



# Choosing your first telescope

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June, 2009



## Introduction

Choosing a telescope can be a daunting task for a budding amateur astronomer. There are so many designs available across such a large spectrum of cost and quality that even experienced amateur astronomers feel bewildered sometimes. This article attempts to give an overall description of the telescopes and main accessories available in the hobby today, and also some very general advice on choosing a telescope.

### Binoculars First!

Most people feel that for them to be able to do astronomy, they would need a telescope. That is certainly not true. Astronomy, in essence, is observing the sky. This can be done with nothing more than your own two eyes. In fact, there are many aspects of the sky, such as constellations, the milky way and the movement of the sun, moon and planets that are best viewed with the naked eye.

Optical aids, however, will enable you to explore many thousands of celestial objects that are too small or too faint to be seen with just your eyes. But before you think about getting the latest greatest computerized telescope, maybe you should consider a good pair of binoculars first.

Binoculars are easy to use, provide wide fields of view and greatly increase upon what can be seen with the naked eye. They are also much less expensive than full fledged telescopes, and can be used for non-astronomy purposes. A good pair of binoculars will allow you to become familiar with the sky and the techniques used for observing objects



with telescopes. If you are not sure that astronomy is the hobby for you, a pair of binoculars will allow you to 'test drive' the hobby without any serious investment.

The most popular all purpose binoculars for astronomy are 7x50 or 10x50 binoculars (the first number refers to the magnification of the binoculars while the second number refers to the diameter of the lenses in millimeters).

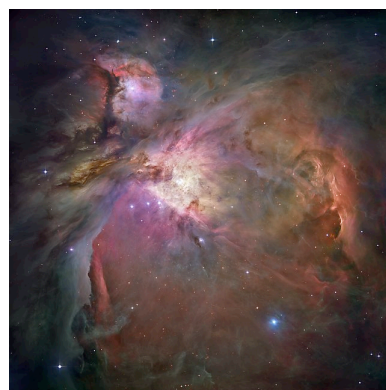
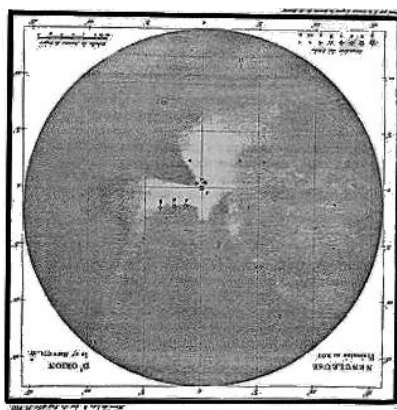
Much smaller binoculars show less objects while much larger ones become difficult to hold

up without a mount or tripod. When choosing a pair of binoculars, stick with well known brands and avoid 'cheap' brands, and remember that it is always preferable to view through the binoculars before you buy them.

### **What to expect when looking through a telescope**

The Hubble Space Telescope has taken many breathtaking pictures of celestial objects. Many astronomy magazines and websites are saturated with these pictures and others similar to them. Even the boxes of cheaper telescopes display these pictures as if the telescope would allow the user to see objects like those in the sky. The truth is, while those pictures are very beautiful, they are also the result of photography, and no telescope in the world would show off beauty and colors in celestial objects like the photos would.

A star, when viewed through a telescope, looks just like a star. Planets such as Saturn and Jupiter show a lot of detail in a telescope, and the Moon is absolutely breathtaking, showing countless crater, rays, mountains and plains. Nebulae, however, appear as dim grey smudges, while galaxies are even dimmer grey smudges. Observing these objects can be quite fulfilling, and a lot of detail can be gleaned with good equipment and a careful eye, provided one does not expect to see the bright colorful images shown in professional photographs.



The Orion Nebula (M42) as seen in a telescope (left) and in a Hubble photograph (right).

## Aperture Vs Power

Many first time telescope buyers are lured by marketing hype that promises 'high power views' of '1000x' or more. The fact is that any telescope can theoretically yield any magnification you want, whether 10x or 5000x, just by changing the eyepiece. The problem is that such high magnifications are not useful. Atmospheric turbulence ensures that magnifications beyond 400x are rarely usable in any telescope, and in fact a lot of observing is done well below 100x. Also keep in mind that higher magnifications yield smaller fields of view and require much sturdier mounts.

More important than power is aperture. The primary purpose of any telescope is to gather light, so the size of the objective lens or mirror, called the 'aperture', which is the main gatherer of light, is the most important consideration for any telescope. Generally speaking, the larger the aperture, the more light the telescope can gather, and the better the view. Thus, a 10" SCT will always outperform a 6" reflector of similar quality, which will in turn outperform a 4" refractor. Keep in mind that aperture is usually expressed in either millimeters or inches, so a 127mm telescope would have the same aperture as a 5" telescope. Conventional wisdom states that the useful maximum magnification for any telescope is about 50x per inch of aperture.

## Focal Length and Focal Ratio

The focal length of a telescope is the distance from the primary lens or mirror to the point where the light is brought to focus. For refractors and reflectors, this length corresponds closely to the length of the telescope tube. Focal Ratio is the ratio of a telescope's focal length to its aperture. For example, a telescope with a focal length of 900mm and an aperture of 100mm will have a focal ratio of 9, called F/9 (to get this number, divide the focal length by the aperture).

$$\text{Focal Ratio} = \text{Focal length} / \text{Aperture}$$

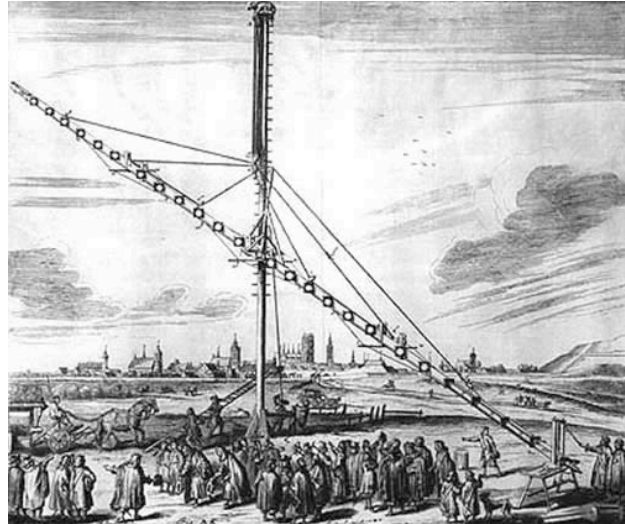
These numbers are very important. The focal length determines what power or magnification the telescope will give with any given eyepiece. Longer focal lengths give higher powers with narrower fields of view, while shorter focal lengths give lower powers with wider fields of view. For example, a 10mm eyepiece in a 500mm focal length telescope gives a magnification of 50x, while the same eyepiece in a 1000mm focal length telescope gives a magnification of 100x (to calculate magnification or power, simply divide the telescope focal length by the eyepiece focal length).

$$\text{Power} = \text{Telescope Focal Length} / \text{Eyepiece Focal Length}$$

Focal ratio is important to the optical quality of the telescope. Telescopes with high focal ratios (F/8 and above), called 'slow' telescopes, are easier to manufacture without optical defects. The slower the telescope, the easier it is to make high quality optics. The problem with this is that for any given aperture, if we want to increase the focal ratio we would have to increase the focal length, thus making the optical tube of the telescope longer and longer. In the early days of astronomy, some telescopes were longer than 100 feet! The other problem is that the magnifications provided by these telescopes are very high, with a

corresponding narrow field of view, which is perfect for certain objects such as the planets, but there are other objects in the sky that are best viewed under lower magnifications.

In order to make telescopes more portable, easier to mount and having wider fields of view, telescopes have to be made 'fast', which simply means having a lower focal ratio. There are many telescopes available today in the F/4 to F/6 range. These telescopes fit the largest aperture into the shortest tube possible, and provide the widest fields of view for their aperture. The problem with these telescopes is that it is significantly more difficult to make a fast lens than a slow lens (or mirror). If the optical components are not of the highest quality, aberrations will be apparent. For refractors, there will be chromatic aberration which produces false color and soft images. For reflectors, there will be comatic aberration, which causes objects that are not centered in the field of view to be distorted. There are fast telescopes that are of very high quality and do not display these problems, but they are usually very expensive.



Hevelius' 150 foot telescope (1641), designed to have a long focal length to increase optical quality.

### **Size vs portability**

Even though larger aperture telescopes always show better images than smaller ones, there are many reasons why a small telescopes are more desirable in certain situations. The first of these reasons is portability. The best telescope is the one that you use the most often. Many amateur astronomers have large telescopes that they rarely use because they are too difficult to take outside, they take too long to setup, too long to cool down and are just overkill on many nights. Some amateur telescopes are so big that they require a ladder to get up to the eyepiece! Many other astronomers live in light polluted urban areas and have to travel to get to a dark sky, and it is easier to travel with a smaller telescope. Keep in mind that a small telescope under a dark sky will show more than a large telescope under a light polluted sky.

Confused about what size you should get? The general rule of thumb is to get the largest telescope that you can easily carry around that will fit into your budget. The smallest size you should get is 80mm (about 3") of aperture. These telescopes provide large fields of view and are extremely portable. They are good for bright objects such as the moon, planets, double stars and vast star fields, but are not the best choice for faint galaxies and nebulae. Going up to 150mm (6") greatly expands the amount of objects that can be seen, so that bright nebulae, galaxies and globular clusters become good targets as well. For going after faint galaxies and nebulae, an 8" telescope and a dark sky are a must. 10" and over are considered big telescopes, and would excel at all objects, but have a limited field of view.

Also keep in mind that the design of the telescope plays a big part in its portability— a 6" refractor will be significantly larger and more difficult to mount than a 6" SCT.

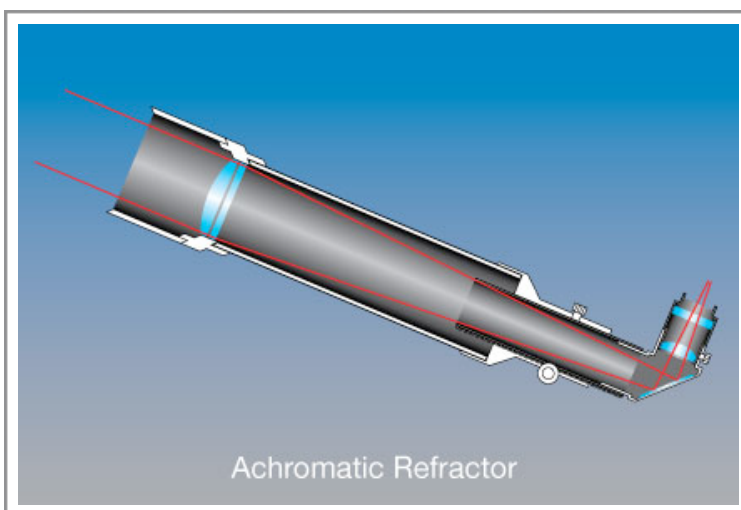


## Three types of telescopes:

Telescopes not only have different sizes but they come in different designs as well. There are three main types of telescopes used by amateur astronomers today: Refracting Telescopes, which use lenses; Reflecting Telescopes, which use mirrors; and Compound Telescopes, which use both. Each of the designs have their own advantages and disadvantages, and are each suited to different situations.

### Refracting Telescopes

Refracting telescopes use an objective lens to gather light and focus it to a single point. These telescopes are simple, rugged and easy to manufacture, and provide crisp, sharp images. Unlike the other types of telescopes, there is no 'central obstruction' in the objective, so images are brighter, sharper and more contrasty than images in similar sized telescopes of other designs. Inch for inch, refractors are the most expensive telescope design. They are usually not available in sizes over 6". Because of this, they are most often used for bright targets requiring sharp optics, such as the moon, planets, double stars and bright nebulae, and also for their wide fields of view.



Simple refractors do not focus light properly and produce images that have color distortions, called chromatic aberration. There are two main refractor designs that deal with this problem: achromatic refractors and apochromatic refractors.

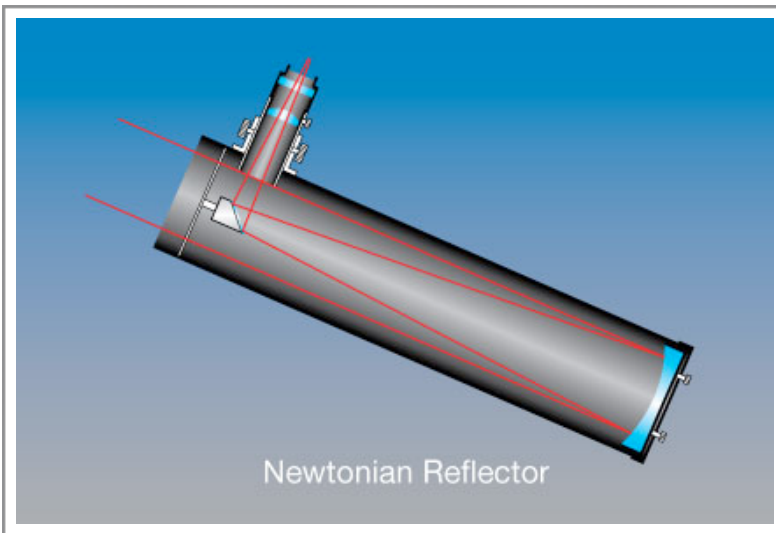
Achromatic refractors use two lens elements to try to minimize chromatic aberration. This technique only works well on long focal ratio telescopes, so short focal ratio instruments that use this

design usually exhibit a fair amount of false color on bright objects. However, these telescopes are rugged and cheap. The long focal ratio versions (F/8 and above) are excellent for lunar and planetary work but are cumbersome and not very portable. The short focal ratio versions (F/6 and below) are very portable, quick to set up and provide very wide field views, but show false color on bright objects such as the moon and planets.

Apochromatic refractors use multiple lens elements and special low dispersion glass to eliminate chromatic aberration. This technique works wonderfully for refractors of short focal ratios as well, resulting in portable telescopes that excel on the moon and planets while providing wide fields of view and ease of transport and setup. These telescopes, however, are extremely expensive, sometimes costing more than several large telescopes put together. Inch for inch, they are the best optical performers bar none, and they make excellent lunar and planetary telescopes, wide field telescopes and portable telescopes. They are the best small telescopes available, and are considered by many to be the finest instruments available for amateur astronomy, provided you can afford them.

## Reflecting Telescopes

Reflecting telescopes (also known as Newtonian telescopes) use a curved mirror to gather and focus light. Mirrors do not suffer from the same color distortions that plague refractors, and are much easier to manufacture in larger sizes than lenses. Because of this, reflecting telescopes are the design of choice for large aperture telescopes, including professional observatories.



Reflecting telescopes require a secondary mirror to direct light to the eyepiece. This 'central obstruction' reduces the brightness and contrast of the image somewhat. Fast focal ratio reflectors (F/5 or faster) also suffer from an aberration called coma, which causes objects towards the edge of the field to become distorted. What these telescopes lose, however, is usually made up by the sheer size of their primary mirrors, as reflectors are inch for inch the cheapest design available. They

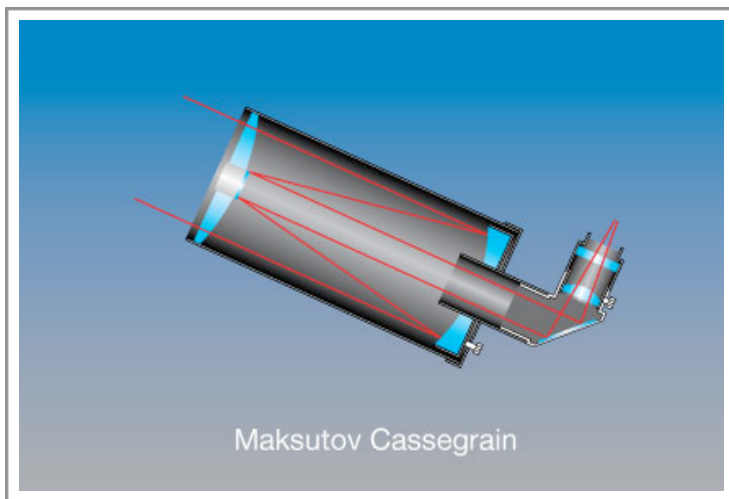
do require some periodic tweaking (collimation) to keep the optics perfectly aligned, and some amount of 'cool down' time for the optics to reach equilibrium with ambient temperatures before use.

Large reflectors (over 8") are excellent for chasing down the faintest fuzziest objects from a dark location, and give brighter views of all other objects. There are amateur reflector telescopes available for this purpose that have mirrors over 30" in diameter! Telescopes of this size are usually difficult to mount and use simple inexpensive mounts called "Dobsonian" mounts. A reflecting telescope on a Dobsonian mount is often called a Dobsonian telescope or just a 'dob'. These are the best telescopes when the most aperture for your dollar is required.

## Compound Telescopes

Compound telescopes, also known as catadioptric telescopes, use a combination of lenses (correcting plates) and mirrors to gather and focus light. The idea was to make a telescope that would not require a long unwieldy tube like the existing refractors and reflectors. The result was a compact telescope design that would allow amateurs to easily handle and mount large aperture telescopes, offering a combination of size and portability. In fact, most compound telescopes have long focal lengths and slow focal ratios (F/10 and slower), which would normally require very long optical tubes, yet they are the shortest and most compact telescope design.

There are two main types of compound telescopes: Schmidt Cassegrains (SCT) and Maksutov Cassegrains (MCT or Mak). Of the two, SCTs are generally cheaper and available in larger apertures, while Maks are generally smaller, more expensive, and provide somewhat sharper images. Both versions provide high quality images free of false color.



The design does have some drawbacks. They are significantly more expensive than similarly sized reflectors (although cheaper than apochromatic refractors), they suffer from a central obstruction and coma like reflectors, their optics are more difficult to align properly (for SCTs, not Maks), they have long focal ratios resulting in narrow fields of view, and they take a lot of time to cool down and reach thermal equilibrium before they are ready for use. Also, most SCTs achieve focus by moving the main mirror, and this

introduces some quirks such as 'image shift' while focusing and 'mirror flop' while moving around.

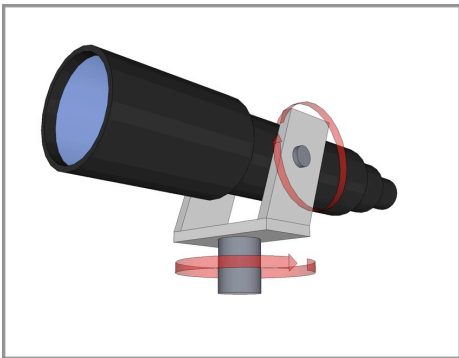
Despite these disadvantages, their combination of large aperture and small size make them excellent 'all round' telescopes, and in fact these are probably the most popular amateur telescope design. They also combine very well with computerized telescope mounts because of their compact size— they are very easy to mount, compared to refractors and reflectors. These telescopes are usually available in sizes ranging from 5" to 14", and may be the best choice for someone who only wants one telescope, or who needs a combination of large aperture and portability in a computerized telescopes.

# Telescope mounts

The best telescope in the world is useless without a proper mounting system. This is evident even when looking at the moon through binoculars: the high magnification amplifies every movement of the instrument. Just as there are different types of telescopes differing in cost and complexity, there are different designs of mounts. I will briefly mention three types of mounts: Altitude Azimuth, Equatorial, and Computerized or Go To mounts.

## Altitude azimuth / Dobsonian Mounts

Altitude Azimuth mounts are the simplest design available. These mounts allow you to move the telescope in an up-down direction (changing the vertical direction or altitude in the sky that the telescope points to) or in a left-right direction (changing the horizontal direction or azimuth that the telescope points to). It is this simple up down left right operation that makes this type of mount a favorite for small instruments used at low powers. The simplicity of the mount also makes it very quick to setup and easy to transport.



These mounts are also relatively cheap to manufacture, and this has led to their widespread usage on large 'Dobsonian' telescopes. Dobsonian mounts are a special type of altitude azimuth mount usually used on large reflector telescopes. Large telescopes, 10" and over, would require an extremely heavy and expensive mount if they were to be equatorially mounted. Dobsonian mounts make it very practical for amateurs to own huge telescopes, without having to worry about the technical and financial implications of mounting such a telescope.

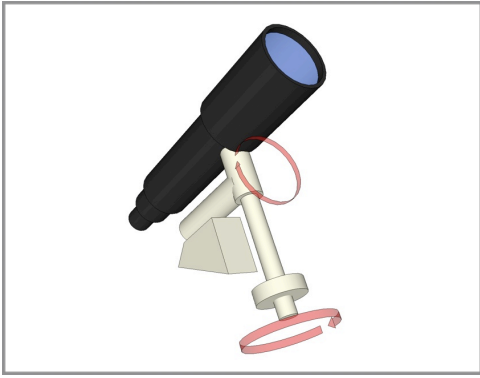
The great drawback of these mounts is that they cannot track the night sky. As the earth spins, objects in the sky rise in the east, travel across the sky, and set in the west. Since altitude azimuth mounts only move up, down, left or right, they cannot be configured to track an object using only one axis. This makes them difficult (although not impossible) to use at very high magnifications, as the telescope needs to be constantly nudged to keep the object within the field of view. It also makes these mounts useless for long exposure astrophotography— they are strictly for visual use.

## Equatorial Mounts

Equatorial mounts are designed to allow the telescope to track the movement of the sky using just one axis. This usually involves setting the mount to the current latitude of the observer, and then pointing the mount to the north celestial pole, or the north star, Polaris. Once this is accomplished, the telescope becomes 'mapped' to the global celestial coordinates, and adjusting one axis causes the telescope to move in the same direction as the stars. A simple motor is often used in these mounts to have the telescope track automatically. This is very important for observing at high powers (as is often the case when observing planets) because the objects tend to drift out of the field of view very quickly if the telescope is not tracking. It is also critical for long exposure astrophotography, because any movement of the sky relative to the camera causes images to exhibit 'trails'.

The disadvantage of equatorial mounts is that they are heavier, more complex and more expensive. This makes them less desirable for amateurs who want a light portable system for visual use, or who do not want the hassle of polar alignment every time the telescope





needs to be used. A larger telescope also requires a larger mount, and it quickly becomes impractical to acquire a large enough equatorial mount for telescopes larger than 14”.

These mounts are popular for more advanced and technically inclined amateurs who do not mind spending extra time to do a proper polar alignment and setting up the tracking system for relaxed high power observing, and are essential for anyone serious about astrophotography. In fact, for astrophotography, the mount is the most critical part of the entire setup, and often costs more than the telescope itself.

### **Computerized**

The introduction of affordable computerized telescope mounts revolutionized amateur astronomy. These mounts simplify one of the greatest challenges of amateur astronomy: finding the object you want to look at in the night sky. Computerized mounts, also known as Go-To mounts, usually feature a control pad with a display screen. The operator is usually required to perform a simplified alignment routine which the telescope uses to determine its position. Some mounts are equipped with GPS to aid this process. After the alignment, the telescope is ready to go and all the operator has to do is choose an object stored in the telescope’s database the the mount automatically points the telescope to that object. These mounts can also track the object across the sky, and offer more advanced features such as guided tours of the night sky.

The drawbacks of these systems are cost and complexity. While prices have been coming down as the technology advances, and the interfaces have been getting simpler and more user friendly, they do still require a little bit of technical inclination to get them to work properly. There are also low cost options available that do not work very well. These cheap Go-To systems are difficult to align and are rarely able to accurately find an object even when aligned. These should be avoided at all cost. Also, many of these telescope will not operate without an available power source.

Many amateur astronomers, however, believe that the biggest drawback of these telescopes is the loss of intimacy with the night sky. Many astronomers derive great satisfaction in exploring the sky from the eyepiece, tracking down faint and hard to find objects and in the process stumbling across features in the night sky that they would have never thought to look for. They believe that this fulfilling aspect of the hobby is lost when one can ‘point and click’ to find and object.

The ability to quickly locate an object, however, is very useful. The ability to locate objects in light polluted skies (which is traditionally difficult to do because there are less visible stars that can be used to point your way towards the object) is also very useful. This also makes it easier for a beginner to find faint objects without having to learn vast swaths of the night sky. For these reasons computerized telescope mounts are extremely popular with all who can afford the extra cost, and are willing to perform the required alignment.

## Accessories

There are an incomprehensible amount of accessories available to the amateur astronomer today. Many of these are only useful in specific situations, but there are some accessories that everyone should have.

### Eyepieces

After the telescope itself, the next most important component of the optical train is the eyepiece. The telescope is responsible for gathering light and bringing it to focus to create an image. It is the eyepiece that is responsible for magnifying this image and presenting it to the eye. The amount of magnification depends on the focal length of the eyepiece, so that different eyepieces are used when different magnifications are desired. The shorter the focal length of the eyepiece, the higher the magnification will be.



High power eyepieces range from 2.5mm to 10mm, medium power from about 10mm to 20mm and low power from 20mm up to 40mm. A well rounded eyepiece collection will contain several eyepieces covering a wide range of focal lengths. The actual magnification achieved at the eyepiece can be calculated by dividing the focal length of the telescope (which varies from telescope to telescope) by the focal length of the eyepiece. For example, inserting a 20mm eyepiece into a telescope with a 500mm focal length yields a magnification of 25x.

Eye relief refers to the distance your eye has to be from the eyepiece while viewing, and ranges from about 2mm to 20mm. A minimum eye relief of about 5mm is required to accommodate eyelashes comfortably, while 20mm is required in order to look through the eyepiece while wearing glasses. Any longer than 20mm makes it difficult to keep the eye in the correct position for viewing. Eye relief is usually good in long focal length, low power eyepieces, but becomes shorter in short focal length, high power eyepieces. Some modern high power eyepieces are specifically designed to provide ample eye relief as well as short focal lengths.

Apparent field of view (AFOV) is a value that determines how wide the field of view is when looking through the telescope. This measurement, which ranges from 35 degrees all the way up to 100 degrees, is important because it is easier to find objects in the sky with a wider field of view, and objects appear more pleasing and are easier to view when there is 'space' around them. Some objects are so large that they will not fit into a small field of view, even at low power. Modern Plossl eyepieces generally provide around 50 degrees AFOV, which is comfortable enough for general usage. Specially designed wide field eyepieces provide significantly more, usually ranging from 60 to 80 degrees. The wider the AFOV is, the more difficult the eyepiece becomes to manufacture without introducing aberrations, so well corrected ultra wide field eyepieces are very expensive. These highly prized eyepieces offer AFOVs from 80 to 100 degrees, and give the impression of 'walking in space' when viewing through them.

## **Eyepiece designs**

Eyepieces come in several different designs. By far the most popular eyepieces for amateur astronomers today are Plossl eyepieces, which are affordable, free from major aberrations, and provide a decent field of view. They do suffer from short eye relief in the short focal length range, and off axis aberrations on longer focal length ranges. Cheaper versions may also exhibit internal reflections. However, they are excellent all round performers at a decent price.

Orthoscopic eyepieces are an older design that are tack sharp and provide pristine images. They are almost completely free of optical aberrations, and have decent eye relief. Their main disadvantage is a relatively narrow apparent field of view of 40 - 45 degrees. Orthoscopic eyepieces were quite popular before Plossls came about, but still make excellent high power eyepieces for lunar and planetary observing.

Wide field eyepieces, such as the exquisite Naglers and Ethos, are among the most expensive eyepieces in the hobby. These eyepieces use a large number of optical elements to correct off axis aberrations, providing a large field of view (80 - 100 degrees) that is perfectly flat, sharp and dark across the entire field. The tradeoff is that these eyepieces become very heavy, being referred to as 'hand grenades' by many amateurs. They are also extremely expensive, often costing more than a small telescope.

## **Finders**

These are miniature telescopes with a very wide field of view that are attached to the main telescope and are used to help locate objects in the sky. They are described in terms of power and aperture, so a 9x50 finder has 50mm aperture and 9x power. Right angle finders differ from regular finders in that the eyepiece is at right angles to the main tube, allowing for more comfortable viewing.

Red dot finders (also known as reflex finders) project a red dot onto the night sky. You simply move the telescope till the dot is over your target. These finders are remarkably useful, being easy to use and accurate, especially for low power, alt-az type telescopes.

## **Diagonals**

Diagonals are mirrored elements that are attached to the back of refractors or catadioptrics (they are not necessary on newtonian reflectors). Their job is to redirect the light from going straight out the back of the instrument, instead sending the light out perpendicular to the optical tube. The telescope eyepiece is then attached to the diagonal instead of directly to the back of the telescope.

This arrangement makes for much more comfortable viewing, as it is a little difficult to get under an instrument when it is pointing high in the sky. The diagonal allows you to stand next to the telescope instead of having to go under it. The tradeoff is a very slight drop in the brightness of the image as some light is lost as light reflects off the mirror or prism. Some modern diagonals use special dielectric coatings to increase the reflectivity of the mirrors, resulting in a brighter image at the eyepiece.

## **Filters**

Filters are devices that allow certain wavelengths of light to pass through them, while blocking others. So a red filter, for example, will allow red light to pass through, while blocking all other colors and wavelengths. There are many types of filters available, each serving a different purpose.

Color filters allow certain colors to pass, and can usually be found in red, green, blue and yellow. These filters can be used to emphasize certain features on the planets, such as ice caps on Mars or details in Jupiter's atmosphere. They are also used in astrophotography.

Neutral density filters cut back on all the colors, yielding a dimmer image. These are used mostly to cut down the brightness of the moon and other extremely bright objects, which can be quite dazzling when viewed through a large telescope. Polarizing filters can also be used for this purpose, with the advantage that the strength of the filter can be adjusted.

Light pollution filters allow wavelengths from celestial objects to pass through, while blocking wavelengths generated by artificial lighting, thus allowing objects in the sky to be observed even in heavily light polluted areas. While the final image will be dimmer, the background sky will be dimmer yet, creating more contrast between the object and the background sky. The narrowband versions of these filters work pretty well, but only for certain types of objects. Bright emission nebulae are helped the most, but certain objects such as galaxies are not helped at all.

Solar filters are a special type of filter designed to allow the telescope to be used to observe the sun. Viewing the sun through a telescope with a filter can cause severe eye damage, but with a properly applied filter it can be done safely. The type of filter that fits over the top of the telescope, covering its aperture, is safer than the type that screws onto the eyepiece.

### **Barlows**

A barlow is a device used to modify the magnification provided by an eyepiece. For example, a 2x barlow will double the magnification of any eyepiece used with it. A 3x barlow will triple the magnification. If you have a barlow, you will effectively double the amount of magnifications available in your eyepiece collection, as each eyepiece can be used by itself or with the barlow. It should be noted that some cheap telescopes come with 3x barlows designed to give the telescope extremely high magnifications (such as 1000x). Telescopes are generally useless at those magnifications so you would want to choose eyepiece/barlow combinations that would give useful magnifications (50x per inch of aperture).

### **Collimators**

Collimation refers to the precise aligning of all the optical components of a telescope. This alignment is critical in ensuring that images are sharp, especially at high magnifications. Some telescopes, such as long focal ratio refractors and Maksutov Cassegrains hold their collimation very well and this procedure is rarely, if ever, done by the user. Fast Newtonian Reflectors and SCTs, on the other hand, need almost constant attention by the user to keep their optics in collimation.

Collimators are a family of tools designed to aid in the collimation process. They can be as simple as a sight tube or as complicated as a barlowed laser. Laser collimators are very popular and they are quite good for quick collimations, and are simple for beginners to understand.

## Recommendations

So, after all is said and done, what telescope would I suggest you get? Well, there are a large number of factors, such as what type of observing would interest you, how light polluted is your home, how critical is portability etc.. However, a few general suggestion can be made.

A good beginner's telescope is a 6" or 8" dobsonian reflector. These telescopes are cheap, relatively portable, simple, easy to use and have plenty of aperture to view thousands of objects. Considering the price point that they are available at today, they are the perfect beginners instrument.

For someone who has a bit more money to spend and is technically inclined, an 8" SCT on a computerized equatorial mount is a very versatile system, that you can spend a lifetime observing with. It may take a little longer to cool down, but it more than makes up for that with good aperture, added portability and a motorized mount.

If maximum portability at a low price point is needed, a 100mm achromatic refractor at F/6 or F/7 on an Alt/Az mount is a versatile system that is easy to transport and easy to use. There will be false color on bright objects, and the relatively small aperture means the faintest objects will be beyond your reach, but this system will give breathtaking wide field views of bright deep sky objects, star clusters and double stars. If money is no object, then a similarly sized apochromatic or ED refractor (80mm - 100mm, F/7) will provide the same wide field views and portability, but with sharper views and without the false color on bright objects.



An 8" Dobsonian, quite possibly the perfect beginner's telescope.