**Galileoscope Observing Guide**

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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 theMoon, 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.

One object not 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 can 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.

Another 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**

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.

When talking to students about observing, remind them that when they are choosing an observing site they should always keep safety in mind. They should not to use private property without permission and if they use a public park, they need to be sure to observe park hours and rules.

**Observing the Moon**

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.

Many people think the best time to observe the Moon is when it is full. However, 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 (<http://www.skyandtelescope.com> ) or *Astronomy* magazine (<http://www.astronomy.com> ). You can run a free planetarium program on your computer called *Stellarium* (<http://www.stellarium.org> ) that will give you the Moon’s rise and set times for any day.

**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.

**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.

**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.

Insert Milky Way image here.

**Observing Jupiter**

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.

**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 2009 and beyond**

The best time to observe Jupiter in 2009 is in late summer/early fall. Jupiter reaches opposition, when it is closest to the Earth and opposite of the Sun, on August 14/15, 2009. At opposition, Jupiter rises at sunset, is high in the sky at midnight, and sets at sunrise. Jupiter is at its closest approach to Earth and appears brightest in the sky and largest though a telescope. Jupiter remains well positioned for evening observing for the rest of 2009. In 2010, Jupiter will be at opposition, and brightest in September. For specific viewing times at your location, consult an online star chart program such as *Stellarium* (<http://www.stellarium.org> ).

**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.