Galileoscope Observing Guide 2011

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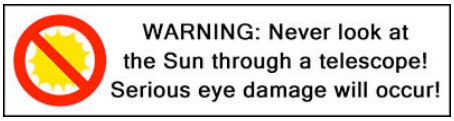
Introduction to Observing with the Galileoscope

The Galileoscope provides exceptional optical quality for its price. You can explore the night sky and see craters on the Moon, Saturn's rings, Jupiter's moons, star clusters, double stars, and an endless variety of fascinating astronomical objects.

As with any endeavor, you will get better at astronomical observing the more you practice. You will get better at finding objects in the night sky, and you will learn to find objects that are not visible to the naked eye. As you become a more experienced observer, you will notice more detail in the objects you observe. Using the telescope will become second nature!

This guide will lead you through how to observe with the Galileoscope. We will highlight observing the Moon, the phases of Venus, the four Galilean moons of Jupiter, and the rings of Saturn. These are four of the objects that Galileo observed 400 years ago and that led to a revolution in our understanding of the Universe.

One object <u>not</u> to observe is the Sun:



THE GALILEOSCOPE IS NOT A SOLAR TELESCOPE AND SHOULD NEVER BE POINTED AT THE SUN!

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Observing Tips and Tricks

The Galileoscope is designed for ease of use. Once the telescope is put together, the only moving part is the focuser. However, you will find your observing experience much more enjoyable if you know a few observing basics before heading out under the night sky. In fact, start using the Galileoscope in the daytime, to familiarize yourself with how to use it.

The View Is Upside Down!
The first thing you will notice about the Galileoscope is the view through the eyepiece is upside down and right and left are reversed. This point of view does not matter for astronomical objects — whether Jupiter is upside down is not a concern. To make the image become upright requires more lenses — and each lens absorbs more light, dimming the image. Therefore astronomers have chosen not to add these lenses, wanting to preserve the maximum amount of light when looking at dim objects.

The Galileoscope Needs a Stable Mount
Because it has high magnification, it needs a tripod to steady the image. The telescope has a special camera thread so it can attach to any photo tripod made anywhere in the world. Without a tripod or an improvised way of holding it steady, the Galileoscope cannot give its maximum performance, except in the frustration department. Even a small table-top tripod is a big improvement over just holding the telescope. Find a tripod! Buy a tripod! This is *so* important!

If a photographic-type tripod is unavailable, the Galileoscope may be steadied against a wall or a post for brief views of the Moon or planets. However, it will perform much better when attached securely to even a crude tripod.

You can attach the Galileoscope to a broom handle or fence post using a bolt put through the handle or post and then attached to the tripod nut on the bottom of the Galileoscope.

A crude, but useful tripod can be constructed from a cardboard box using a method developed by Alan Gould of the Lawrence Hall of Science. The illustration shows how a telescope tube (this picture is of a different type of telescope) would be attached to a box using a bolt going into the box. The box can be put on a table and rotated in azimuth (like a tank turret) by moving the whole box. The telescope can also be pointed at different altitudes or angles above the horizon by rotating the telescope tube around the bolt where it attaches to the box. Looking straight up is never easy though but can be done by placing the box near the edge of a table.

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Be Sure to Achieve a Good Focus
If the telescope is not properly focused, it will not produce good images. The Galileoscope can be focused by sliding the eyepiece tube (which holds the eyepiece) in and out of the main tube. Take care not to pull the eyepiece from the focusing tube. For closer objects the focusing tube is extended and pulled out. For objects that are far away the eyepiece tube should be pushed in. Take care not to put your fingerprints on the eyepiece outer lens.

For closer objects, the telescope may not come to a focus. It has been designed to work the best when looking at objects that are very far away — like planets! To play with the focus first aim the telescope at an object that is far away using the sights on the top of the telescope tube.

When you achieve a good focus, stars should appear as sharp points of light. Simply slide the focuser slowly back and forth to find the best focus possible. If you move the focuser too quickly, you may miss the focus point. You can rotate the focus tube while drawing it in and out if that helps make the motion smoother.

The telescope is designed to be used while wearing prescription glasses. (Take off your sunglasses, though.) Most people should leave their glasses on when using the Galileoscope. If you prefer to remove your glasses, that is fine as well. You need to remember that the focus point may be different for different people, especially if they remove their glasses. If someone is slightly nearsighted or farsighted, they may need to adjust the focus.

Start Using Low Magnification
The Galileoscope has a magnification of 25 times (25x) in its default configuration. You can increase the magnification to 50x using the supplied Barlow lens, which fits into the focusing tube, with the eyepiece inserted into the Barlow lens.

Objects are easier to find if you use 25x. The field of view of the telescope is 1.5 degrees with a magnification of 25x. This large field of view makes it easier to find objects in the sky. When you increase the magnification to 50x, the diameter of the field of view is 0.75 degree. This smaller field of view means you are looking at an area of sky only ¼ as large in area! When you look at a smaller portion of the sky, it is more difficult to find the object you are looking for.

You should always find the object with low magnification first. Once you have found the object, carefully insert the Barlow lens without moving the telescope. If you accidentally move the telescope while inserting the Barlow, the object may not be in your field of view anymore and you should start over at low power.

Where to Observe
When choosing an observing site always keep safety in mind. Do not to use private

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property without permission and if you use a public park, be sure to observe park hours and rules.

You will want to find a place that is as dark as possible. At the very least be sure there are no street lights shining directly on you or creating glare. You may contact your local astronomy club for recommendations; they frequently have dark sites for observing or can make recommendations. Often the best site is the most convenient one: your backyard or balcony. As you progess you will want to find observing sites where you do not look over heated buildings, if possible. The hot air rising from buildings may cause the image to shimmer. You will notice if this is a problem because the image will become unsteady. Objects closer to the horizon also suffer from this same effect. Try to be patient and let the object get at least 30 to 45 degrees above the horizon for the best view.

Another important considering is your view of the horizon. You do not want lots of tall trees or buildings nearby as they restrict your view. You do not want to miss seeing some of the best sights in the sky if a tree or building is in the way!

You also want fairly level ground. A tripod can be adjusted to make up for small bumps, but you want to avoid the side of a steep hill.

Again, your safety is the primary consideration.

Universal Time

Since people observe at different locations all around the world, we need a common time system. This system is called Universal Time (UT) and is based on the time at the Prime Meridian. You need to know your time zone and add or subtract an appropriate number of hours from UT. You may need to adjust for daylight savings time as well.

For the United States, you subtract a certain number of hours from UT depending on which time zone you live in. The chart below shows how many hours to subtract for time zones in the continental U.S.

Time Zone	Standard Time Subtract	Daylight Savings Time Subtract
Eastern	5 hours	4 hours
Central	6 hours	5 hours
Mountain	7 hours	6 hours
Pacific	8 hours	7 hours

All times for events are given in UT. You might notice that sometimes the full Moon occurs on a different day than listed in the chart. Remember the date of the full Moon is given in UT which may be a day ahead or behind your time!

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Observing the Moon

Introduction

The Moon is a natural observing target. It is large, bright, easy to find, and has lots of interesting details to explore. You can see a wide variety of details including craters, the so-called seas (dark areas called maria), rays, and mountains.

The Moon as seen through the Galileoscope.
(courtesy A. Jaunsen. Norway)

Many people think the best time to observe the Moon is when it is full. When the Moon is full, the Sun is high in the sky on the surface of the Moon. Therefore, the shadows cast by craters and mountains are small and details are hard to see. The Moon is considered best to observe near first quarter or last quarter. At first quarter the Moon rises near noon and is high in the sky at sunset — a convenient time to observe. The Moon can also be observed in the daytime at certain phases. However, the Moon is better observed at night or at sunrise or sunset.

Most major newspapers list the phase of the Moon as well as when it rises and sets each day. Online sources include *Sky & Telescope* magazine (www.skyandtelescope.com) or *Astronomy* magazine (www.astronomy.com). You can run a free planetarium program on your computer called *Stellarium* (www.stellarium.org) that will give you the Moon's rise and set times for any day.

Moon Phases For 2011

The following chart gives the dates for New Moon, First Quarter Moon, Full Moon, and Third Quarter Moon for 2011 (all dates are in Universal Time).

Month	New Moon	First Quarter	Full Moon	Third Quarter
January	4	12	19	26
February	3	11	18	24
March	4	12	19	26
April	3	11	18	25
May	3	10	17	24
June	1	9	15	23
July	1,30	8	15	23
August	6	13	21	29
September	4	12	20	27
October	4	12	20	28
November	2	10	18	25

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December	2	10	18	24

Moon Conjunctions
The Moon frequently has nice encounters with other planets which can be very pretty visually as well as photographically. However, it is very rare that the Moon is close enough in the sky to a planet to see them both in the field of view of the Galileoscope.

Timing is important when viewing conjunctions with the Moon. The Moon moves about listed below, the Moon will have moved four degrees in that time. A few of the better conjunctions for 2010 are listed below.

January 2nd, 14UT: Mercury is 3.7 degrees north of the Moon in the pre-dawn sky.

January 30th, 3UT: Venus is 3.4 degrees north of the Moon in the in the pre-dawn sky.

February 1st, 16UT: Me3rcury is 3.5 degrees south of the Moon in the pre-dawn sky.

March 1st, 3UT: Venus is 1.6 degrees south of the Moon in the pre-dawn sky.

March 31st, 8UT: Venus is 5.5 degrees south of the Moon in the pre-dawn sky.

May 1st, 14UT: Jupiter is 5.6 degrees south of the Moon in the pre-dawn sky

May 1st, 15UT: Mars is 5.2 degrees south of the Moon in the pre-dawn sky.

May 29th, 10UT: Jupiter is 5.4 degrees south of the Moon in the pre-dawn sky.

May 30th, 17UT: Mars is 3.7 degrees south of the Moon in the pre-dawn sky.

May 31, 15UT: Mercury is 3.7 degrees south of the Moon in the pre-dawn sky.

June 26th, 5UT: Jupiter is 5.1 degrees south of the Moon in the pre-dawn sky.

June 30th, 7UT: Venus is .1 degree south of the Moon low in the pre-dawn sky.

July 23rd, 21UT: Jupiter is 4.9 degrees south of the Moon in the pre-dawn sky.

August 1st, 10UT: Mercury is 1.3 degrees north of the Moon low in the west after sunset.

August 20th, 9UT: Jupiter is 4.7 degrees south of the Moon in the pre-dawn sky.

August 25th, 12UT: Mars is 2.7 degrees north of the Moon in the pre-dawn sky.

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September 16th, 15UT: Jupiter is 4.6 degrees south of the Moon in the pre-dawn sky.

September 28th, 6UT: Venus is 5.4 degrees north of the Moon low in the evening sky right after sunset.

October 13th: 16UT: Jupiter is 4.7 degrees south of the Moon in the mid to late evening sky.

October 28th, 12UT: Mercury is 0.3 degrees north of the Moon very low in the west after sunset.

October 28th, 4UT: Venus is 1.9 degrees north of the Moon very low in the west after sunset.

November 9th, 15UT: Jupiter is 4.8 degrees south of the Moon in the east after sunset.

November 26th, 9UT: Mercury is 1.6 degrees south of the Moon low in the west after sunset.

November 27th, 4UT: Venus is 2.7 degrees south of the Moon in the west after sunset.

December 6th, 16UT: Jupiter is 4.9 degrees south of the Moon in the east after sunset.

December 23rd, 3UT: Mercury is 2.6 degrees north of the Moon in the east before sunrise.

Lunar Eclipses
There are two chances to see lunar eclipses this year depending on where you live.

The first lunar eclipse occurs on June 15th and the Moon passes almost directly through the center of Earth's shadow. The penumbral phases begin at 17:23:05 but you probably won't notice much change until the umbral phase starts at 18:22:37. Totality begins at 19:22:11 and the Moon passes through the darkest part of the shadow at 20:12:37UT. Totality ends at 21:03:02 and the Moon leaves the umbra at 22:02:35.

Central Asia, the Middle East and western Africa can see the entire eclipse. Eastern Asia and Australia can see the eclipse at moonset but may not see entire eclipse. Eastern Africa and much of South America can see part of the eclipse at Moonrise. This eclipse will not be visible in North America.

The second lunar eclipse occurs on December 10th. The penumbral phase begins at 11:33:36UT and the umbral phase begins at 12:45:43UT. Totality begins at 14:06:16UT and ends at 14:57:24UT. The umbral phase ends at 16:17:58UT.

The entire eclipse is visible from most of Asia and Australia. Most of Africa and Europe can see part of the eclipse at Moonrise. Most of North America can see part of the

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eclipse at Moonset. The eclipse is not visible from South America.

Surface Features

Craters
Most people notice craters when they look at the Moon. The largest craters are hundreds of miles across. Craters have raised walls. Craters on the Moon are formed by meteoroid impacts. Since the Moon has no erosion processes, craters can last for billions of years. Very large craters frequently have what is called a central peak. When a large meteoroid strikes the Moon, it compresses the surface. The surface rebounds and forms a peak in the middle of the crater. When a crater is near the terminator (the dividing line between the dark and light areas of the Moon, where the Sun is either rising or setting), you can sometimes see a lighted central peak while the floor of the crater is dark. Using simple geometry and the length of shadows allows the height of these central peaks to be calculated.

Maria
Maria are also called seas. Maria appear as large dark areas on the Moon. They were originally thought to be oceans but are now known to be ancient lava flows. Maria are younger than other parts of the Moon's surface and have few craters. The near side of the Moon has several large maria that you can see labeled on the map on the next page.

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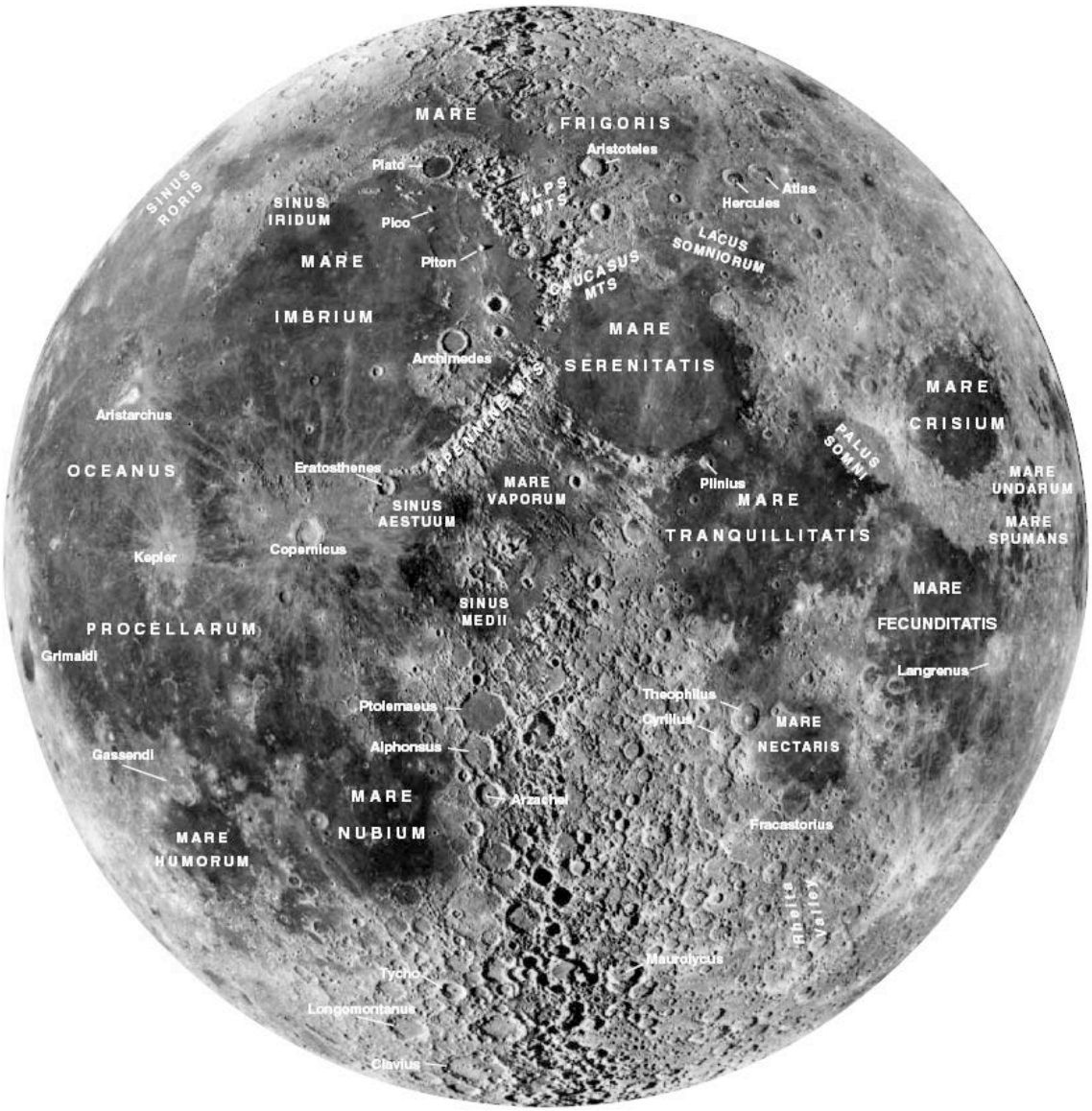

Moon map courtesy UCO/Lick Observatory and *Sky & Telescope* magazine.

Rays

Fresh impact craters have rays emanating from their center. Rays are material that was ejected from the crater during the impact of the meteorite. Rays tend to fade over time as they are exposed to sunlight. Bright rays indicate a very young crater. The rays on the Moon can best be seen at a full Moon. At this time the rays are very prominent and impressive, even though the shadows on the lunar surface disappear.

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Observing Venus

Introduction

Venus is the second brightest object in the night sky. Since it orbits closer to the Sun than the Earth, Venus is always visible either before sunrise or after sunset, except for short periods of time when it is in the same direction as the Sun. Venus begins 2009 as the evening star, setting more than 3 hours after the Sun in mid-January. It passes into the morning sky in April.

Venus orbits about 67 million miles from the Sun (compared to Earth's 93 million mile orbit) and is very close to the same size as Earth. The similarities end there. Venus has a very thick atmosphere with a pressure 90 times that of the surface of the Earth. Clouds hide its surface from our view. Its temperature rises to almost 900 degrees Fahrenheit due to a runaway greenhouse effect. Venus is very inhospitable to life.

Observing Venus

Although surface features are not visible due to the cloud cover, Galileo made an important observation of Venus. He observed that Venus goes through phases just like our Moon. Galileo also noticed substantial differences in the size of the disk of Venus through his telescope at different times in its orbit. These two pieces of information led him to the conclusion that Venus and the Earth orbited the Sun.

The phases of Venus. Image credit Statis Kalyvas.

You will need to observe Venus over the course of several weeks to see the changes take place. If Venus is in the evening sky, you will notice its disk goes from full, to half lit, to a slender crescent. During this time you will notice Venus increases in size as it approaches Earth. Then it appears very close to the Sun and is lost in the glare.

In the morning sky, the process is reversed. Venus will start off as a large crescent and shrink to a half lit disk and shrink further as it becomes full and gets closer to the Sun in direction. Then as it gets to the full phases it passes behind the Sun and becomes invisible. Venus is moving away from us when we see it in the morning sky.

Make sketches of Venus over time. Be sure to sketch its size relative to the field of view

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of your telescope so you can see the changes in size as well as the phases.

Venus in 2011

Venus is always very bright and easy to identify when it is visible in the sky. Since it orbits closer to the Sun, it is always visible either after sunset or before sunrise. In fact due to the orbit of Venus inside the orbit of the Earth Venus is restricted to being within 47 degrees of the Sun. So a bright object farther than this in its angle to the Sun is not Venus.

Venus starts the year high in the pre-dawn sky. Venus is at greatest western elongation (separation from the Sun) on January 8th. Venus rises over three hours before the Sun on this date and is about 50% illuminated. Venus continues to pull ahead of Earth as they orbit around the Sun. As a result, Venus gets farther away resulting in its apparent size getting smaller. The phase of Venus progresses toward full as more of the surface is illuminated.

Venus remains a nice morning object for the first half of 2011. In July Venus rapidly dives toward the Sun and passes through inferior conjunction (when it is on the opposite side of the Sun) on August 16th.

Venus appears very low in the evening sky in September of 2001. However, due to the shallow angle the ecliptic makes with the horizon, Venus stays very low in the western sky in late 2011.

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Observing Jupiter

Introduction
Jupiter is the largest of the planets and always appears very bright in the sky when it is visible. Jupiter is one of the most impressive sites in a small telescope and shows a variety of details to the patient observer.

Jupiter is about 88,000 miles in diameter and orbits almost 500 million miles from the Sun. It is a gas giant that does not have a solid surface. Jupiter's atmosphere has distinctive cloud bands and the Great Red Spot, a storm over twice the diameter of the Earth that has been raging for over 300 years.

Jupiter and the Galilean Moons. Image Credit Don Waid.

Observing
Jupiter is easy to find as it is one of the brightest objects in the sky. You can find its position from various sources (see the Observing Resources section). Jupiter is easily visible to the naked eye.

The first thing that people notice through a telescope are the four Galilean Moons. You may only see three (or even two on rare occasions) if one or more of the Moons is either directly in front of or directly behind the planet. The Moons all orbit in the same plane so they usually lie very close to a straight line.

The four Galilean Moons are, in order from nearest to farthest from Jupiter, Io, Europa, Ganymede, and Callisto. Io orbits the fastest of the Moons taking a little under 2 days to orbit the planet. Callisto takes almost two weeks to complete one orbit. You can watch the Moons change position in as little as a couple of hours over the course of a night.

Sometimes you can see one of the Moons cast a shadow on Jupiter. The shadow will move across the face of Jupiter as the Moon orbits. Predictions for when you can see shadows transit Jupiter are available online (see the *Observing Resources* section).

Look closely at the disk of Jupiter. Most people quickly notice the bands across the equator of the planet. These are Jupiter's equatorial bands. If you look carefully and the air is steady (the "seeing" is good), you may see other bands as well.

The Great Red Spot is difficult to see with the Galileoscope, but is worth pursuing. The Great Red Spot is a large storm on the surface of Jupiter that has been raging for at least 300 years. The diameter of the Great Red Spot is over twice the diameter of Earth! Use your favorite observing program to be sure the Great Red Spot is visible and not on the

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other side of the planet. You may want to use a Barlow lens or higher magnification eyepiece when you attempt to find the Great Red Spot. The Great Red Spot changes color and is currently rather pale, more salmon colored than red. Check observing reports on the internet as it may change back to a deeper red at any time!

You may notice that Jupiter does not appear perfectly round but rather has a squished appearance. Jupiter rotates on its axis very quickly (under 10 hours at the equator). Its rapid rotation causes a bulge at the equator that is visible in small telescopes. Can you see the elongated shape of Jupiter?

Jupiter in 2011

Jupiter starts 2011 high in the west-southwest as the sky gets dark. Although Jupiter is well past opposition, its large size always makes it a bright target that will show surface details to dedicated observers and its four Galilean Moons are always easily visible in even the smallest of telescopes. Observe Jupiter quickly, however, as it will be setting earlier each evening. By early March, Jupiter is being caught in the glow of twilight and the turbulence of Earth's atmosphere that blurs much of the detail you can see when it is higher in the sky. By late March Jupiter is lost in the Sun's glare and it is in conjunction with the Sun (on the opposite side of the Sun from Earth) on April 14th.

Jupiter emerges into the morning sky a few weeks later and begins its climb away from the Sun. By mid-July, Jupiter is rising over three hours before the Sun. In early August, Jupiter rises around midnight and will be well positioned for observing in the pre-dawn hours. Jupiter comes to opposition (closest approach to Earth) for 2011 on October 29th. On this date, Jupiter will rise at sunset, be highest in the sky at midnight, and set at sunrise. Jupiter rises a few minutes earlier each night and will be well positioned for observing in the evening sky for the rest of 2011.

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Observing Saturn

Introduction
Saturn is one of the most beautiful sites in a small telescope. Its rings never cease to captivate even seasoned observers. Although the rings appear impressive, they are made up of rocks and ice. The rings are only a few hundred meters thick, but they are made of very reflective material so the appear bright.

Saturn has a bright satellite called Titan which is also easily visible. Titan is the second largest satellite in the solar system and the only moon known to have a thick atmosphere. The pressure at the surface of Titan is 50% greater than Earth's atmospheric pressure!

Observing
Saturn is typically fairly bright and easy to pick out with the naked eye even when it is far from Earth. Consult the *Observing Resources* section for various computer programs and web sites that will provide you with Saturn's location on a given day.

Once you have a well-focused image of Saturn, look for its rings. They should be just visible at 25x in the Galileoscope. If you have the Barlow lens, use it to increase the magnification (or you can use any standard 1.25" telescope eyepiece). At higher magnification, you may see the Cassini Division in the rings. The Cassini Division is a gap in the rings and will show up as a dark band. Surface details on Saturn are usually difficult to detect through a small telescope. The bands and zones are very pale and have low contrast.

Saturn's largest Moon, Titan, is an easy observing target. Titan orbits Saturn once about every 16 days. You can find Titan's position by consulting the Observing Resources section. Unlike Jupiter's Moons, Titan's shadow is rarely visible on Saturn due to the presence of the rings. Only when the rings are nearly edge on (as they are in 2009) can you hope to see Titan's shadow on Saturn.

Saturn in 2011

Saturn stars the year in the constellation of Virgo and rises about 1am. Saturn will be well positioned for observing high in the pre-dawn sky during the early part of 2011. Saturn rises a few minutes earlier each evening as it heads toward opposition on April 3rd. On this night, Saturn rises at sunset, is highest in the sky at midnight and sets at dawn. Saturn will be well positioned for evening observing the next few months.

By early August, Saturn will be low in the southwest as they sky gets dark. Saturn is in conjunction with the Sun on October 13th and will not be visible at this time. By early December, Saturn is rising about three hours before sunrise and low in the southeast as the Sun comes up. Saturn will rise about five hours before the Sun at the end of

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December and will be a better morning observing target at this time.

Saturn's rings are starting to open up more as well. Earth and Saturn went through a ring plane crossing in 2009 and the rings were almost edge on and difficult to see. As Saturn progresses in its orbit, the rings will open progressively wider the next several years and become a more impressive sight. Even without a telescope, experienced observers can tell that Saturn appears brighter as its rings open up and reflect more light toward Earth. The rings are tilted almost 5 degrees at the beginning of the year. As Earth passes Saturn, the angle decreases to about 1.6 degrees in late May/early June. By the end of the year, the rings have opened up to a little over 10 degrees. Our changing perspective on Saturn's rings is a very rewarding observation to make.

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Other Planets

Mercury
Mercury undergoes phases like Venus and can be a satisfying telescopic object. However Mercury never gets more than 28 degrees in angle from the Sun. This means that it is always close to the western horizon after sunset in the evening sky or close to the eastern horizon before sunrise. Like Venus, Mercury is brightest and most interesting when it is in a crescent phases. The best time to see it is just after sunset or just before sunrise. You will never see Mercury in the middle of the night or even a few hours after sunset. Consult the *Observing Resources* section for information on how to find Mercury.

Mercury is always close to the Sun either in the morning or evening. To find Mercury, go out near the night (or morning) of greatest elongation. You can usually only see Mercury well a few days before or after these dates.

Evening Appearances in 2011: March 23rd, July 20th, November 14th
Morning Appearances in 2011: January 9th, May 7th, September 3rd, December 23rd

Not all appearances of Mercury are created equal. Mercury has an elliptical orbit so it is farther from the Sun during some appearances than others. You also have to take into account the angle the ecliptic makes with the horizon to see how high Mercury will be in the sky. The ecliptic is steep to the horizon in the evening in the winter and spring for the northern hemisphere so the March and November evening appearances of Mercury will be easier to see. The ecliptic is steeply inclined to the horizon in summer and fall so the September appearance of Mercury will be the best morning appearance in 2011.

Mercury undergoes phases like Venus. However, Mercury is much smaller and farther away from the Earth so they are more difficult to observe.

There is a story that Copernicus never saw Mercury and expressed this regret on this deathbed. Don't let this happen to you!

Mars
Mars captures the public imagination. When it shines brightly in the sky, it has a distinctive reddish color that stands out in the night sky.

Mars is only half the diameter of the Earth, however. Even when it gets close to Earth (as it does about once every two years when it is at opposition) it is still a small planet (compared to Jupiter, for example) appears small in a telescope. You can tell that Mars (or any planet) is at opposition as this always occurs when Mars rises near sunset (Investigation for you: Why?)

Unfortunately, 2011 is not a good year for observing Mars. Mars comes to opposition

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once every 2 years or so. Mars was at opposition on January 29th, 2010 and will not beat opposition again until March 3rd, 2012.

Mars starts the year very close to the Sun after sunset (too close to observe for all practical purposes). Mars passes through Superior conjunction on February 13th. Mars will slowly emerge from the glare of the Sun in the morning sky but it will take a while for Mars to get high enough to see well. Mars stays in the morning sky, slowly getting higher throughout the year. Mars is still far away from Earth at the end of the year and you will need a large telescope, high magnification and good seeing to detect any surface detail.

Uranus and Neptune

Uranus and Neptune are not visible to the naked eye but you can see them with the Galileoscope. The difficult part is pointing the telescope at the right part of the sky.

You will not see any surface detail on these distant planets as they are appear small even through relatively large amateur telescopes. Consult the *Observing Resource* section for information on how to find Uranus and Neptune on where to find detailed finder charts.

Uranus and Neptune move very slowly relative to the background stars due to their great distances. Their brightnesses and relative sizes vary significantly less than those of the inner planets as the distance between Earth and the planet changes. Therefore, you can pretty much try to observe them whenever they are easily visible in the sky and you do not have to wait for opposition to get the best view. However, near opposition is still a convenient time to observe since Uranus and Neptune are visible all night long.

Uranus comes to opposition on September 26th and is in the constellation of Pisces. Uranus can just barely be seen under a very dark sky but you will need patience and a very good star chart to find it. You are much better off using a small telescope to find it. Uranus will appear as a very small blue object with just a hint of a disk, slightly different than stars which are points.

Neptune comes to opposition about a month earlier on August 22nd in the constellation of Aquarius. It's will appear smaller and fainter than Uranus but have a similar color.

Pluto is too faint to be seen with the Galileoscope.

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Conjunctions and Other Sky Events

Since all the planets orbit the Sun fairly close to the same plane, you can frequently see planets pass fairly close to each other and/or the Moon in the night sky. These events are called conjunctions. Conjunctions can be very rewarding to observe as you watch the planets move relative to each other through the night sky. Usually no telescope is required to see these celestial events.

Here are some of the more notable events in 2011.

January 2nd, 14UT: Mercury is 3.7 degrees north of the Moon in the pre-dawn sky. Mercury is frequently difficult to see and the Moon provides a useful guide to find it on this morning.

January 30th, 3UT: Venus is 3.4 degrees north of the Moon (with Mercury very low in the sky beneath them just before dawn).

March 1st, 3UT: Venus is 1.6 degrees south of the Moon in the pre-dawn sky.

March 5th, 12UT: Mercury is 6 degrees south of the Moon just after sunset (Jupiter will be low in the west above the Moon as well).

March 16th, 3UT: Mercury is 2 degrees north of Jupiter just after sunset. You can watch these planets several days before and after this close approach and observe their relative motions in the sky.

March 31st, 8UT: Venus is 5.5 degrees south of the Moon in the pre-dawn sky.

April 19, 7UT: Mercury is only 0.6 degrees north of Mars in the pre-dawn sky. The observation will be challenging, but both objects will fit in the same field of view for most small telescopes.

May 2011 Morning Conjunctions

In May of 2011 there are a series of conjunctions in the morning sky involving four planets: Mercury, Venus, Jupiter and Mars. The Moon passes through the gathering planets in late April/early May and again in late May. You will want to observe this gathering often to see the changes that take place from day to day in their relative positions. The dates for the closest approaches between different pairs of planets and the Moon are listed below.

May 1st, 4UT: Mars is 0.4 degrees north of Jupiter and Jupiter is 5.6 degrees south of the

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Moon.

May 10th, 5UT: Mercury is 1.5 degrees south of Venus.

May 11, 14UT: Venus is 0.6 degrees south of Jupiter and Mercury is 2.0 degrees south of Jupiter.

May 15th, 21UT: Mercury is 1.4 degrees south of Venus.

May 21st, 1UT: Mercury is 2.1 degrees south of Mars.

May 23rd, 8UT: Venus is 1.0 degree south of Mars.

May 29th, 10UT: Jupiter is 5.4 degrees south of the Moon.

May 30, 17UT: Mars is 3.7 degrees south of the Moon

May 31st 1 UT: Venus is 4.3 degrees south of the Moon and Mercury is 3.7 degrees south of the Moon at 15UT.

June 26th, 5UT: Jupiter is 5.1 degrees south of the Moon.

June 28th, 18UT: Mars is 3.7 degrees south of the Moon.

July 2nd, 23UT: Mercury is 4.9 degrees north of the crescent Moon just after sunset.

July 23rd, 21UT: Jupiter is 4.9 degrees south of the Moon.

July 27th, 16UT: Mars is 0.5 degrees north of the Moon.

August 1st, 10UT: Mercury is 1.3 degrees north of the Moon

August 20th, 9UT: Jupiter is 4.7 degrees south of the Moon.

August 25th, 12UT: Mars is 2.7 degrees north of the Moon.

September 16th, 15UT: Jupiter is 4.6 degrees south of the Moon.

September 23rd, 6UT: Mars is 4.6 degrees north of the Moon.

October 13th, 16UT: Jupiter is 4.7 degrees south of the Moon rising in east in the early evening.

October 28th, 2UT: Mercury is 0.3 degrees north of the Moon and Venus is 1.9 degrees north of the Moon (4UT) in the west at sunset.

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November 9th, 15UT: Jupiter is 4.8 degrees south of the Moon in the eastern sky at sunset.

November 26th, 9UT: Mercury is 1.6 degrees south of the Moon

November 27th, 4UT: Venus is 2.7 degrees south of the Moon

December 6th, 16UT: Jupiter is 4.9 degrees south of the Moon in the evening sky.

December 23rd, 3UT: Mercury is 2.6 degrees north of the Moon

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Other Objects

The Pleiades
Galileo observed the Pleiades star cluster, and it is a lovely sight. Your Galileoscope was designed to give you a view of nearly this entire group of stars, which is also known as the Seven Sisters.

The Pleiades are visible to the naked eye even with moderate light pollution. They are best viewed from late fall to early spring. Many people mistake the Pleiades for the Little Dipper. The Pleiades do have a shape similar to a small dipper, but they are not near the North Star and are much smaller than the Little Dipper.

Observing the Pleiades through the Galileoscope will reveal many more stars than you can see visually. Use 25x when observing the Pleiades with the Galileoscope for the best view. The larger field of view allows you to see most of the cluster at one time and will be much more impressive than if you use higher magnification.

The Pleiades are an open cluster. They are young hot stars that were all born about the same time from the same cloud of gas and dust.

The Orion Nebula
Galileo looked at the Orion Nebula, and you can too. The nebula is easily found in the sword of Orion. Orion is best viewed during the winter months from late November through late March.

Note the color of the nebula (gray, perhaps with a slight greenish tinge) and the small pattern of stars in the center. At 50x, you may be able to see the four stars at the center called the Trapezium (look closely!). Take your time and look at the intricate patterns present in the gas cloud.

Orion is a stellar nursery — astronomers have observed new stars being born here from this giant cloud of gas and dust. It is relatively nearby…about 1,200 light-years away. As the nearest large star-forming region, the Orion Nebula is a subject of intensive study by professional astronomers.

The Milky Way
The Milky Way is best observed from a dark site. In the summer, you can see the Milky Way starting in the south and stretching high into the sky. You are looking toward the center of our galaxy and see the band of light formed by countless distant stars.

The Galileoscope will reveal many of these stars. Simply scan up and down the Milky Way slowly. You will find many star clusters as well as nebula (star forming regions). You can consult the *Observing Resources* section for information on specific objects

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visible in the Milky Way.

Recording Your Observations

You may wish to keep track of your observations. It can be gratifying to see the list of object you have found and observed grow. Recording details of your observations let you see how your observing skills grow and improve over time.

Many observing logs have a place to make a sketch of your object. A circle represents the field of view of your eyepiece. Try to sketch your object to scale. If it covers half of your eyepiece field of view, it should cover half the circle in your observing log.

The next page has a sample observing log you can print out and use to record your observations.

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Observing Log

Observer _____ Object _____

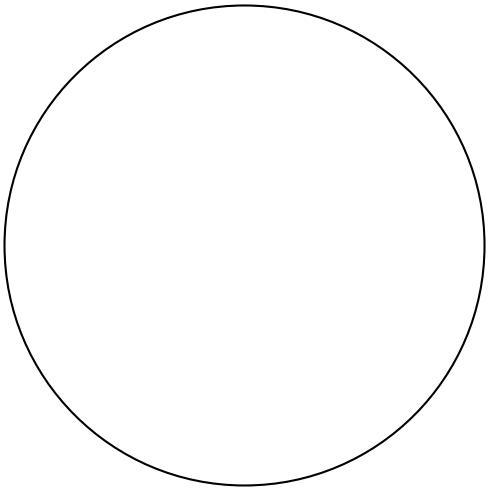
Date _____ Constellation _____

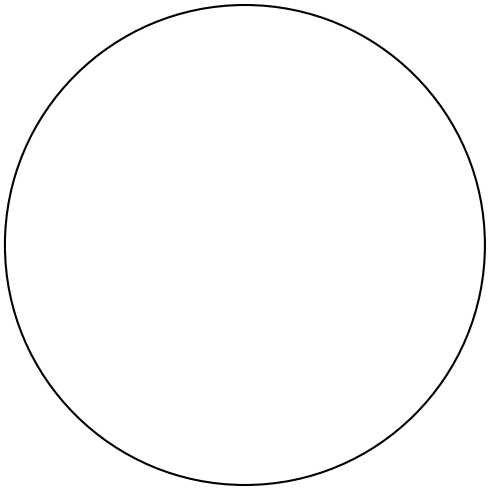
Time _____ Telescope _____

Location _____ Magnification(s) _____

Field Drawing

LOW-POWER VIEW **HIGH-POWER VIEW**





OBSERVING NOTES AND COMMENTS

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Observing Resources

There are many good observing resources available online. Here are some of the best free web sites and programs.

Sellarium: http://www.stellarium.org/
Stellarium is a free open source planetarium program. It is available for Windows, Mac OS X, and Linux. Stellarium allows you to input your location, date and time and see what objects are visible in the night sky.

WorldWide Telescope: http://www.worldwidetelescope.org/Home.aspx
Microsoft's WorldWide Telescope is a powerful program that allows you to explore the night sky. It can function as a traditional planetarium program but allows you to call up astronomical images from a variety of sources and create you own tours of the night sky. It is currently only available for Windows, but a web-based version is coming soon.

Google Sky: http://www.google.com/sky/
Google Sky is an extension of Google Earth that will function as a planetarium program in addition to allowing you to access images and data on astronomical objects. Clicking on any object brings up information on the object and links to images. You can see the night sky as it appears from anywhere on Earth.

Virtual Moon Atlas: http://www.ap-i.net/avl/en/start
The Virtual Moon Atlas is a free computer program that shows that allows you to make highly detailed maps of the Moon to assist in observations. You can find the phase of the Moon as well as rise and set times. You can find features by name and determine the best time to observe different features on the Moon. Available for Windows and OS X.

Sky Charts: http://www.stargazing.net/astropc/index.html
Sky Charts is a free planetarium program available for Windows. Once you enter your location and time, you can see what is visible in the night sky to help you plan your observations.

Uncle Al's Sky Wheel: http://www.lhs.berkeley.edu/starclock/skywheel.html
Uncle Al's Sky Wheel is a free printable planisphere. Once assembled, this sky chart can be set to help you find the constellations at any time of night for any night of the year. Sky Wheels are very useful if you are you are observing and do not have access to a computer at your observing site.

Heavens Above: http://www.heavens-above.com/
Heavens Above is best known for its predictions of visible satellite passes. This site also has information on visible comets, the Moon and the planets to help you determine what is visible in the night sky. You can find rise and set times as well as locations for all the major planets and bright comets.

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Spaceweather.com: http://www.spaceweather.com/
Spaceweather focuses on the Sun, sunspots, and northern lights. Spaceweather posts information on planetary conjunctions and posts pictures from amateur and professional astronomers around the world. They frequently highlight upcoming conjunctions in the night sky.

Sky & Telescope: http://www.skyandtelescope.com/
Sky & Telescope magazine's website is a good repository for news as well as observing information. They have sky charts, observing tips and trick as well as a wealth of astronomy news.

Astronomy: http://www.astronomy.com/
Astronomy magazine covers astronomy news as well as provides observing information. You can access sky charts, product reviews, breaking news, sky charts and a wide variety of observing tips.

Astronomy Cast: http://www.astronomycast.com/
One of the most popular and well produced astronomy podcasts on the web intended for a general audience. Topics cover all areas of astronomy and you can search the catalog of podcasts by topic. The popular question shows allow listeners to send in their own questions to be answered.

Juplet: http://www.shallowsky.com/jupiter.html
The "Juplet" will plot the positions of Jupiter's four Galilean Moons for a given date and time. This applet is extremely easy to use. You can identify which of the Moons will be visible and their precise location.

Jupiter's Moons Javascript Utility:
http://www.skyandtelescope.com/observing/objects/javascript/3307071.html#
This more powerful applet will also predict when you can see satellite shadows cross the face of Jupiter. In addition to a map of the positions of the Moon, it provides a narrative of major events such as show transits and eclipses with start and end times.

Saturn's Moons Javascript Utility:
http://www.skyandtelescope.com/observing/objects/planets/3308506.html
This online tool allows you to find the position of Saturn's moons on any given night and time. The applet will match the view as seen through your telescope, reversing and inverting the image as appropriate for your optical system.

You Are Galileo:
http://www-irc.mtk.nao.ac.jp/~webadm/Galileo-E/index.php
You are Galileo, developed by the National Observatory of Japan, focuses on students recreating Galileo's historic observations. It includes observing guides and logs for several objects., Students can make observations and send them in to receive observing certificates.

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