



*Observing in Pennsylvania, Maryland, and West Virginia*

[www.tristateastronomers.org](http://www.tristateastronomers.org)

## *Guide to Buying a Telescope*



**Dobsonian Mount**



**German Equatorial Mount**

***Confused?  
We can help!***



**Alt-Az Fork Mount**



**Altazimuth Mount**

## **WHAT TELESCOPE SHOULD I PURCHASE?**

The most frequently asked question by someone new to astronomy is, “What is the best telescope for a beginning enthusiast?” The answer to that question is another question— what are your interests? You may be wasting your money on a telescope if you buy one before you have learned something about the various objects in the night sky and learn to navigate your way around it. You can accomplish that by doing some reading and observing with your naked eyes and a sky chart. Most bookstores carry sky charts and/or planispheres. These latter devices are graphical devices that can be set to show you the sky on the date and time you will be observing. Be sure whatever you use is large enough to read at night using a red filtered flashlight. A red lens flashlight will help keep your eyes dark adapted so you can see more stars. However, too bright a red light will still reduce your night vision so don’t overdo it. While you are buying your sky chart find an introductory astronomy book that looks interesting and purchase it as well. With this small investment and some time on the internet, you can get a general understanding of the constellations, learn how to find the North Star (Polaris) and discover what is meant by some astronomy terms such as declination (astronomical latitude) and right ascension (astronomical longitude).

You may also want to consider joining or visiting your local astronomy club. It is the best way to learn about different telescopes as well as being a great reservoir of knowledge about astronomy in general. You will find folks of every skill level from beginners like you to advanced amateur astronomers. Some may even have their own observatories, but what they all share is a willingness to talk to and help educate you if you want them to. These clubs get together to view the skies and may also have star parties open to the public. Star parties enable you to look through different telescopes and ask the owners what they consider the pros and cons of each. Many amateur astronomers have several telescopes so ask which one they use most often. That is very telling as the best scope is one that you use a lot.

A wonderful source of information on astronomical observing, equipment, and discussion forums is the Cloudy Nights Telescope Reviews located on the web at <http://www.cloudynights.com/index.php>. Be sure to check out the forums as there is not an astronomy topic that isn’t covered by them. You can get a lot of great information by searching the equipment forums and/or joining Cloudy Nights and asking questions of other forum members.

However, before you go and make a big investment in a telescope, you may want to consider doing some observing with binoculars. If you don’t already own a decent set of binoculars, you may want to purchase a set. A good size to get for astronomical use is something in range of 7x50 to 10x50. The first number (e.g., 7 or 10) refers to the magnification. The second number (e.g., 50) represents the size of the opening (aperture) of the front; the larger the aperture, the more light the binoculars will collect so you can see dimmer objects. You will need to consider the weight and size of your choice because you will need to hold them steady and over

time that can become difficult. Some binoculars can be attached to a tripod and that will eliminate the need to worry about the size or weight.

Once you have decided you are ready to buy a telescope, which one you purchase depends on what you want to see, which type of telescope you prefer, and how much you intend to spend. You should plan on doing some research to educate yourself before buying one. When you are ready to purchase a scope, first on your list of requirements should be ease of use. Larger and more expensive telescopes are wonderful; the views are sharper and impressive and they are able to see farther because they can gather more light and display dimmer objects. But the trade off is weight and set up time. You'll see more objects and enjoy astronomy much more with a smaller telescope you use frequently than you will with a larger one you rarely have the time or energy to set up. In a sense, a telescope costing \$1,000.00 that you only use 10 times a year is far more costly than a \$1,000.00 telescope you use 10 times a month. Whatever you do, be sure you have fun on the journey of discovering which telescope is the best for you.

Lastly, we will look at the most important consideration when you are purchasing a telescope, its aperture. Since the main purpose of a telescope is to gather light you will want to buy the largest aperture you can afford without giving up portability. The larger the aperture the more you will see and in finer detail.

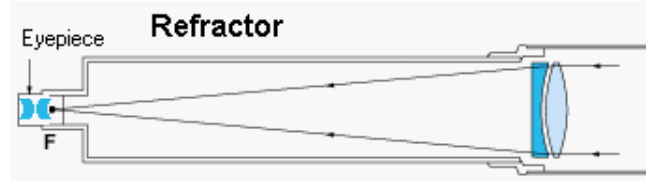
In general, you should not buy a telescope from a department store, a toy store, or from televised or on-line mass marketers. Never buy a telescope that is marketed based on magnification. All the magnification in the world is useless if the lens quality of the telescope is so poor all you see are fuzzy images surrounded with rainbow colors. A quality beginner telescope can be had for anywhere from several hundred to several thousand dollars. But no matter what you spend, your telescope is not going to give you images as great as those from Hubble. Even astrophotographs taken with whatever type of telescope you buy will show more detail than you will see through your scope while observing because of the ability of photographs to collect light from dim images over very long periods of time. All that said however, a quality scope will show you beautiful images that will please you for many, many years.

Now let's discuss what telescopes are available to an amateur astronomer. The options available to today's consumer can seem overwhelming. So the purpose of this guide is to give you some general information that you can use when you make your decision. The final choice you make will be determined by your personal preferences, your intended use, and your budget.

There are three basic types of telescopes (reflectors, refractors, and compound scopes) so we'll go over the pros and cons of each. We'll also go over the different telescope mounts available. Lastly, we will discuss aperture and focal lengths and their importance in your decision making process.

## Telescope Types

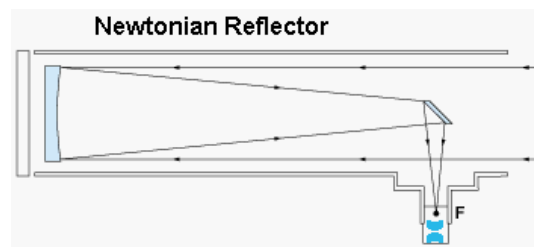
**Refractors-** This type of telescope uses lenses instead of mirrors and the main lens is located at the front of the tube. The image is projected through a smaller eyepiece lens at rear of the tube.



**Pros-** this telescope generally have sharper images, particularly for planetary and lunar objects.

**Cons-** Some secondary colors may be visible in all but the best units. This is known as chromatic aberration and results in a rainbow-like appearance around objects. Cheap "department store" telescopes typically have so much chromatic aberration they are very frustrating to use. A quality scope may have some, but it won't be significant enough to seriously degrade the images you see. Refractors can get very expensive as the aperture increases.

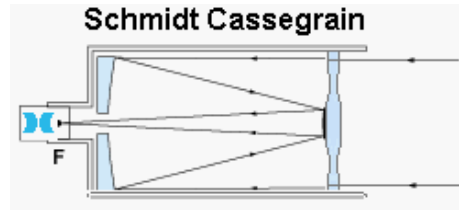
**Reflectors-** This type of telescope gathers light using a concave mirror at the rear of the main tube. The image is then bounced back to a smaller mirror at the front of the telescope. The smaller mirror is then viewed through the eyepiece which magnifies the image. Some types of reflectors are Newtonians and Dobsonians.



**Pros-** This type of telescope is generally less expensive for any given aperture.

**Cons-** You will need to make adjustments to the mirrors occasionally. Also the resulting image may be either upside down or flipped left to right.

**Compound-** As the name suggest this type of telescope employees both mirrors and lenses and fold the optical path back on itself, resulting in a compact tube. The most common design is the so-called "Schmidt-Cassegrain Telescope" or "SCT". Another compound type you'll see is the Maksutov-Cassegrain.

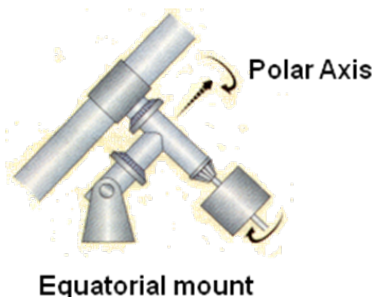


Pros-These telescopes are the most compact of the three designs, they are less expensive than refractors particularly as you go up in aperture. They are very popular.

Cons- They are more expensive than simple reflectors. Because they are designed with a piece of glass at the end of the scope that points to the sky, they can collect dew during an observing session if you don't use an accessory dew shield.

### Telescope Mounts

There are two types of mounts: the altitude-azimuth (Alt-Az) and the equatorial mount. The primary difference is in the way they move. The Alt-Az moves on two axes all the time: up-down (altitude) and left-right (azimuth). The equatorial mount also uses two axes but one (the polar axis) is used to align the axis of other with the rotational axis of the earth. Once that is done, the telescope need only move on the aligned axis to account for the rotation of the earth and so keep the object you are viewing in the viewfinder.



A variation on the Alt –Azimuth mount is the Dobsonian mount used with some reflecting telescopes. This mount offers the advantage of low price that allows you to buy a reflector with larger aperture. You have to determine what you think you'll be using your scope for most of the time. Equatorial mounts are preferred for astrophotography. Alt-Az mounts tend to be more comfortable for visual observing because the way the mounts work, the eyepiece moves around less with an Alt-Az than an equatorial set up. Although many Alt-Az mounts can be set up in equatorial mode, this requires an accessory device called a wedge. Finally, Alt-Az mounts tend to be lighter than equatorial mounts as the latter require counterbalance weights.



**Altazimuth Mount**



**Dobsonian Mount**



**Alt-Az Fork Mount**

Whatever type mount you buy, it should be stable. You can test this by tapping gently on the side of the telescope tube or eyepiece while viewing an object and noting how long it takes for the image to stop shaking. It should not vibrate for more than a second or so after you lightly rap the telescope.

Mounts come in either manual or computer-controlled versions. The latter enables the scope to continually track an object once you get it in the field of view. Without this feature, you will have to continually make adjustments to the mount to keep an object in view. Computer driven or “GoTo” mounts also contain a database of astronomical objects that you can select from a list, then hit a button and the telescope finds the object for you. This is a very handy feature for a new amateur astronomer and can get you observing very quickly. Computerized mounts require an alignment procedure each time you use them, but if you follow instructions provided with your equipment, you’ll do fine. Generally, you’ll need to enter some basic information like your location, the date and the time. After this initial set up, you align the scope by pointing it at a couple of bright stars so it can get its bearings so-to-speak. Some scopes require you to know the names of the alignment stars you point to during alignment, but that is not a problem if you have a basic sky chart with the stars labeled. However, many scopes also have an alignment mode that lets you point the scope to ANY 3 bright stars in the sky and it figures out which ones they were. How easy is that? Once your computerized scope is aligned, you can have the computer take you on a tour of the night sky or ask it to take you to a specific star, planet, or other astronomical object.

Well, it’s now up to you. If you take the advice in this short note and do some research, you’ll be ready to make an informed purchase of a telescope that can bring you years of enjoyment.

Good Luck and Clear Skies!

*The TriState Astronomers*

## Telescope Purchase Process Summary

1. Learn about Astronomy
  - a. Get a book or two, sky chart, and red lens flashlight
  - b. Learn astronomical terms, about the constellations, and how to find the north star
2. Join a local astronomy club
  - a. Ask the members for their advice
  - b. Attend some local star parties and observe through different telescopes
3. Try Binoculars
  - a. 7X50 or 10X50
  - b. Use a tripod to steady your view
4. Once you've decided you want to buy a telescope
  - a. What do you want to do with the telescope?
    - 1) Planetary and Lunar
    - 2) Deep Sky objects (star clusters, galaxies, nebulae, etc)
    - 3) All of the above
  - b. How much can you afford?
    - 1) Plan to spend at least \$300-500 for a quality manually controlled scope. Computerized mounts add capability but of course cost more.
    - 2) Don't under spend. A cheap or too small of a scope will disappoint you. Get a good scope to start; you can always "upgrade" later to improve your views
  - c. Strike a balance between telescope aperture size and portability
    - 1) Get the largest scope you can afford AND easily handle
    - 2) You won't use a scope that's too cumbersome to carry and set up
    - 3) To arrive at a solution that works for you: do your homework, visit a local dealer, talk to folks that own scopes, and look at other folks' scopes.
5. Some general buying suggestions based on what you want to observe
  - a. You want to do mainly planetary/lunar observing and bright deep-sky objects:  
Consider buying a refractor with a 3 inch (80mm) aperture  
Approximate starting cost: \$300
  - b. You want to do mainly Deep Sky observing:  
Consider buying a reflector with a 6-8 inch (150-200 mm) aperture  
Approximate starting cost \$300-\$1000
  - c. You want to do both planetary and deep sky observing:  
Consider buying an SCT with an alt azimuth mount with a 6-8 inch (150-200 mm) aperture  
Approximate starting cost: \$1,000-\$1,400
  - d. You think you will want to do astrophotography  
Use above buying guides based on your desired targets but only consider equatorial mounts
6. Some telescope manufacturers: Orion, Celestron, Meade, Stellarvue, Vixen, etc.

## ***Selected References***

### Books

*The Backyard Astronomer's Guide* by Terence Dickinson and Alan Dyer. Good source of information on telescopes, accessories, and some basics of observing.

*Turn Left at Orion* by Guy Consolmagno & Dan M. Davis. This introductory text focuses on objects you can see with a small telescope. It includes sketches of every object listed and organizes them by season.

*Nightwatch: A Practical Guide to Viewing the Universe*, by Terence Dickenson. This introductory text covers observing basics and includes observing aides such as star charts.

### Equipment

Some retailers on the Web:

Orion Telescopes & Binoculars at <http://www.telescope.com>

Oceanside Photo and Telescope (OPT) Corp at <http://www.optcorp.com>

Local: Hands On Optics, Damascus, MD and on the web at <http://handsonoptics.com>

### Astronomy on the Web

*The Backyard Astronomer's Guide* on the web at  
[http://www.backyardastronomy.com/Backyard Astronomy/Backyard Astronomers Guide.htm](http://www.backyardastronomy.com/Backyard_Astronomy/Backyard_Astronomers_Guide.htm)  
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The Celestial Observer at <http://calsky.com/>

Heavens Above at <http://www.heavens-above.com/>

Space Weather at <http://spaceweather.com/>

Online Books on Planetary & Lunar Science & Exploration at  
[http://nssdc.gsfc.nasa.gov/planetary/online\\_books.html#moon](http://nssdc.gsfc.nasa.gov/planetary/online_books.html#moon)

One of the best places to get information and assistance on astronomical topics on the web is the Cloudy Nights Telescope Reviews web site and its forums located at:

<http://www.cloudynights.com/index.php>