How to Use your First Telescope

Hopefully you have read my previous article *Buying Your First Telescope*. If you have not, go read it now and follow the advice – I'll still be here when you get back! While you're gone you might as well read my equipment guide *Telescope Accessories (Visual)* on the Amateur Telescope Making Page.

If you purchase a telescope (as opposed to building one) the first thing to do is read the instructions; there is no substitute for that. Assemble your new telescope outdoors in broad daylight and become familiar with any controls it might have. Remember the next time you do this it could be in total darkness with just a faint red flashlight to help you out. Learning how to dis-assemble it for transport is just as important. You will probably find you need to keep a few simple tools and batteries nearby; put them in a container and place them next to the telescope so you will have them when you need them.

Upon reaching a dark sky site, unload the mount first, then set the telescope atop it. This is where the telescopes manual is the most important. Setting up the telescope could be literally a 15 second process for a small dobsonian or an hour-long task for a more complex mount. As all telescopes are a little different I can't give specific instructions for the set up of your model. If you own a reflector be certain to check the collimation – once again that is in the manual.

After the initial set-up your first concern is aligning the finder. This is often where the first-time telescope user makes the first critical mistake; *just because you slid the finder into its mount doesn't mean it is useable.*

Locate an easily visible and recognizable object at least a half mile away or a full mile if you can manage it. I have a particular fondness for radio towers, but you can use almost anything – a dead tree works well too. The key requirements are that it stands out just above the horizon, is distinctive and does not move (like a star does). Put your lowest magnification eyepiece (it's the one with the largest mm number stamped on the barrel) into the focuser of the main scope and point it at the horizon; you should have roughly half horizon and half sky in your field of view. Now sweep the telescope back and forth along the horizon until you locate your selected object. Carefully center the main scope on the red light on the top of the tower or whatever object you have chosen. Now look through the finder. Chances are you will see your object off center. Adjust the finder until the red dot (or crosshairs) are on your object. Close is not good enough, *it has got to be dead center*. There are two or three screws (sometimes six!) on the finder to help you do this. The next time you use the telescope the finder will require a smaller adjustment. Check the main scope again to make sure your fiddling with the finder did not make it drift off target.

Most beginner telescopes come with a red dot finder; instead of a dot it may use nested circles, or a grid, but the operation is the same. If your telescope came with a regular finder scope – buy a red dot finder; you really do need one. Keep the finder scope, it may well come in handy later.

Using a red dot finder could not be any easier! *Keep both eyes open,* one on the sky and the other peering thru the finder; you will see a red dot on the sky. Place the red dot on the object you wish to view, then look thru the telescope and there is the object! There is one caveat; you need to be using the lowest power possible on your telescope. This is always the eyepiece with the longest focal length – stamped in mm on the barrel. After you locate your object you may wish to switch to a higher magnification (a smaller focal length.)

Focusing the eyepiece can be a source of confusion for the beginner unfamiliar with the use of a telescope. Point the telescope anywhere there is a clear patch of sky. Rotate the focus knob until any dim

stars are merely tiny pinpricks of light. When they are at their smallest, the telescope is now in focus. Change to a higher magnification; now the telescope is no longer in focus, the stars are no longer pinpricks. Rotate the focus knob so the eyepiece moves closer to the telescope, the stars should come back into focus.

A note about focusing: the image may be in focus for your eye, but somewhat out of focus for someone else. This is especially true if you remove your eyeglasses for observing. People who are astigmatic should always keep their eyeglasses on; nearsighted or farsighted people do not need to wear their glasses as the telescope can easily compensate for those vision problems – but you will have trouble sharing your view with friends.

Put the lowest magnifying eyepiece back in and refocus. Now look for a real object to observe. The Moon is always a popular choice, especially if you live in the city where the stars are erased by the bright lights. Contrary to your first instinct, the worst time to observe the Moon telescopically is when it is full. The Moon is composed of low contrast rocks – when it is full, the Sun is positioned vertically and the surface features appear flat and mostly featureless. At some other phase, first quarter for example, the Sun is at an angle and casts dramatic shadows that make features practically jump out at you.

When focusing on the Moon the edge, (called the limb), should be as sharp as a tack. Sometimes it is not, and may look unsteady or even boiling. This is caused by Earth's atmosphere – tiny currents of air only a few inches wide are disturbing the image. This is called "bad seeing" in the astronomical jargon and is the bane of astronomers worldwide. It is the primary reason the Hubble Space Telescope was launched, to get above the unsteady atmosphere. Uneven temperatures are the cause. These air currents may exist inside your telescope; if so, waiting until the temperature of your telescope is the same as the surrounding air will make them go away. (Some astronomers use cooling fans to hurry the process.) Usually these air currents exist between your telescope and the object under study in which case you can do little. Relocation of your observing spot can be helpful sometimes, grassy fields far away from hot asphalt roofs and roads are about the best the average person can do. Professionals prefer mountain tops to get *above* the air currents as much as possible.

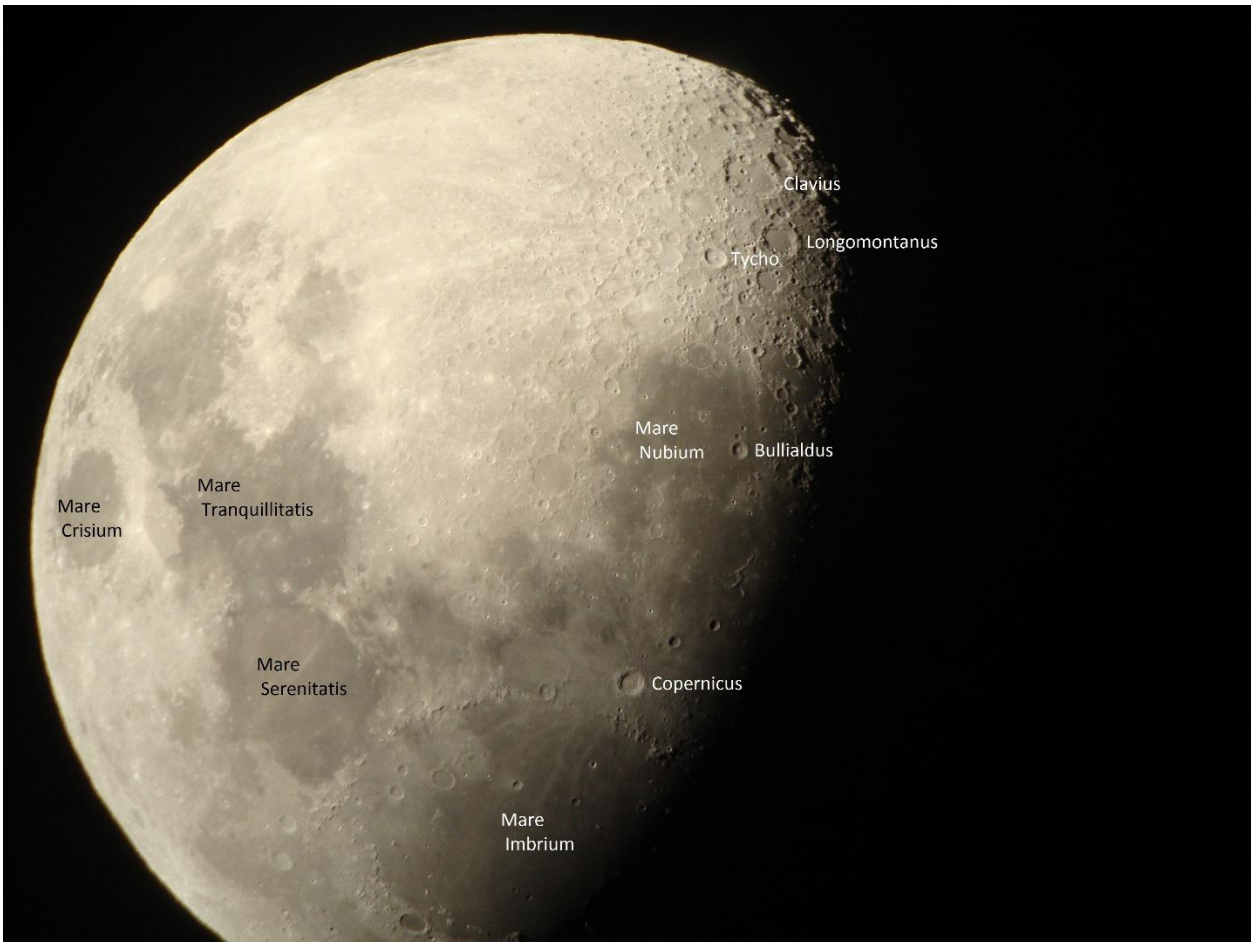
Fortunately for us, not all nights have bad seeing. Nights with higher humidity tend to steady the air and improve seeing. In humid states like Florida the seeing is definitely better than average. Unfortunately, higher humidity leads to less transparency of the air. It's like looking through a light fog. Just to add insult to injury, high humidity leads to dew which will quickly end your observing session. It's not a good idea to wipe your lenses or mirrors off – that can damage them. Just take them home and let them dry naturally. There are ways to combat dew; observers use shields, shrouds, hair dryers or dew heaters with varying levels of success.

If it sounds like the perfect night is rare – it is – but don't let that stop you. It is still possible to see quite a bit on the many average nights. On nights with below average transparency, planets are a good observing choice. The brighter star clusters show up well too. On nights with good transparency fainter stuff like galaxies are a fine choice.

Returning to the Moon, you must have noticed by now that using a reflector makes the Moon appear upside down. More subtly, if using a refractor or a catadioptric telescope, the Moon appears upright - but a mirror image. These can cause some problems when tracking celestial objects manually, but do not worry, with an hour or so of practice it becomes second nature.

More problematic are maps (often called charts). Maps that are not meant for telescopic use are printed with north at the top and normal image (that is, not a mirror image) typical of earthly maps. Such a map

turned upside down can be used with a reflector, but that makes it tough to read the labels. Mass confusion results when such a map is used with a refractor. If you purchase a map for use on the Moon or any celestial object make sure it is printed specifically to match the kind of telescope you use. Astrophotos are typically printed with South as up as most telescopes are reflectors. This is not a hard-fast rule as astronomers are apt to say, "there is no up or down in space!"



Above is a picture of the Moon taken at about 50x; south is at the top. The photo was taken with an ordinary point and shoot type of camera, not a specialized astrocamera, so some of the crisp detail that can be seen with your eye is missing.

The Moon is an object that never fails to astonish. Because it is so bright it takes high magnification very well. Drop your highest magnifying eyepiece (the one with the smallest mm number stamped on the barrel) and check it out! Remember to refocus inwards.

In case you haven't noticed yet, objects in the sky move through your telescopes field of view fairly rapidly – and the higher the power the faster they move. This is not really an issue if your telescope is computer controlled but it can be annoying to a beginner without the automatic option; eventually you will get used to it. This movement is not inherent in your telescope, but the earth itself is moving. The accepted technique to deal with the motion is to let the telescope drift (*all hands off*) until the object is near the edge of the field of view, and then nudge the telescope to bring the object back into full view.

A bigger problem with higher magnification is that the object under observation becomes both dimmer and a bit fuzzier. This becomes worse and worse as the magnification increases until the object becomes nothing but a dim gray fog. The problem is in the nature of light itself and can not be fixed. Rule of thumb on maximum usable magnification is 50x for every inch of aperture. Best views are probably attained at less than half of the maximum magnification. In any event magnification of even the largest telescopes is limited to around 400x or less, most of the time, because of our unstable atmosphere.

Now let's try out another target. Pick a planet to view. Jupiter and Saturn are always reliably entertaining, but Mars is good only about once every 26 months when it makes a close approach to Earth. Venus is the third brightest object in the sky after the Sun or Moon, but it is covered with clouds and is not particularly interesting to view. It does display phases though and the crescent is quite beautiful when it is close by Earth.

Let's try Jupiter for an example. Find Jupiter by using a star chart generated by your cell phone or a computer. You should have little trouble as it is always one of the brighter objects in the sky (when above the horizon of course!). Use your lowest power eyepiece and the red dot finder to zero in on its location.

Jupiter is a very large planet, but it is also very far away. A small disk should be in your telescopes field of view. First off notice there are two parallel lines on Jupiter's disk. Those are two bands of clouds on either side of its equator. Next observe that there are little stars lined up on either side of Jupiter's equator; there are usually three or four of them. Those are not stars at all but are the largest of Jupiter's satellites! During a single evening you can see the closest ones to the planet moving around. From time to time one or more satellites will throw a shadow on Jupiter's disk – a solar eclipse on another planet! You can find dates and times of such events on the internet.

Switch to high power.

A telescope always shows you more than you initially think it does. Spend some time looking at Jupiter and little details you may not have noticed before start coming into view. The longer you look the more you see. You may begin to see additional cloud bands on Jupiter; the dusky bands over the poles are easiest to observe. The two bands near the equator begin to resolve into swirls and festoons near their edges. After 15 or 20 minutes you might notice their position has moved slightly as the planet spins. On a good night you may see a spot or two including the Great Red Spot. The Great Red Spot is not always red; for some years it was a salmon color and mostly invisible in a small telescope except for the notch it makes in the Southern Equatorial Belt. Recently it has darkened to its more famous color, but is smaller than usual.

Now lets try a much more challenging target – the Ring Nebula in the constellation Lyra. It is very faint and is in fact completely invisible to the naked eye. You might think your red dot finder useless for an object like that, but it is not so. There is a technique called "star hopping" which, with practice, will find even invisible objects and amaze your friends who do not know the trick. An accurate and detailed star chart is an indispensable part of the technique until you get the location memorized. In general, to use the star hopping technique, find an easily identified star and work your way to the desired object by hopping from star to star.

Example:

Turn the brightness down on your red dot finder until it barely glows; this enables you to see the fainter stars better. Put the lowest power eyepiece you own in the telescope – star hopping is impossible with

high power. The field of view on your red dot finder is about ten degrees, your low power eyepiece has a field of view of around one degree by comparison.

The next part is done with your naked eye. Find Vega; an easy task as it is one of the brightest stars in the sky. It is in the constellation Lyra and is the only bright star in it. Quite close to Vega are two much dimmer stars of equal brightness, together they form an equilateral triangle. Near to one of the dim stars are three additional ones, also of about equal brightness forming a very nice parallelogram. (In star hopping one uses a lot of geometrical terms). All of this should be very plain on your chart and not at all hard to find in the sky. Also on your chart you will see the Ring Nebula marked, it may be listed as M57.

Mentally draw a line between the two stars of the parallelogram furthest from Vega. You will notice that the Ring Nebula almost exactly on this line and almost, but not quite, halfway between the two stars. You can not see the Ring Nebula with your eyes, but you can easily see where you need to put the red dot between the two stars. (This is all much easier to see in the sky than to describe.)

Look through your telescope; if you have done a good job you will see a tiny star or disk that looks out of focus although all the other stars look just fine. This star is the Ring Nebula (M57). Center the fuzzy star, quickly switch to high power and refocus. A tiny ring leaps into view! A large telescope shows a lot of haze within the ring while a small one shows little or none.

If you don't happen to see it on your first try, recheck the position of your red dot; if that does not work slowly sweep the scope back and forth until you find the nebula.

That's all there is to it! About anything within the grasp of your telescope can be located using similar methods.

At your first opportunity acquire a list of Messier objects from the internet or a book. Locate them on your chart – they are labeled M1, M2 etc. They are the showpieces of the sky.

There is a limitation to star hopping; there are spots in the sky where useable stars are not found close to your object and the further you are away from a useable star the less likely you are to locate your object easily. These are the spots where a telescopic finder comes in handy. A finder scope has a much wider field of view than your main telescope, but much less than your red dot finder. The finder scope will possibly make your chosen object visible and you may turn your telescope to it. At worst your finder will make additional stars visible and you may use those to continue to hop to your object. In this situation use the red dot finder to locate a convenient star first, then examine your chart for telescopic stars to lead you to your destination. It greatly helps if your chart maps stars to the highest magnitude your telescopic finder can see.

Stuff to look at:

Nebulas: Nebula is derived from the Latin word for cloud, and that is pretty much what they look like. They come in a few different types: Emission nebulas glow with their own light, Reflection nebulas shine, as the name implies, by reflected light from nearby stars. It is not at all uncommon for a particular nebula to be of mixed type. Planetary nebulas are the remains of dying stars and have nothing at all to do with actual planets. They can show small disks similar looking to planets, hence the name. Nebulas are frequently associated with star clusters.

Star Clusters: Clusters come in two basic types, open or galactic, and globular. Open clusters contain just a few tens of stars up to a few thousand stars sprawled out in a random way. Open clusters often

contain associated nebulosity. Globular clusters contain ten thousand to around a million stars gathered into a tightly organized globe; a small telescope can't pry out the individual stars in the center of the globe. Larger sized amateur ones can; it is quite a sight! Globular clusters never contain nebulosity.

Galaxies: A galaxy can contain a few million to perhaps a hundred trillion stars. (Yes, I said trillion!) They are a terrific distance away and tend to be quite faint although a couple can be seen by the naked eye. They come in several types: spiral, elliptical, and irregular. They look very much like nebulas in a small telescope and were so classed until the 20th century.

Double Stars: Not all stars are alone like the Sun, many have stellar companions. Important scientific knowledge can be gained by a close study of double stars but for the beginner it is enough that some doubles are quite beautiful. Check out Albireo, (Beta Cygni) in the beak of Cygnus the Swan to see what I mean.

The above list is not exhaustive; any number of other things are visible in your telescope. Comets, asteroids, moons, not to mention other planets within our Solar System are within your reach. Variable stars, white dwarfs and red supergiants roam our galaxy. The universe is yours!

Notes on observing techniques

Averted vision is your friend. You eye is most sensitive to dim light when you are not looking directly at it. Objects and details that are invisible when you stare right at it are reveled when you look ever so slightly to one side. On the other hand, if you want to determine the color of an object, stare right at it.

Low magnification is also your friend. Objects in space are largely invisible to the naked eye not because they are small, but because they are faint. The apparent size of the Andromeda Galaxy is several times that of the full moon, but it's hard to spot because it's faint. Low magnification maximizes your telescopes light gathering ability. Probably 80% of the time I have my lowest magnification eyepiece in the telescope. The big exceptions are double stars, where the extra magnification may be needed to "split" a close double and planets, which have quite tiny disks.

In general, the higher an object is in the sky, the brighter and better it looks. When ever possible look at an object when it is at its greatest height above the horizon.

On cool, dewy nights keep your eyepieces in a warm pocket (caps on!). This will greatly help with the dew. Once all your eyepieces dew up your observing is over. If you are not using your telescope for awhile it is also a good idea to cap the tube and your finders too.

Refocus often, it seems to rest your eyes a bit and sometimes you find your focus better than it was before.

Occasionally, especially when using dobsonian mounts, the telescope may become unbalanced when using large eyepieces or finderscopes. Add weight to the opposite end to restore balance. Buy a box of shotgun pellets and attach Velcro to a soft bag full of the pellets. Stick the bag on the end of the telescope when required. This will save you a trip to the hospital someday. It is all too easy to drop steel weights on your feet in the dark and break your toes or worse. Bags of shot don't hurt very much!