Galileoscope Observing Guide 2012

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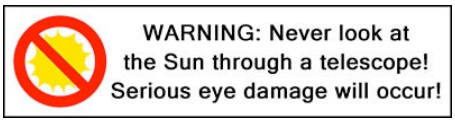
Introduction to Observing with the Galileoscope

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!

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.

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 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 progress 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 Saving 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!

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 photographed 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 2012

The following chart gives the dates for New Moon, First Quarter Moon, Full Moon, and Third Quarter Moon for 2012 (all dates are in Universal Time).

Month	New Moon	First Quarter	Full Moon	Third Quarter
January	23	1/31	9	16
February	21	-	7	14
March	22	1/30	8	15
April	21	29	6	13
May	20	28	6	12
June	19	27	4	11
July	19	26	3	11
August	17	24	2/31	9
September	16	22	30	8
October	15	22	29	8
November	13	20	28	7
December	13	20	28	6

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 2012 are listed below.

January 3rd, 3:00UT: Jupiter is five degrees south of the Moon

January 26th, 19:00UT: Venus is seven degrees south of the Moon

January 30th, 15:00UT: Jupiter is five degrees south of the Moon

February 10th, 12:00UT: Mars is ten degrees north of the Moon

February 23rd, 6:00UT: Mercury is six degrees south of the Moon

February 25th, 22:00UT: Venus is three degrees south of the Moon

March 8th, 6:00UT: Mars is ten degrees north of the Moon

March 11th, 7:00UT: Saturn is six degrees north of the Moon

March 26th, 0:00UT: Jupiter is three degrees south of the Moon

March 26th, 18:00UT: Venus is 1.8 degrees north of the Moon

April 7th, 14:00UT: Saturn six degrees north of the Moon

April 19th, 2:00UT: Mercury eight degrees south of the Moon

April 22nd, 19:00UT: Jupiter is two degrees south of the Moon

April 25, 2:00UT: Venus is six degrees north of the Moon

May 1st, 14:00UT: Mars is eight degrees north of the Moon

May 4th, 22:00UT: Saturn is six degrees north of the Moon

May 22nd, 21:00UT: Venus is five degrees north of the Moon

May 29th, 11:00UT: Mars is seven degrees north of the Moon

June 1st, 5:00UT: Saturn is seven degrees north of the Moon

June 17th: 8:00UT: Jupiter is 1.1 degrees south of the Moon

June 18th, 1:00UT: Venus is 2 degrees south of the Moon

June 28th, 12:00UT: Saturn is six degrees north of the Moon

July 15th, 3:00UT: Jupiter is 0.5 degrees south of the Moon

July 15th, 15:00UT: Venus is four degrees south of the Moon

July 20th, 8:00UT: Mercury is 0.5 degrees north of the Moon

July 24th, 22:00UT: Mars is four degrees north of the Moon

August 13th, 20:00UT: Venus is 0.6 degrees south of the Moon

August 16th, 5:00UT: Mercury is four degrees north of the Moon

August 22nd, 3:00UT: Saturn is five degrees north of the Moon

August 22nd, 8:00UT: Mars is two degrees north of the Moon

September 8th, 11:00UT: Jupiter is 0.6 degrees N of the Moon

September 12th, 17:00UT: Venus is four degrees north of the Moon

September 18th, 14:00UT: Saturn is five degrees north of the Moon

September 19th, 21:00UT: Mars is 0.1 degrees north of the Moon

October 5th, 21:00UT: Jupiter is 0.9 degrees north of the Moon

October 17th, 2:00UT: Mercury is 1.3 degrees south of the Moon

October 18th. 13:00UT: Mars is two degrees south of the Moon

November 2nd, 1:00UT: Jupiter is 0.9 degrees north of the Moon

November 11th, 18:00UT: Venus is five degrees north of the Moon

November 29th, 1:00UT: Jupiter is 0.6 degrees north of the Moon

December 10th, 12:00UT: Saturn is four degrees north of the Moon

December 11th, 14:00UT: Venus is 1.6 degrees north of the Moon

December 12th, 1:00UT: Mercury is 1.1 degrees north of the Moon

December 15th, 10:00UT: Mars is six degrees south of the Moon

December 26th, 0:00UT: Jupiter is 0.4 degrees north of the Moon

Lunar Eclipses
There are no total lunar eclipses in 2012. The is a partial lunar eclipse on June 4th and a penumbral lunar eclipse on November 28th.

On June 4th, the penumbral eclipse begins at 8:48UT. The Moon enters the umbra of Earth's shadow at 9:59UT. Maximum eclipse occurs at 11:03UT. The umbral phase ends at 12:06UT and the penumbral phase ends at 13:18UT. At maximum eclipse, 37.5% of the Moon with be in Earth's shadow.

The timing of this eclipse favors the Pacific Islands New Zealand, and eastern Australia. Most of North America will see the eclipse occurring as the Moon sets. The eclipse will be in progress at Moonrise for eastern Asia. The eclipse is not visible from Europe, Africa and most of South America.

A penumbral eclipse occurs on November 28th. The Moon will never enter the darkest part of Earth's shadow, but this is a fairly deep penumbral eclipse so observers should notice the change in the brightness of the Moon, particularly the northern half. The penumbral eclipse begins at 12:14UT, greatest eclipse is at 14:33UT and the eclipse ends at 16:51UT.

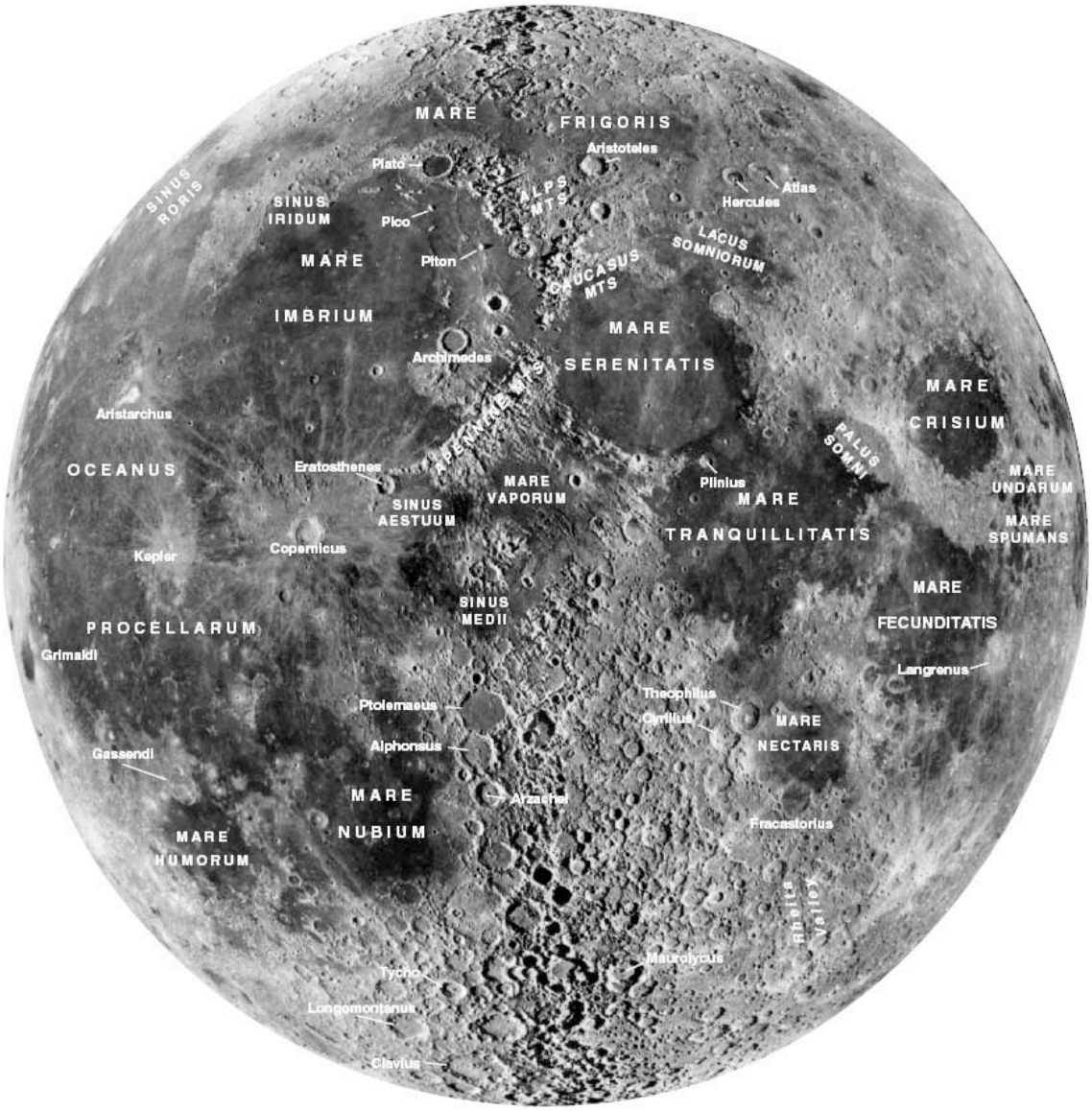
This eclipse will occur at Moonset for most of North America. The entire eclipse will be visible in New Zealand, Australia and most of Asia. The eclipse will occur at Moonrise for most of Europe and Africa. The eclipse is not visible from South America or west Africa.

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 this map:



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.

Solar Eclipses

2012 features two solar eclipses. We will focus on the first on which occurs on May 20th (the second solar eclipse on November 13th only touches land on a small part of Australia and the path is mostly over the South Pacific so few people will have an opportunity to observe it).

An annular eclipse will occur on May 20th, 2012. An annular eclipse differs from a total eclipse. Earth's Moon has an elliptical orbit. An annular eclipse occurs when the Moon is near apogee (farthest point from Earth) and the Moon appears too small in the sky to totally cover the disk of the Sun. At maximum eclipse from the center line, the Moon will have a thin ring (or annulus) of the Sun visible around it. It is not safe to observe an annular eclipse without proper eye protection.

The annular eclipse starts in eastern China and passes over Japan (near Tokyo) before crossing the Pacific Ocean. The path of annularity crosses over northern California, through Nevada, northern Arizona, southern Utah, and central New Mexico before ending at sunset in Texas. Much of the western and central United States will see a partial eclipse near sunset.

Annual eclipses are not safe to view with the naked eye. Be sure you are using eclipse glasses or a full aperture solar filter if you are using a telescope or binoculars. The plastic eyepiece makes the Galileoscope unsuitable for solar projection. However, you can build a Sun Funnel for the Galileoscope. For instructions on how to build a Sun Funnel, see http://transitofvenus.org/june2012/eye-safety/293-build-a-sun-funnel-for-group-viewing-with-a-telescope (the Sun Funnel is also useful for observing the Transit of Venus in June so this is a great year to build one!) The Sun Funnel can be used on any telescope that accepts a 1.25" eyepiece.

NASA has an interactive map you can use to find the extent of the eclipse and times at http://eclipse.gsfc.nasa.gov/SEgoogle/SEgoogle2001/SE2012May20Agoogle.html

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

Venus in 2012

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 in the western sky after sunset. It will be easy to spot due to its brightness. On February 10th, Venus will pass only 18 arc minutes from the planet Uranus. This conjunction should be visible in binoculars or a small telescope. Venus reaches greatest eastern elongation from the Sun on March 27th. On June 1st Venus passes only 12 arc minutes from Mercury. This will be a challenging observation as they are very low in the sky at the time.

The highlight of the year for Venus occurs on June 5th when Venus will transit the Sun. Transits are rare events and the next one will not occur until 2117, so don't miss this one! To observe the transit, you will need a properly filtered telescope of a pair of eclipse glasses. WARNING: DO NOT LOOK AT THE SUN WITHOUT PROPER EYE PROECTION. NEVER LOOK AT THE SUN THROUGH A TELESCOPE WITHOUT A FULL APERTURE SOLAR FILTER OR USING SOLAR PROJECTION.

You can build a Sun Funnel for the Galileoscopes using inexpensive pieces. You will want to build and test the Sun Funnel in advance of the transit. You can find directions how to build a sun funnel online at http://transitofvenus.org/june2012/eye-safety/293-build-a-sun-funnel-for-group-viewing-with-a-telescope

The transit begins at first contact at 22:09UT. First contact is when the edge of Venus touches the edge of the Sun. Second contact occurs at 22:27UT. Second contact is when the entire disk of Venus is on the Sun. Greatest transit occurs at 1:29UT. Third contact (when the edge of Venus begins moving off the Sun) occurs at 4:31UT and the transit ends with fourth contact at 4:49UT.

For most of North America, the transit will be in progress at sunset. The mid-Pacific through central Asia and Australia will see the entire transit. Western Asia, , Europe and east Africa will see the transit at sunrise. Western Africa and most of South America will not see the transit.

Many observatories and astronomy clubs will be hosting events to observe the transit. Be sure not to miss this historic event!

After the transit, Venus returns to the morning sky. On August 13th, the Moon will occult Venus at 20:00UT. The occultation will be visible from most of North America and eastern Asia. The exact time for the beginning and end of the transit will depend on your location. You can find a tool that will generate predictions for your location at http://transit.savage-garden.org/en/occultations/?id=20

Venus reaches greatest western elongation from the Sun on August 15th. Venus will begin slowly descending toward the Sun as the year progresses. On November 26th, Venus will have a very close conjunction with Saturn in the morning sky.

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 its four Galilean satellites (moons). Courtesy 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 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 2012

Jupiter passed opposition in October and starts 2012 high in the southern sky after sunset near the Aries-Pisces border. Jupiter moves into Aries and remains there until it is lost in the Sun's glow in mid to late April. Jupiter is in conjunction with the Sun on May 13th and emerges into the morning sky in June.

Jupiter is a morning for several months until it moves into the late evening sky. Jupiter reaches opposition on December 3rd in the constellation of Taurus. Jupiter will be well placed for observing for the entire month of December.

Observing Saturn

Introduction
Saturn is one of the most beautiful sights 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.

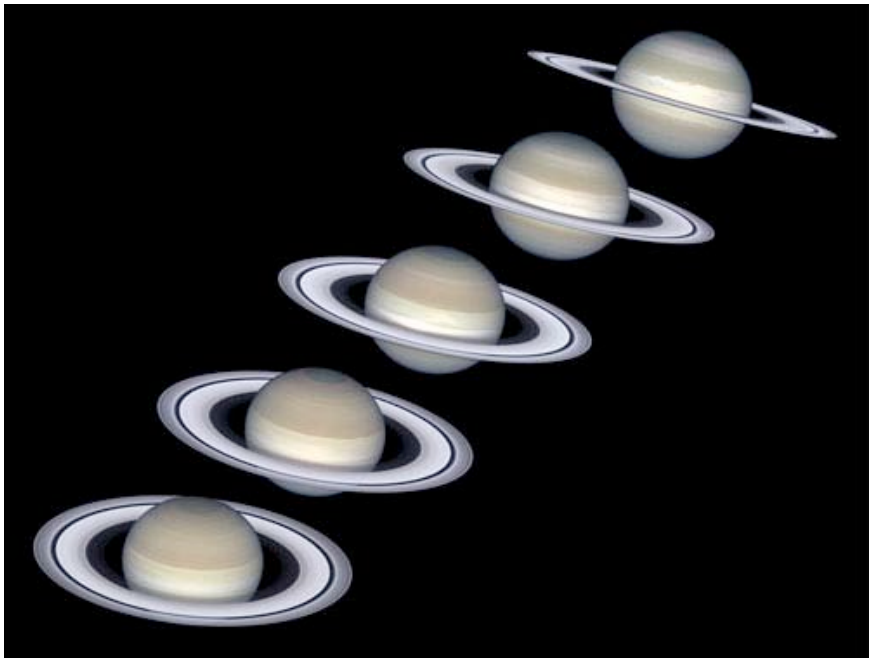
Saturn's largest Moon, Titan, is an easy observing target. Titan orbits Saturn once about every 16 days. You can find Titan's position by consulting the Observing Resources section. Unlike Jupiter's Moons, Titan's shadow is rarely visible on Saturn due to the presence of the rings. Only when the rings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

Saturn in 2012

Saturn starts the year in Virgo and does not rise until almost 2am local time. The best time to observe Saturn is right before sunrise when it is higher in the sky. Fortunately, Saturn rises a few minutes earlier each day making it easier to observe.

Saturn will come to opposition on April 15th. Saturn will rise at sunset, be highest in the sky at midnight and set at sunrise. Opposition marks Saturn's closest approach to Earth for the year and you will see the most detail if you observe during the weeks around opposition. Saturn will be well positioned for observing most of the summer in the constellation of Virgo. Saturn will be low in the west at sunset by late August/early September and getting difficult to observe. Saturn will be lost in the Sun's glare by early October. Saturn is in conjunction with the Sun on October 25th and will not emerge into the morning sky until early December.

If you observed Saturn last year, you will notice its rings are much more prominent. The rings are opening up after a ring plane crossing in 2009 when they were very difficult to observe. By the end of the year, the rings will have opened up to 18.8 degrees and will open even further in 2013.



Saturn from the Hubble Space Telescope. Courtesy NASA/STScI.

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 2012: March 5th, July 1st, October 26th
Morning Appearances in 2012: April 18th, August 16th, December 4th

It should be noted that Mercury starts January in the eastern sky before sunrise as it recently reached greatest western elongation on 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?)

Mars comes to opposition on March 3rd in the constellation of Leo. Mars has an elliptical orbit and will be near aphelion (its farthest point from the Sun) during this opposition so Mars will be farther from Earth and appear fainter and smaller than most oppositions.

Mars is a small planet so it is difficult to see lots of surface detail even at opposition. Still, Mars will be one of the brightest objects in the sky this spring and is bound to draw your attention. Mars is one of the objects you will want to push your Galileoscope up to 50x by using the Barlow lens. The summer solstice occurs for the northern hemisphere of Mars on March 30th. The northern polar cap will be small if not gone and the southern polar cap (where it is winter) will be growing. Keen eyed observers may spot them at 50x, but it is a challenging observation! Look closely for subtle markings.

Since Mars is small, the best time to observe is in the few weeks before and after the opposition. Mars will be too small to see much surface detail most of the year unless you have a large telescope.

Mars will move into Virgo later in the year. By early August, Mars will be very low in the west at sunset and be lost in the Sun's glare shortly thereafter.

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 spends the year in the constellation of Pisces. Uranus and Venus will have a very close conjunction on February 10th when they will be within 0.3 degrees of each other. The bright Venus and the faint Uranus will both easily fit in the same field of view for most telescopes. The challenge is picking out the faint Uranus with the bright Venus nearby!

Uranus will be lost to the Sun's glare in March. Uranus will be at opposition on September 29th.

Neptune begins the year low in the western sky and has its own close encounter with Venus on January 13th when they will be separated by 1.2 degrees (close enough to fit both in the field of view of the Galileoscope). Wait until the sky gets dark. Venus will be low in the west making for a challenging observation.

Neptune will come to opposition on August 24th while it is in the constellation of Aquarius. It's brightness does not vary significantly throughout the year so any clear, dark night it is visible you can attempt to see it.

Pluto is too faint to be seen with the Galileoscope.

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 2012.

January 13th, 7:00UT: Venus is 1.2 degrees south of Neptune

February 10th, 5:00UT: Venus is 0.3 degrees north of Uranus

March 3rd: Mars at opposition

March 6th, 23UT: Mercury is three degrees north of Uranus

March 15th, 10:00UT: Venus is three degrees north of Jupiter

April 15th: Saturn at opposition

April 22nd, 2:00UT: Mercury is two degrees south of Uranus

May 20th: Annular solar eclipse (see Solar Eclipse section)

June 4th: Partial lunar eclipse (see Moon section)

June 6th: Transit of Venus (See Venus section)

July 3rd, 23:00UT: Mercury is two degrees south of the Beehive Cluster

August 10th: Venus is five degrees south of M35

August 13th: 20:00UT: Moon occults Venus

August 18th, 21:00UT: Mercury is two degrees south of the Beehive Cluster

September 13th, 23:00UT: Venus is three degrees south of the Beehive Cluster

October 6th, 7:00UT: Mercury is 3 degrees south of Saturn

November 27th, 5:00UT: Venus is 0.6 degrees south of Saturn

November 28th, 20:00UT: Penumbral Lunar Eclipse

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 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.

Observing Log

Observer _____ Object _____

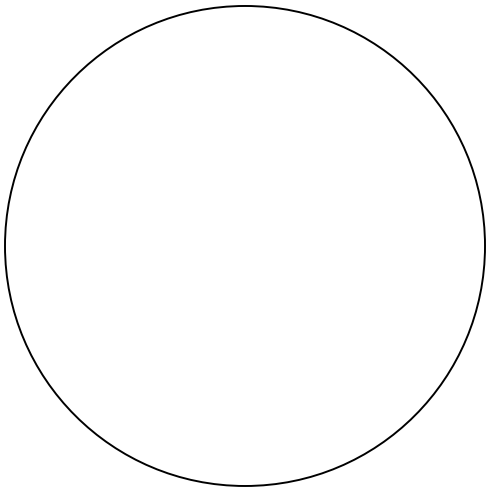
Date _____ Constellation _____

Time _____ Telescope _____

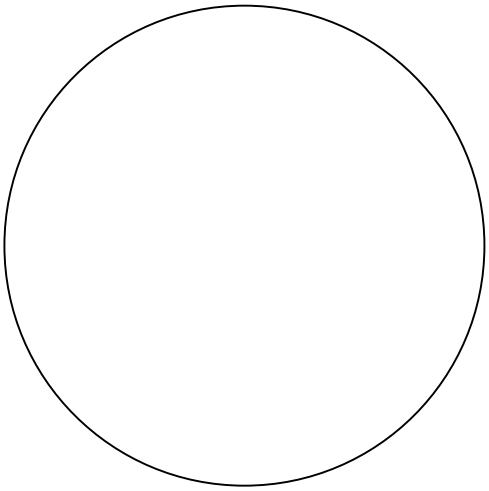
Location _____ Magnification(s) _____

Field Drawing

LOW-POWER VIEW



HIGH-POWER VIEW



OBSERVING NOTES AND COMMENTS

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.

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.