image.

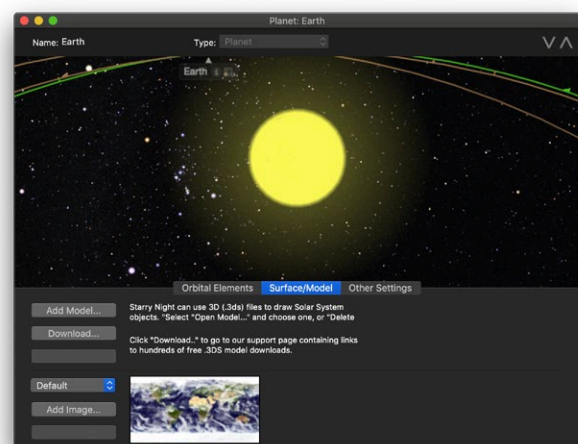
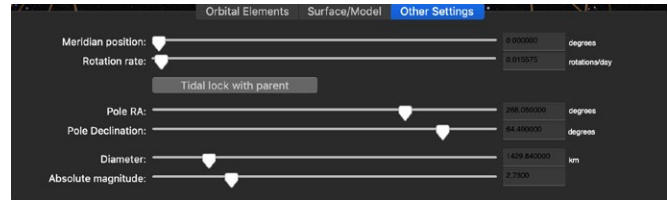


Image size and appearance: There is some restriction on image size. The maximum size is 1500 by 1500 pixels, while the minimum is 25 by 25 pixels. If the picture is too big or too small, your computer will beep twice and not allow the paste. We recommend using images that are about 600 pixels long by 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 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, look at the default images of the planets. These images can give you an idea of 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 object. The place on the object where the two sides of the image meet should now be seamless.

Other Settings: Using the sliders and data boxes in this tab, you can enter information about your new planet’s rotation rate, pole positions, diameter and absolute magnitude.



Meridian Position: Sets the position of the object’s prime meridian, in J2000 equatorial coordinates.

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

Tidal Lock With Parent: Over time, many objects in the solar system become gravitationally locked, that is, they keep the same face toward 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’s north pole, in reference to the Equatorial coordinate system.

Pole Dec: Sets the declination of the object’s north pole, in reference to the Equatorial coordinate system.

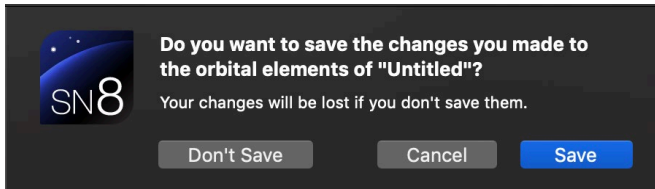
Diameter: Sets the diameter of your new object, measured in kilometers.

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

Absolute Magnitude: Sets the inherent brightness of your object.

Saving Changes: Once you have entered all of the data for your new object, close the Orbit Editor. A dialog box will appear, warning you that changes have been made to this database.

Note: Any new objects or changes you have made using the Orbit Editor are not permanently saved until you press the **Save** button in this dialog box!



If you now open the search results pane by clearing the search text box in the toolbar, you will see your new object listed in its appropriate place among the other solar system objects. You can now center on the object, turn on its orbit, or perform any of the other functions you can do with solar system objects in Starry Night.

Updating Data: To change any of the information for any new objects you have added with the Orbit Editor, open the object's contextual menu and choose **Edit Orbital Elements**. This reopens the Orbit Editor and allows you to make any necessary changes.

Example: Adding a New Planet

This example shows you how to use the Orbit Editor to add an imaginary new planet to our solar system.

- 1 Choose **File>New>New Asteroid Orbiting sun** from the main menu to open the Orbit Editor dialog box.
- 2 Change the object type to "Planet" and name the new object "Planet X".
- 3 The orbit of your new object is shown in red. Use the **Increase Elevation** button in the Orbit Editor dialog box to rocket out to an elevation of about 25 AU's. The outermost brown orbit which you can see is the orbit of Jupiter.
- 4 Use the Mean Distance slider in the orbital elements section of the Orbit Editor to increase your planet's mean distance to about 20 AU's. As you do this, the red orbit that marks your planet will get larger, eventually encompassing the orbit of Jupiter.
- 5 Close the Orbit Editor window by pressing **Save**.
- 6 Open the search results pane by clearing the search text box. You should see "Planet X" listed just underneath Jupiter. You can now center on Planet X, turn on its orbit, or perform any of the other functions you can do with planets in Starry Night.

Adding Objects 2 (Multiple Solar System Objects)

The Orbit Editor is handy when you want to add one or two new objects. However, it is cumbersome to add large numbers of objects (for example, a set of dim asteroids). To add multiple comets, satellites or asteroids, the best approach is to manually edit the comet, asteroid and satellite files.

The data for these objects is stored in the files "asteroids.txt", "comets.txt" and "satellites.txt", which are all located in the "/Users/<username>/Library/Application Support/Simulation Curriculum/Starry Night 8 Prefs/Sky Data" folder (on the Macintosh), and "\Users\<YourUserName>\AppData\Local\Simulation Curriculum\Starry Night 8 Prefs\Sky Data" (on Windows).

You can open these files with a text editor and copy and paste orbital elements for new objects. This would be of use if you wanted a larger satellite database (for example) than the version in Starry Night's "satellites.txt" file.

If you do plan to edit text files directly, make sure you have the "Automatically check for updates"

option in the **Startup** tab of the Preferences dialog box unchecked, because the automatic update will wipe out any data you have added to these files. Editing these data files is only recommended if you want to add a large number of objects. If you only want to add one or two objects, consider using the Orbit Editor instead.

Adding Objects 3 (Stars)

PRODUCT SPECIFIC FEATURE

PRO PLUS ✓ **PRO** ✓ ENTHUSIAST —

More than 16 million stars are included in Starry Night with the initial default installation. However, for some observers, this will not be enough! If you are using a CCD camera to capture images of the night sky, you will be able to take images with stars that are dimmer than the dimmest stars in Starry Night (the dimmest stars are about magnitude 14.5). For this reason, Starry Night includes online access to the USNO star catalog, a database of 500 million stars, as dim as 21th magnitude. The entire database would occupy about 15 CDs, so Starry Night allows you to download data for only the region of sky that you are interested in.

Downloading stars from the online star database works in this manner:

- 1 Center on the area of sky you are interested in and zoom in. You need to select a relatively small section of the sky (i.e. a small field of view). Otherwise, the star file would be too large to easily download.
- 2 Make sure **Automatically Download Data** is selected in the **Help** menu. Starry Night will begin downloading the appropriate star file. Each file will vary in size from about 100 kilobytes to 1.5 megabytes. Once the file is downloaded, you will see the new stars on your screen. The downloaded star files are now a

permanent part of your database, and will be present every time you run Starry Night in the future.

Automatically Download Data: If you choose **Help>Automatically Download Data** from the main menu, Starry Night will automatically download the appropriate star data files from the Internet whenever you zoom in to a small enough field of view. Only select this option if you have a fast connection to the Internet while you are running Starry Night!

Deleting Downloaded Star Data: Starry Night saves all star data that you have downloaded from the Internet on your hard drive, so the stars will be present every time you run the program (you do not need to download the files again). If you wish to delete these downloaded star data to free up space on your hard drive, choose the **General** tab in the Preferences dialog window and press the **Clear Star Cache** button.

Adding Objects 4 (Databases)

PRODUCT SPECIFIC FEATURE

PRO PLUS ✓ **PRO** ✓ ENTHUSIAST —

You can do more than add individual objects to Starry Night, you can add entire databases! In fact, many of the databases described in "Databases 4 (Other)" on page 65 were originally created by Starry Night owners. The recipe for creating a custom database is simple:

- 1 Create a plain text file in the approved format (see below for format examples).
- 2 Run Starry Night and choose **File>Build Data File** from the menu. A dialog box

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will open that prompts you to choose a file. Select the original text file from your hard drive. Starry Night will build a new data file based on your text file. This data file will be optimized for the rapid access the program needs to quickly plot out the thousands of objects displayed onscreen. If your original text file was not in the correct format, Starry Night will display an error message at this stage.

- 3 Once the data conversion process is complete, Starry Night will prompt you to name the new data file and save it to your hard drive. By default, the new data file will be saved in the same folder as your original text file. Change this so that the new data file is saved to your “/ Simulation Curriculum/Starry Night 8 Prefs/Sky Data” folder.
- 4 Exit and restart Starry Night. Open the **Options** search results pane. Your database will be listed, in the “Options for Other Objects” layer.

Once you have created a database, all of the regular database options can be used to control the display of your database. In addition, you can use the search text box to locate any object in your database, and open the **Info Window** for any object to get more information.

Database Format Examples: The “Extra Databases” folder on the Starry Night DVD (also available on our online Knowledge Base) contains several sample text files. Each file is in the proper format for Starry Night’s **Build Data File** command to build a database. The file “Simple.txt” shows a very basic database, while the file “NGC/IC.txt” shows the actual text file which was used to create an older version of our NGC/IC database. This file

is extensively commented, to help you understand exactly what each section of the file is used for. You should look at the “NGC/IC.txt” file before attempting to build your own database. A few highlights of building databases are described below.

Basic Fields: For every object in your database, you can enter the following information fields: catalog number, catalog kind, magnitude, kind, right ascension, declination, and name. See the “NGC/IC.txt” file to learn the meanings of each of these fields. The magnitude and name fields are optional—if an object does not have a known value for one or both of these fields, just leave the field blank. The other fields are mandatory.

Optional Fields: You can add up to 8 additional information fields for your database. These fields will then appear in Starry Night’s **Info Window** for every object in your database. Different databases will have different information fields. Certain optional field labels have specific meanings, and are actually used by Starry Night when it draws your object onscreen. For example, Starry Night can use the optional field “Diameter” to draw your object a specific size. See the “NGC/IC.txt” file for more details.

Object Symbols: For each type of object in your database, Starry Night can show a different symbol onscreen, in the color of your choice. For example, a database of galaxies might be represented onscreen with yellow symbols to mark spiral galaxies, and red symbols to mark elliptical galaxies. Yellow triangles might mark barred spiral galaxies, while yellow circles mark unbarred spiral galaxies. You can use Starry Night’s built-in symbols, or you can create your own symbols.

User Images

PRODUCT SPECIFIC FEATURE

PRO PLUS ✓ **PRO** ✓ **ENTHUSIAST** —

Starry Night lets you add images of any area of the night sky. You can use your own images, or download them from the Digitized Sky Survey or any other Internet site.

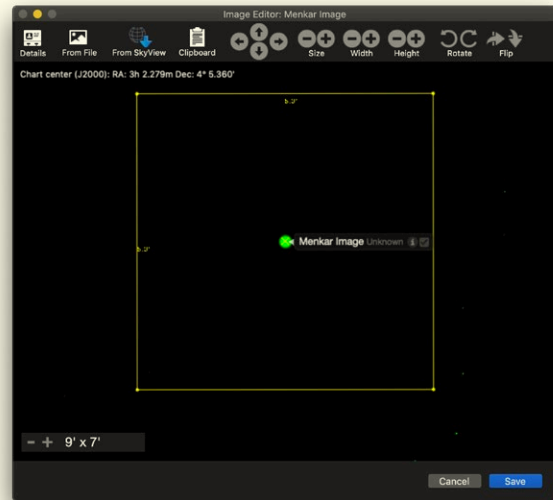
Note: This section covers adding images for objects that do not already have an image in Starry Night. To modify the images of objects that already have images (planets, moons, Messier objects, etc.), see “Modifying Images and Models” on page 138.

Adding Your Own Images: You can add any image on your computer’s hard drive to Starry Night. If you want to add an image from an Internet site, first save this image to your hard drive. Once the image that you want to add to Starry Night is on your hard drive, follow these steps:

- 1 Right-click (**Ctrl**-click on the Mac) on the object or area of the sky where you want to add your image. For example, assume you want to add an image of the globular cluster NGC 5466. You would first find NGC 5466 onscreen, and then right-click (**Ctrl**-click on the Mac) on it.

Tip: It is also possible to add images that cover more than one object, for example, a wide-field image that includes several galaxies and nebulae. Just right-click (**Ctrl**-click on the Mac) on any of the objects that appear in the image, and choose **Add Image** from the object’s contextual menu. You can then use the Image Editor controls (described in the next section) to line up your image correctly.

- 2 Choose **Add Image** from the object’s contextual menu. This opens the Image Editor dialog box.



- 3 Click the **From File** button or the **Clipboard** button. The **From File** button allows you to select an image from your hard drive, while the **Clipboard** button will paste an image that you have copied to your clipboard. Once you have selected the image, press **OK** and your image will be pasted into the Image Editor window.
- 4 Align the image using the controls available in the Image Editor. There are controls for sizing, shifting, flipping, and rotating the image as needed. All of these controls are described in “Image Editor Controls” on page 135. All nearby stars from Starry Night’s databases appear in green, making it easier to visually align your image with any stars that might be in it.
- 5 Once your image is aligned, press the **Details** button in the upper left corner of

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the window. This opens a dialog box which lets you name your image and add other optional information, such as picture source, notes, object kind, magnitude, and distance.

- 6 The Image Editor window also has a Background Reduction box (the box only becomes visible after you have pasted in an image).

Background reduction

This box allows you to reduce the brightness of an image. If you have an overexposed image, placing it into Starry Night will often result in an unattractive, “boxy” look where the edges of your image contrast greatly with the black background sky. Reducing the image brightness using this box can eliminate this problem. Once you have adjusted your image brightness and entered all relevant information, press **Save** to exit the Image Editor.

Adding Images from SkyView: You can use Starry Night’s web link to Digitized Sky Surveys to download and paste in images of galaxies, nebulae, or any other objects. See “Downloading Photographic Images” on page 60 for more about Digitized Sky Surveys.

To add an image from a Digitized Sky Survey:

- 1 Right-click (**Ctrl**-click on the Mac) on the object of which you would like to download an image.
- 2 Choose **Add Image** from the object’s contextual menu to open the Image Editor. Starry Night will have automatically guessed at the area of the sky for which you wish to download an image, based on the size of the original object you selected. This area will be marked with a yellow square. In most cases you will not need to change this, but you can enlarge, shrink or shift the image bounds if you wish, using the Image Editor controls, described in “Image Editor Controls” on page 135.
- 3 Click the **From SkyView** button. Select “DSS” from the menu. Starry Night will begin downloading the DSS image. This may take a few minutes, depending on the server load. Once the image is downloaded, it will appear in the Image Editor dialog box.
- 4 The image should automatically be aligned with the background stars. If for some reason, it is not perfectly aligned, you can align the image using the Image Editor controls.
- 5 When you are satisfied that your image is correctly aligned, press the **Details** button in the upper left corner of the window, to add an image name, add other information, and use the Background Reduction box (if necessary). Then press **Save** twice to exit the Image Editor.

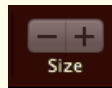
Note: *Downloading images from Digitized Sky Surveys is not the same as downloading star data from the Internet (discussed in “Adding Objects 3 (Stars)” on page 133). When you down-*

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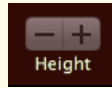
load star data, each star can be selected as an individual object in *Starry Night*. When you download a sky survey image, the individual stars in this image cannot be selected, and no information can be obtained about them from the program.

Image Editor Controls: The **celestial sphere** is an imaginary globe that encloses Earth. We can imagine that all the stars, planets, and other celestial objects are painted onto the inner surface of this sphere. Adding an image to *Starry Night* means painting a new image onto the inner surface of this sphere. The following Image Editor controls affect the placement of your image on the celestial sphere:

Size: Increases or decreases the area that your image occupies on the celestial sphere.



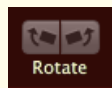
Height: Increases or decreases the vertical extent of your image on the celestial sphere, while leaving the horizontal extent unchanged.



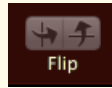
Width: Increases or decreases the horizontal extent of your image on the celestial sphere, while leaving the vertical extent unchanged.



Rotate: Rotates the position of your image on the celestial sphere in a clockwise or counterclockwise direction.



Flip: Flips your image horizontally or vertically relative to the background stars.



Slide: Slides the position of your image on the celestial sphere horizontally or vertically.



Zoom: This control does not affect the placement of your image on the celestial sphere, it simply zooms your view in or out. If you used the Image Editor to increase or decrease the area of your image, you may need to use these **zoom** buttons to see the full extent of your image.



Accessing Your Images: All images that you add go into a new database called “User Images”. You control this database by using the “User Images” options in the Deep Space layer of the **Options** search results pane. As with all other databases, you can turn the database on/off, or search for specific objects in the database.

Note: Images that you have added are mapped onto a section of the celestial sphere, not to a particular object. For example, assume you have added a new image that shows an NGC object. You would turn this image on/off by using the “User Images” options in the **Options** search results pane, not the “NGC/IC” options.

Editing Your Images: You can modify any of your custom images at any time. Locate the image onscreen and right-click (**Ctrl**-click on the Mac) on the image to open its contextual menu. Choose **Edit Image** to open the Image Editor. You can adjust the existing image, or press the **Clear Image** button to add a completely new image.

Tip: It is easier to open an image's contextual menu if you turn off every database in the **Options** search results pane except “User Images”. Otherwise, you may find *Starry Night* opening the contextual menu for an object, instead of the menu for its image.

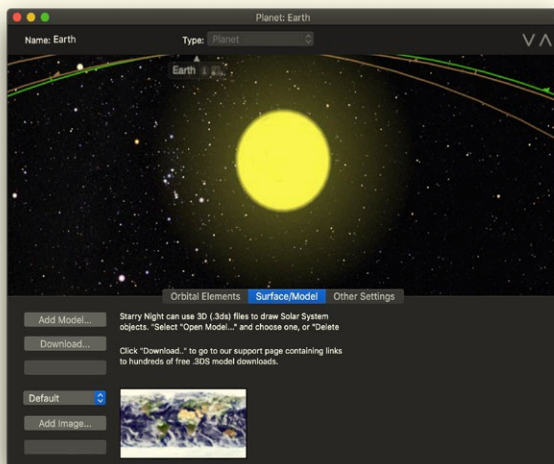
Modifying Images and Models

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It is possible to replace any of the built-in images and models in Starry Night with images or models of your own. The images you can replace fall into two categories: objects in our solar system, and deep space objects in the “Messier” and “Bright Objects” databases. The models you can replace fall only into the solar system category.

Solar System Objects: To modify the image or model of any object in our solar system, right-click on the object (**Ctrl**-click on the Mac) to open its contextual menu. Choose **Surface Image/Model>Add/Edit** from the menu.



The dialog box that opens has exactly the same controls as the **Surface Image/Model** tab in the Orbit Editor, which you use to add surface

images and models for new solar system objects. See “Surface/Model Tab” on page 138 for information on these controls.

For some objects in our solar system, such as the moon, Earth and Mars, you have an option of planetary textures. To select a default texture for an object, use the dropdown menu above the **Add Image** button.

Messier and Bright NGC Objects: You can modify any of the images in Starry Night’s “Messier” and “Bright NGC Objects” database of deep space objects by performing the following steps (see “Messier Objects” on page 64 and “Bright NGC Objects” on page 64 if you have forgotten which objects are included in these databases):

- 1 Right-click (**Ctrl**-click on the Mac) on the object whose image you want to replace.
- 2 Choose **Edit Image** from the object’s contextual menu.
- 3 Press the **Clear Image** button to clear the existing image.
- 4 Press the **From File** button to select an image from your hard drive, or the **From SkyView** button to download an image from a Digitized Sky Survey.
- 5 Position and size your image correctly using the Image Editor’s controls.
- 6 Click **Save**.

Note: Use caution when replacing these images. Once you replace an image, you cannot return to the original image without reinstalling Starry Night.

Custom Horizons

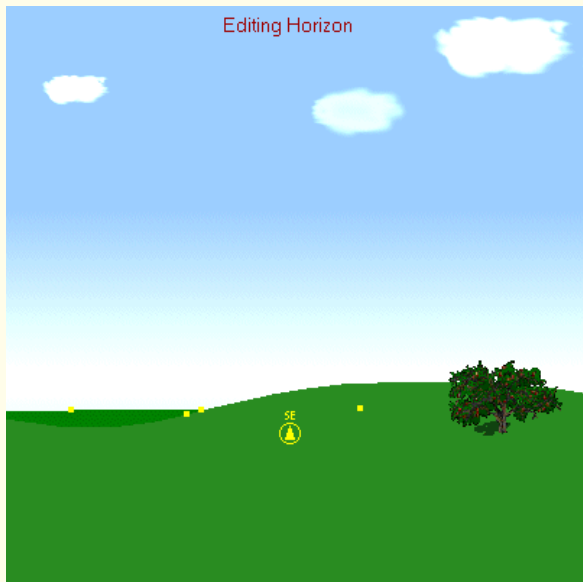
PRODUCT SPECIFIC FEATURE

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To make your viewing experience even more realistic, you can modify your surroundings in Starry Night to more closely resemble the area in which you live.

To modify the scenery set:

- 1 Open the **Options** search results pane, expand the Local View layer and open the Local Horizon Options dialog box.
- 2 Check the box marked “Custom” and then close the dialog box.
- 3 Choose **Edit>Edit Custom Horizon** from the main menu.



- 4 A series of yellow squares, or nodes, appear on the far and near horizons. If you click and drag a node, you can adjust the topography of the landscape in the current view. You can also click on any of the trees along the horizon, and drag them. This will change their size and/or position.

- 5 When you are finished editing the horizon, select **Edit>Edit Custom Horizon** again. A dialog box will appear, telling you that changes have been made to the horizon and asking if you want to save these changes. If you are satisfied with the changes, select **Save**.

Photorealistic Horizons

One of the exciting features of Starry Night is the ability to simulate your local landscape by adding 360 degree photos of your own backyard and favorite observing sites. By default Starry Night comes with several photorealistic horizons that you can use when viewing from the Earth. Visit <http://www.astronomy.support.com> for instructions on how to add your own custom horizons!

Not only can you make your own photorealistic horizons for Earth, but also for any planet and many moons in the solar system.

If you'd like to share your own photorealistic landscape with other Starry Night users, you can submit your final work to us.

Customizing the Favorites Menu

You were introduced to the **Favorites** menu in “The Favorites Menu” on page 120. Recall that this menu is a quick shortcut to a selection of pre-made Starry Night files. The options at the top of this menu allow you to customize this menu and add your own files. This can be particularly effective if you are giving a lecture or presentation and need to open a lot of files in a short period of time.

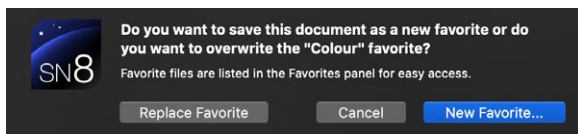
Adding new files or folders: To add a new file to the **Favorites** Favorites search results pane, set up a scene in Starry Night, exactly as if

you were creating a new file (see “Example: Creating Files” on page 119 if you are not familiar with creating Starry Night files). Then choose **Favorites>Save Favorite** from the main menu. The Favorites search results pane will open and prompt you to name your file. From now on, your file will be listed at the bottom of both the **Favorites** menu and the **Favorites** search results pane, and can be opened in the same fashion as any other file in these menus.

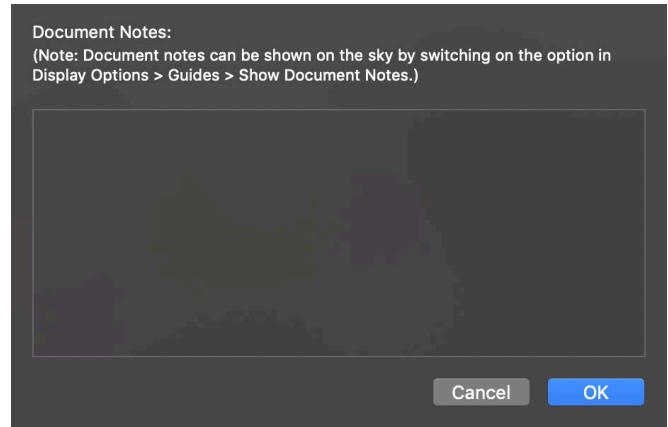
If you plan to add a lot of files to the **Favorites** menu, you may wish to create folders within this menu to subdivide your files and make them easier to retrieve. To do this, choose **Favorites>Add Favorite Folder** from the main menu.

Files and folders in the **Favorites** search results pane are “drag and drop”, so it is easy to move them around and arrange them in the order you prefer.

Modifying files: You can modify any of the files listed in the **Favorites** menu. To modify a file, first open the file, from the **Favorites** menu, or the **Favorites** search results pane. Next, modify the file in any fashion using the Starry Night controls. Finally, choose **Favorites>Save Favorite** from the main menu. A dialog box will appear, asking you if you wish to overwrite the existing file. Choose **Replace Favorite** to overwrite the existing file.



Adding notes to files: You can add personal text notes to any file in the **Favorites** search results pane. Open the **Favorites** file you want to add a note to and select **File>Edit Document Notes**.



Use the text box to enter any additional information about the file. Then click the **OK** button. To attach and save your note to the file, you must resave the file from the **Favorites>Save Favorite** menu.

A small info icon will then appear to the left of the file name in the **Favorites** pane. Click this icon to read your notes. If you wish to edit the note you added, select **File>Edit Document Notes** and resave the file to make the changes permanent.

Custom Asterisms

Different cultures see the stars in different ways, joining them together to form recognizable patterns. Each one of these patterns is called an **asterism**. While today, the stick figures for the 88 “official” constellations are the best-known set of asterisms, many other sets exist. Even for the 88 “official” constellations, there is more than one way to draw the stick figures. Starry Night makes it possible for you to create your own set of custom asterisms. To create a new set of asterisms, you need to create a plain text file in the proper format, and save this file in your “Simulation Curriculum\Starry Night 8 Prefs\Sky Data\Asterisms” folder. The next time you run Starry Night, open the **Options** search results pane and expand the Constellations layer. Open the Constellation Options dialog box. Your new set of asterisms will be listed alongside the other sets of stick figures.

To see the format for an asterism file, open the text file “Oriental Moon Stations.txt” in your “Starry Night\Sky Data\Asterisms” folder. This is the exact file which Starry Night uses to render the Oriental moon station set of stick figures onscreen. The format is quite straightforward. You need to specify a name for your new set of asterisms (for example, “Oriental Moon Stations”).

For each asterism in this set, you need to enter the asterism's name, the approximate position in the sky of the asterism's center, and each of the lines between stars that define the shape and size of this asterism.

Note: *If you create a new set of asterisms and would like to share it with other users, please contact us at <http://astronomysupport.com>. We would love to have a reference set of files that depicts the figures of many cultures!*

Backing Up Custom Data

You may wish to back up your custom data in case of a computer problem. If you ever change computers, you will also need to move this custom data. This section outlines where each piece of custom information is stored, so you will know which files you need to back up

Windows/Mac File Structure Differences:

Most custom data is stored inside the “Starry Night 8 Prefs” folder. On Windows, the “Starry Night 8 Prefs” folder is inside the “C:\Users\\AppData\Local\Simulation Curriculum\” folder. On the Mac, the “Starry Night 8 Prefs” folder is inside the “User/Library/Application Support/Simulation Curriculum” folder.”

Settings Files: If you have customized your settings, using the menu option **Options>Save Current Options as Default**, these changes will be saved in the file “Default Settings.sno” in the “Starry Night 8 Prefs\Options>Save Preset... command to create additional settings files, these files (including your print settings) will be saved in the “Starry Night 8 Prefs\View Options” folder.

Objects Added With the Orbit Editor: The “User Planets.ssd” file in the “Starry Night 8 Prefs\

Objects Added By Modifying Text Files (Satellites, Comets, Asteroids): These objects are stored in the files “Satellites.txt”, “Comets.txt”, and “Asteroids.txt”, all in the “Starry Night 8 Prefs\Sky Data” folder.

Databases: Any databases you have added will be stored in the “Sky Data” folder. For example, a database named “Spacecraft” would be saved as the file “Spacecraft.ssd”.

Modified Images: If you have modified any images of solar system objects by pasting in new images, these images will be saved in the “Starry Night 8 Prefs\Sky Data\Planet Images” folder under the object's name. For example, a modified image of the sun will be saved as “sun.pct”. “If you have modified images in the “Messier” database, the text file named “Messier Objects.txt” and “Bright NGC Objects.txt” in the “Sky Data” folder contain information on the size, name and position of all images you have modified. The folders “Sky Data\Messier Objects Images” and “Sky Data\Bright NGC Objects Images” contain the actual image files.”

Custom “Favorites” Files: These files are stored in the “Documents\Starry Night” folder.

Custom Asterisms: New asterism sets are stored in the “Starry Night 8 Prefs\Sky Data\Asterisms” folder.

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FOV Indicators and Equipment List: If you have added any new field of view indicators or created an equipment list (see “Field of View Indicators” on page 103 for more information), these indicators will be saved in the “Starry Night 8 Prefs\Equipment” folder.

Stars: Stars downloaded from the online star database will be saved in the “Starry Night 8 Prefs\Sky Data\USNO” folder.

User Images: The text file named “User Images.txt” in the folder “Sky Data” contains information on the size, name and position of all new images you have added. The folder “Sky Data\User Images Images” contains the actual image files.

Custom Horizons: Changes to the custom horizon profile are saved in the file “Earth.txt” in the “Starry Night 8 Prefs\Sky Data\Horizons” folder. New photorealistic horizon panoramas are saved in the “Starry Night 8 Prefs\Sky Data\Horizon Panoramas” folder.

Observing Lists: Lists created in the Observing Lists pane are saved and backed up to the LiveSky server. You can also view them on LiveSky.com using your free account.”

Object Log Entries: New Observations (Log Entries) are also saved and backed up to the LiveSky server. You can view them on LiveSky.com using your free account.

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Chapter 10

Starry Night Pro Plus

This chapter describes exclusive features available only in Starry Night Pro Plus.

These exclusive features include:

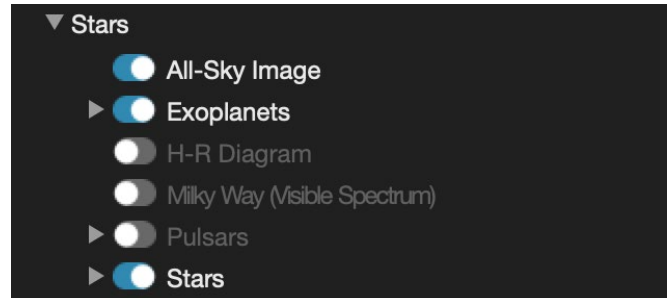
- 1 AllSky CCD Mosaic
- 2 AllSky Options
- 3 AllSky Frequently Asked Questions
- 4 Sky Survey Images
- 5 Planetary Texture Collection
- 6 Nebula Outlines
- 7 MaxIm DL Plug-In (Windows only)

AllSky CCD Mosaic

Have you ever wondered what it would be like to have an interactive, full-color photographic star atlas fused with a powerful desktop planetarium? Starry Night now offers you the most realistic rendition of the night sky by presenting you with the AllSky CCD mosaic of the sky that can be viewed from any location on Earth. The full-color AllSky image is precisely aligned to the Starry Night computer generated stars and databases.

We have named this image 'AllSky' because it provides uniform coverage from pole to pole — the whole sky is a single picture. See the entire Milky Way in exquisite detail and then zoom in to explore dust lanes and nebulae. Why have dots and circles if you can see an actual photo of a star or deep sky object! Exploring the night sky has never been this much fun.

Turning on the AllSky image: Open the **Options** search results pane and expand the Stars layer. You can also type “allsky” in the search text box. Click on the “AllSky Image” checkbox to turn it on.



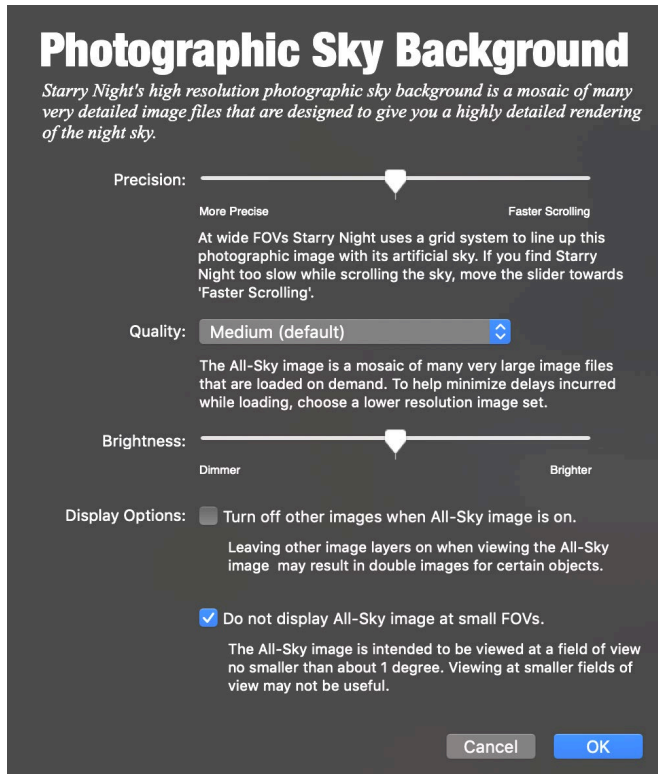
Note: Turning on the AllSky image will turn off all other image databases by default. The AllSky image is overlaid on top of the computer generated stars. This allows you to see an actual photographic image of the stars while still being able to place your cursor on top of any star and identify it.

Tip: The AllSky image presents the entire sky as a full-color, seamless mosaic, and at several resolution levels (5 in all). As you zoom in, a message appears on the upper right corner of the main window informing you that a new image is being loaded in. As you scroll to adjacent areas in the sky, new images are loaded at a resolution level dependent on your zoom (field of view).

AllSky Options

Click on the “AllSky Image” name in the pane to open a dialog box with options for the AllSky image.

Precision: At wide fields of view, Starry Night uses a grid system to line up the AllSky image with the computer generated stars. Moving the Precision slider toward “More Precise” provides a better match between the photographic stars in the AllSky image and the computer generated stars. This takes more processing power. If you find



Starry Night slow while scrolling the sky, move the slider toward “Faster Scrolling”.

Quality: The AllSky image is a seamless mosaic of many large image files that are loaded in on demand when you zoom in or scroll around the sky. To help minimize delays incurred while loading, you can select a lower resolution image set. Each step up in quality doubles the pixel resolution of the image. The High quality option, will only be available if your video card has 96 MB of VRAM and higher.

Brightness: Use the brightness slider to adjust the brightness of the AllSky image.

Display options: Allows you to turn off other images when the AllSky image is on. This will eliminate a ‘double image’ effect. You can also select to not display the AllSky image at fields of view of less than one degree.

Note: The AllSky is a static image. We do take into account precession so that the AllSky photographic stars match the computer generated stars. Unfortunately, the AllSky image cannot

show the proper motion of the stars. For dates far into the distant past or future, the stars in the AllSky image might not match the computer generated stars, which do take into account proper motion.

AllSky CCD Mosaic Frequently Asked Questions

Other planetarium programs present images of certain deep-sky objects, or allow you to click on an object to see a picture. Is Starry Night the same?

The AllSky image in Starry Night presents the ENTIRE sky as a full-color, seamless mosaic, and at several resolution levels dependent upon your zoom setting. An important advantage of this is the consistent resolution, color and depth of coverage, eliminating the uncertainties of comparing images from many and varied sources. And navigating your way around, or zooming in or out, is only a mouse click away.

Starry Night is the world's only available fully interactive, image-based digital sky atlas/planetarium software.

What is the AllSky image quality like?

It is very good! Of course there are unavoidable limitations, which become apparent mainly when zooming in to near 0.5 degrees, the smallest field-of-view setting. In order to make the image database manageable it had to be compressed. We developed a proprietary compression scheme which preserves much of the original image quality, but when zoomed in enough the compression artifacts do start to show up. Remember, you have the entire sky at your disposal, and it's found on one DVD.

How faint can I see?

The stellar limiting magnitude is approximately 14. Although we have seen fainter stars—almost

15th magnitude—we have chosen to be conservative in our claims. Since *Starry Night* is comprised of real images taken under varying conditions, the actual stellar limiting magnitude can vary somewhat. However, in the process of equalizing the imagery for the mosaic, limiting magnitude differences have been reduced to less than those apparent in many published photographic atlases.

How well do small objects like galaxies appear in *Starry Night*?

The native resolution of the original images is 12 arc seconds per pixel. This sampling rate allowed us to fit all the sky image data on one DVD, while still showing a tremendous amount of detail in deep sky objects. For example, there is enough resolution to show structure in the larger showpiece galaxies. Indeed, the recorded detail in most “fuzzies” such as galaxies and nebulae requires 6 to 10-inch (15 to 25 cm) apertures to see visually.

Starry Night Pro Plus, as it is, is pushing the limits of modern computer technology commonly found at home. Had a finer resolution setting been used, the volume of data would have ballooned to unmanageable levels. That would have made scanning around the sky, currently so easy with *Starry Night*, frustratingly slow.

How far can I zoom in and out?

The widest view possible is 180 degrees, which is imposed by the projection currently used. This is equivalent to the amount of sky visible above an obstruction-free horizon, or one-half of the entire celestial sphere. The closest you can zoom in to is a 0.5 degree high field of view—at typical monitor screen sizes, this is equivalent to viewing a globe of the sky about 240 feet (75 meters) in diameter!

How well does the imagery show double stars?

At the imaged resolution of 12 arc seconds per pixel, two faint stars separated by this amount would appear as an elongated blob. In actuality, star images occupy at least a few square pixels in area, so the closest resolvable pair would be nearer to 20 arc seconds.

Can I adjust the view in order to simulate what I might expect to see in my telescope?

You can adjust the brightness of the AllSky image to quite closely mimic a telescopic view. And when you take *Starry Night Pro Plus* outside with your telescope, switch to night vision (red) mode to preserve your dark adaptation.

Can I capture images of the sky display for use elsewhere?

You can export areas of interest as an image by selecting **Export Sky View>As Image** from the **File** menu. You can save the image in a number of popular image formats.

Tip: To make photo-based printouts for field use, simply invert the captured image, convert it to grey scale and send it to your printer.

Does the AllSky image take into account precession and proper motion?

The AllSky is a static image. We do however take into account precession so that the AllSky photographic stars match the computer generated stars.

Unfortunately, the AllSky image cannot show the proper motion of the stars. For dates far into the distant past or future, the stars in the AllSky image might not match the computer generated stars, which do take into account proper motion.

Can you tell me more about the AllSky Image and how it was created?

The story begins in the Arizona desert. Three friends were discussing the possibility of photographing the entire Milky Way. Their conversation progressed... "Why stop there?" One suggested. "If you're going to image the Milky Way you might as well get the whole sky." It took five full years for the AllSky image to become a reality.

Peter Ceravolo, Douglas George, and Dr. Mitchel Savere were those three friends and they spent three years traveling all over Earth photographing the night sky with 'Dorothy', their scientific grade, custom built AP9E CCD camera.

It took over 20,000 individual CCD images to create a composite image that met their expectations.

The dust devils, cloudy weather, and traveling around the globe proved to be the easiest part of their adventure. When the time came to process the AllSky image, 10,000 hours alone were spent rating the brightness of the photos!

*'Dorothy', a custom built AP9E CCD camera.
Dr. Mitchel Savere, Douglas George and Peter Ceravolo on an imaging run with 'Dorothy'.*



Sky Survey Images

Sky Survey images from Planck, IRAS-COBE and 2 Micron reveal a dramatically different view of our sky and even let you explore the relic radiation left over from the Big Bang.



InfraRed 2 Micron: This 2MASS survey image uses near-infrared light at wavelengths longer than that of visible light. At these wavelengths, clouds of dust that obscure our view of more distant stars in our Milky Way galaxy become increasingly transparent. As a result we can see all the way to the very center of the galaxy, showing its overall structure far more clearly than is possible in visible light.



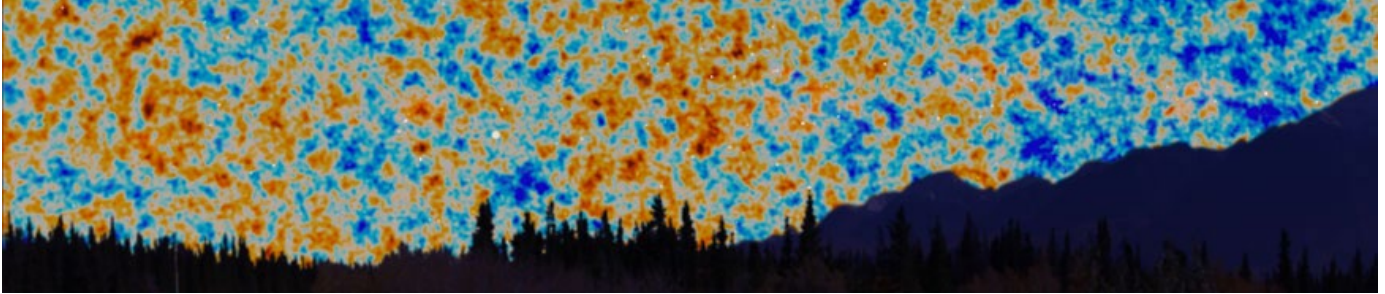
IRAS-COBE Galactic Dust (Color): This image shows the dramatically different view of our sky when viewed in far infrared light. The dust in the Milky Way is mostly distributed in a disk that is very thin. This bright narrow band shows most of the dust in our galaxy. The fainter filaments above and below this disk represent only the very closest dust clouds as seen from our vantage point in the middle of this disk.

Tip: Clicking on the name of a sky survey image opens a dialog box that lets you adjust the brightness of the image.

Planck CMB

This map shows the oldest light in our universe, as detected with the greatest precision yet by the Planck mission. The ancient light, called the cosmic microwave background, or CMB, was imprinted on the sky when the universe was 370,000 years old. It shows tiny temperature fluctuations that correspond to regions of slightly different densities, representing the seeds of all future structure: the stars and galaxies of today.

Brightness: Dimmer Brighter



Planck CMB: This image shows the oldest light in our universe, as detected with the greatest precision yet by the Planck mission. The ancient light, called the cosmic microwave background, or CMB, was imprinted on the sky when the universe was 370,000 years old. It shows tiny temperature fluctuations that correspond to regions of slightly different densities, representing the seeds of all future structure: the stars and galaxies of today.



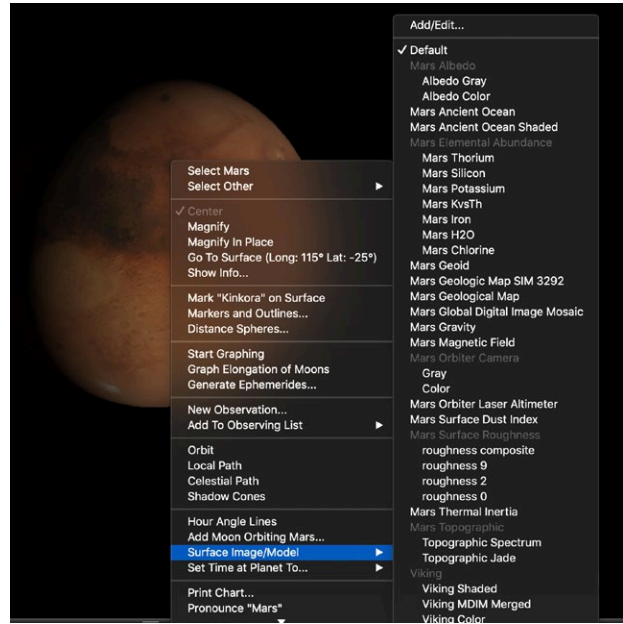
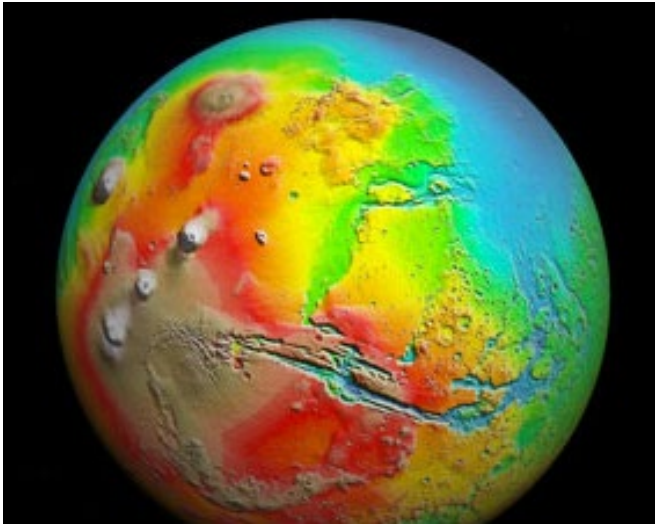
Planck CMB (Alternate): This image shows the oldest light in our universe, as detected with the greatest precision yet by the Planck mission. The ancient light, called the cosmic microwave background, or CMB, was imprinted on the sky when the universe was 370,000 years old. It shows tiny temperature fluctuations that correspond to regions of slightly different densities, representing the seeds of all future structure: the stars and galaxies of today.



Planck Mass Distribution: This image from the Planck mission shows matter between Earth and the edge of the observable universe. Regions with less mass show up as lighter areas while regions with more mass are darker. The greyed-out areas are where light from our own galaxy was too bright, blocking Planck's ability to map the more distant matter.

Planetary Texture Collection

Zoom in and explore the surface of major planets and moons in unprecedented detail with high-resolution surface texture maps.



Starry Night Pro Plus offers over 100 additional planet and moon surface maps showing rock and element locations, mineral composition, chemical distribution, gravity, magnetic field, notable topographic features, and much more.

To view the surface image maps for objects in our solar system, right-click on the object (**Ctrl**-click on the Mac) to open its contextual menu. Choose **Surface Image/Model** from the menu and click on a map name.

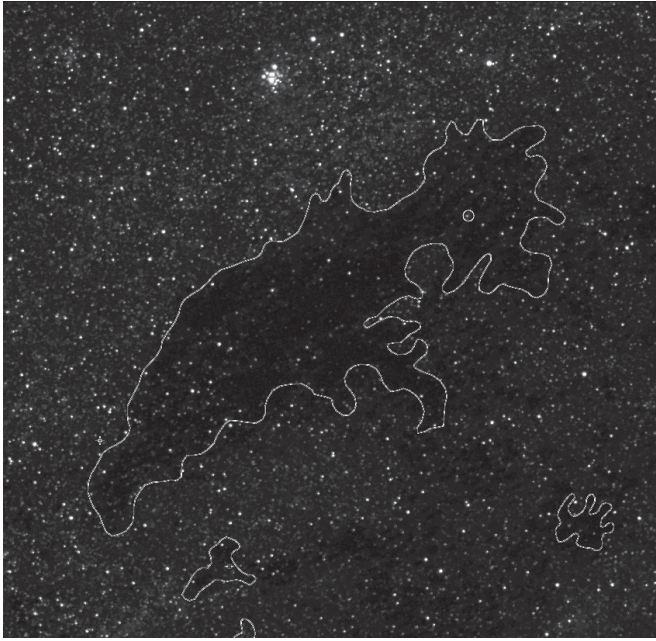
The following solar system objects have more than one surface texture map available:

sun	Saturn	Ganymede
Mercury	Uranus	Titan
Venus	Neptune	Enceladus
Earth	Callisto	Iapetus
Mars	Europa	Vesta
Jupiter	Io	

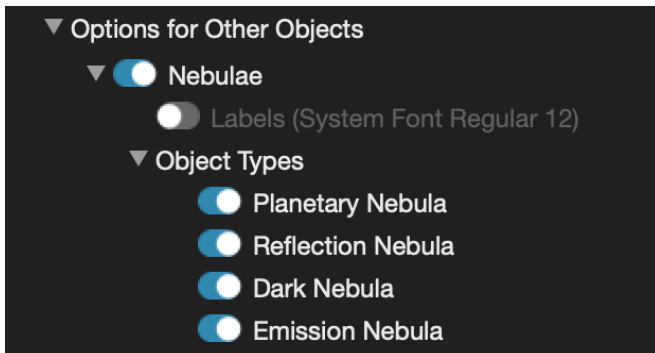
Note: *Starry Night will automatically download higher resolution planetary texture data files from the Internet whenever you zoom in on a planet. You will need a connection to the Internet for this feature.*

Nebula Outlines

Starry Night Pro Plus contains the outlines and positional data for 1400 dark, emission, planetary and reflection nebulae.



Nebula outline options: Open the **Options** search results pane and expand the “Deep Space layer”. Then expand the “Nebula” sub-layer for a list of all available nebula types.

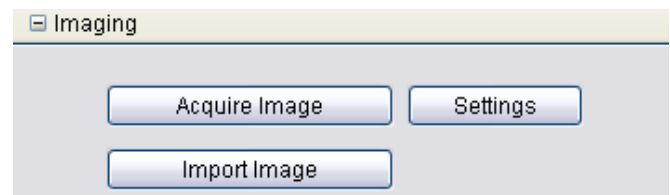


MaxIm DL Plug-In (Windows only)

For years, the software program MaxIm DL from Diffraction Limited has been the premiere package for astronomical CCD imaging and image processing.

Now you can target and capture an image in Starry Night with a plug-in to MaxIm DL. This innovative integration lets you find your target, take and process images with MaxIm DL and then import these pictures back into Starry Night. Take your passion for the night sky to new heights with the ability to create your own stunning astrophotography.

Note: *MaxIm DL Advanced CCD Imaging Software is available only for Windows and is sold separately.*



Example: Capturing Images with Starry Night and MaxIm DL

- 1 Open Starry Night. The plug-in is installed by default.
- 2 Open MaxIm DL and have your telescope and camera ready for imaging.
- 3 Using Starry Night, find a target you are interested in imaging.
- 4 Open the **Telescope** pane in Starry Night.
- 5 Expand the **Imaging** layer to reveal a set of imaging controls. Press the **Acquire Image** button to tell MaxIm DL to take a picture of the current camera field (where the telescope is pointing).
- 6 Control is passed to MaxIm DL, which now takes a picture.

- 7 After MaxIm DL captures the image, press the **Import Image** button in the Imaging layer of the **Telescope** pane of Starry Night to import the image from MaxIm DL into the Starry Night Image Editor window.
- 8 In the Image Editor window, you can adjust the size, rotation, name, notes and other parameters of the image, to match it to the background sky (this will be done automatically if you have MaxIm DL perform a 'Pin-Point' astrometry function on the image before import).

It is that easy. Your image is now stored in Starry Night and can be viewed at any time by checking the User Images box in the Deep Space layer of the **Options** search results pane.

Tip: Images are saved in the "User Images" folder and "User Images.txt" file located by default under "Starry Night 8 Prefs\Sky Data". We suggest you backup this folder and file from time to time.

Plug-in settings: Pressing the **Settings** button allow you to specify the exposure time and binning for the image. Binning shrinks the image by combining adjacent pixels together into a single "super-pixel".

Note: Plug-in requires MaxIm DL version 4.0.7 and higher.

About MaxIm DL: MaxIm DL is the fastest and easiest way to image the night sky. Whether you want to produce stunning portraits, collect science data, or hunt for new objects, MaxIm DL has the tools you need.

Key Benefits:

- 1 Complete observatory integration — control your CCD camera, filter wheel, autoguider, telescope, focuser, and dome. Includes auto-center, auto-focus, and link to planetarium program.
- 2 Supports your equipment — works with more equipment models than any other package.
- 3 Comprehensive image processing tools — dozens of filter and processing options, full image preview, filter by brightness level.
- 4 Image analysis tools — includes photometric analysis, astrometric reduction, supernova hunting, line/area profile, statistics, and more.

Maxim DL from Diffraction Limited
<http://www.cyanogen.com>

Appendix

Keyboard Shortcuts

KEYBOARD FUNCTION WINDOWS MACINTOSH

Note: Shortcuts marked with an * asterisk are only available in Starry Night Pro and Pro Plus.

File Menu (some commands are in the Starry Night menu on the Mac)

New	Ctrl-N	Cmd-N
Open	Ctrl-O	Cmd-O
Close	Alt-F4	Cmd-W
Save	Ctrl-Shift-S	Cmd-Shift-S
Print	Ctrl-P	Cmd-P
Preferences	Ctrl-,	Cmd-,
Exit/Quit	Ctrl-Q	Cmd-Q
Hide Starry Night	—	Cmd-H

Edit Menu

Undo	Ctrl-Z	Cmd-Z
Redo	Ctrl-Shift-Z	Cmd-Shift-Z
Cut	Ctrl-X	Cmd-X
Copy	Ctrl-C	Cmd-C
Paste	Ctrl-V	Cmd-V
Find	Ctrl-F	Cmd-F
Centre on	Ctrl-U	Cmd-U
Select None	Ctrl-Y	Cmd-Y
Show/Hide Info	Ctrl-I	Cmd-I

View Menu

Show/Hide Daylight	Ctrl-D	Cmd-D
Fullscreen*	F7	F7
Show/Hide Graph*	Ctrl-G	Cmd-G
Show/Hide Horizon*	Ctrl-H	B

Options Menu

Viewing Location	Ctrl-L	Cmd-L
Show/Hide		
Search Results Pane	Ctrl-F	Cmd-F
White Sky*	Ctrl-Shift-W	Cmd-Shift-W

KEYBOARD FUNCTION WINDOWS MACINTOSH

Labels Menu

Show/Hide Labels	L	L
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Favorites Menu

Save Favorite	Ctrl-S	Cmd-S
Add Favorite Folder	Ctrl-Shift-N	Cmd-Shift-N

Tool Selection

Hand	spacebar	spacebar
Angular Separation	Ctrl-Shift	Cmd-Ctrl
Location Scroller	Shift	Shift
Arrow Pointer	Ctrl	Ctrl
Zoom In	—	Cmd
Zoom out	—	Opt-Cmd

KEYBOARD FUNCTION WINDOWS & MACINTOSH

Direction Changes

Face North	N
Face East	E
Face South	S
Face West	W
Face Zenith	Z
Zoom in and out	+/-
Move left, right, up or down	Arrow keys

Time Controls

Minute forward	T
Minute back	Shift-T
Hour forward	H
Hour back	Shift-H
Day forward	D
Day back	Shift-D
Month forward	M
Month back	Shift-M
Year forward	Y
Year back	Shift-Y
Step forward one time unit	U
Step back one time unit	Shift-U

KEYBOARD FUNCTION WINDOWS & MACINTOSH**Time Controls** (*continued*)

Increase time step	P
Decrease time step	Shift-P
Reset to now with realtime flow	R
Reset to realtime flow	Shift-R
Next sunrise/sunset	TAB
Previous sunrise/sunset	Shift-TAB
Next moonrise/moonset	O
Previous moonrise/moonset	Shift-O

View Controls

NGC/IC on/off	C
Celestial grid on/off	G
Ecliptic on/off	F
Ecliptic grid on/off	Shift-F
Local grid on/off	Shift-G
Constellations on/off	K
Labels on/off	L
HUD on/off	I
Mark variable stars*	V
Mark binary stars*	Shift-V

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