Galaxies, Nebula and other Deep Sky Objects

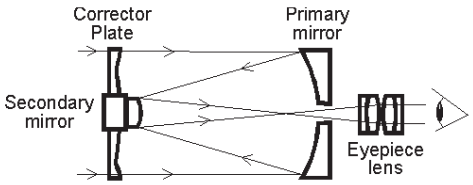
So far, we've concentrated on objects that are pretty close to Earth. As you get farther from Earth, the stuff you're looking at gets dimmer, and harder to find with the naked eye, but they also get bigger. A Galaxy is apt to contain thousands of stars.

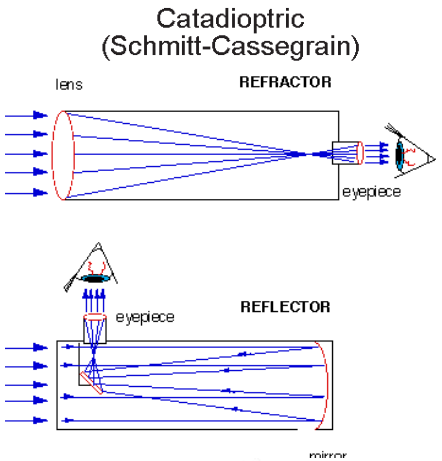
Here, there is no substitute for a big objective lens, and low power. Many people view deep sky objects at 40 to 80 power.

For more detailed information about buying a telescope, please see the links on our homepage www.bmas.org

SCT (Schmidtt-Cassegrain)
Equatorial Fork Mount

Refractor
German Equitorial Mount





Newtonian Reflector
Dobsonian Mount

Many people think they need expensive equipment to enjoy astronomy. The truth is, you don't.

In fact, one of the biggest mistakes you can make is investing in expensive equipment too soon. If you start out observing with just your eyes or a pair of binoculars, you'll get a better understanding of where things are, so when you do move up to a telescope, it will be easier to find what you're looking for.

If you aren't interested in what you can see with a 10 by 50 binocular, you might be wasting your money if you buy a telescope.

If you've decided you really like astronomy, and you want to see more, it's actually time to think about joining an astronomical society. Typical dues for an astronomical society are about $25 for a year. This will give you inexpensive access to good equipment, and a source of friends who will be happy to help you make a good decision when you finally make the plunge.

Buying a Telescope

If the box says *"300 POWER!"*, (or an even higher number) and the whole setup weighs less than 50 pounds, it's a useless toy.

The most important number when buying a telescope is the diameter of the lens or mirror. The wider the lens or mirror is, the more light it can gather.

Diameter of Objective Lens in inches	**Gathers this much light compared to human eye**
1" (25mm)	9
2" (50mm)	36
2.5" (62mm)	56
3" (75mm)	81
6" (150mm)	324
10"(250mm)	900

Serious Amateur telescopes generally don't advertise power, and if they did list a maximum power, it would be low compared to what the toys claim. On a very calm night, when the stars aren't twinkling, a good telescope will allow you to go up to perhaps 45 power per inch of diameter. A truly great one may go up to 80. Many amateur astronomers spend much of their time observing at 10 or 20 power per inch of diameter.

So a real telescope will probably be advertised by the diameter of the objective lens or mirror in inches or millimeters.

The next number you'll be interested in is the focal ratio or focal length of the scope.

This will typically be expressed in millimeters (mm) or inches, or as an F ratio. (i.e. F6) These figures are important when calculating magnification, and we'll cover them later.

The next most important factor is the mount. You want your mount to be stable, but most of us don't have the luxury of having an observatory to keep our personal scopes set up, so you also want the mount to be easy to move. A scope that stays in the house because you cringe at the thought of setting it up won't get much use. Mounts fall into two main categories, with several variations in each.

Altitude Azimuth (or Alt-Az) mounts are usually lower in cost. The draw back to this type of mount is as the earth turns, the telescope will need to be adjusted in two directions to keep an object centered in the field of view. This makes photography of anything but the Moon or planets impractical. The most popular kind of alt-az mount is called the "Dobsonian" after John Dobson, who invented it. The main advantage of the Dobsonian mount is you can build one easily and inexpensively with things you can buy at the hardware store. Many amateure astronomers enjoy building telescopes and mounts as much as looking through them.

The Equatorial Mount is like an alt-az mount, but can be tipped on an angle to match your latitude so once the telescope is properly set up you only need to turn it in one direction to keep an item centered in the field of view. Equatorial mounts often include a motor to gradually turn the telescope for you. Two of the more common equatorial mounts are the "German Equatorial" and the "Fork Mount".

A recent advance in consumer telescopes is the availability of mounts that incorporate computers, and even GPS navigation systems to let the telescope worry about the details of finding the objects you want to see.

With an equatorial mount, you should polar align it each time you set it up so you can use the setting circles to find objects. The Goto scope requires a simpler setup at the beginning of the night, and the GPS mount does practically everything but look through the eyepiece and say "Oooh" and "Ahhh" for you.

Telescopes can use a mirror or a lens to gather light. Mirrors (Reflectors) tend to be less expensive per inch of diameter than ones using only lenses (Refractors). This is because you need multiple elements to color correct a lens, but a mirror needs no color correction. Most refractors use Achromatic lenses, meaning they're color corrected for two of the primary colors. Apochromatic refractors use lenses that are color corrected for all three primary colors, and give wonderful images, but they cost more because they are made from more expensive glass, or have one or two extra lens elements.

Buying a used telescope can make sense. Telescopes are pretty simple devices, and most people take good care of them. Many astronomical gatherings will include a "Swap Table". This is basically an astronomical flea market. Larger gatherings will have 100 or more sellers. eBay can be a good place to buy, but make sure you know what it's worth, because many worthless toys are listed there as if they were valuable instruments. Remember shipping on a large telescope can be considerable.

If you can't afford what you want, wait until you can, or pick something that can be readily resold.

Eyepieces and Magnification

The magnification power of a telescope is determined by taking the focal length of the objective (big) lens or mirror, and dividing it by the focal length of the eyepiece.

A typical 8" telescope will have a focal length of 2000 millimeters, or 80 inches.

With a 40mm eyepiece the magnification would be: **2000/40=50**

At this power, you may be able to see the entire full Moon. The rings of Saturn will be visible, and you'll see the four larger moons of Jupiter, and some detail on Jupiter.

With a 25mm eyepiece you would have 80 power. At this magnification, you could expect to see slightly more than half of the full Moon, and you'd start seeing some detail in the rings of Saturn and the bands of Jupiter. The four larger moons of Jupiter star looking more like disks instead of points of light.

With a 12 mm eyepiece you would have 166 power. At this point, if the atmosphere is still, you will see Cassini's division in the rings of Saturn. If the atmosphere isn't still, you'll start feeling like you're looking through an aquarium.

With an 8mm eyepiece you can expect see more detail on the planets, but bear in mind, as power goes up, your need for a still atmosphere increases.

A 6mm eyepiece is usually the highest power you can expect to get a usable image with on a good night around here. This is 333 power in our hypothetical telescope. If the air is really clear, the things you saw at lower power will be bigger.

Most observers use the lowest power that will let them see the detail they're looking for. It makes finding objects easier, the telescope vibrations are less of a problem, and it's easier for your eyes to compensate for a smaller object than for a blurry one.

If you're a beginner, you probably want to start out with two or three eyepieces. If you shop around, you'll be able to find some reasonably good Plossl eyepieces for about $40 each. Space your eyepieces so you can step up and down in power by 50 to 100% at a time. If you can afford to buy more than four eyepieces, consider buying better quality ones instead.

Barlow Lenses

Some astronomers use something called a Barlow Lens. A Barlow is a device that multiplies the magnification you would get, usually by a factor of 2 to 3 times. If you wear glasses, a Barlow may make sense for you, as it allows you to have your eye farther back from the eyepiece at higher power. If you're not on a tight budget, you'll be better off with eyepieces that offer "long eye relief".

A Barlow is priced about the same as an eyepiece, so if you have a 40 and 25 mm eyepiece, a 2.5 times barlow will allow you to get magnifications you'd get with a 16 and 10mm eyepieces. The bad news is a perfect barlow is still going to cut down on the resolution of the image by the amount it magnifies.

Barlows are how those toy telescopes you see in the discount store get up to several hundred power. Sometimes they even give you two of them.