Choosing a Telescope
Robert Kuberek

Telescopes come in two main classes: refractors and reflectors. Refractors use a series of lenses to focus an image, while reflectors use curved mirrors. Generally, you look through refractors from the back end, either straight through or with a 90 degree diagonal. Reflectors may have the eyepiece holder in the back, like a refractor, or near the front on the side of the main tube. In every case, the critical parameters of the telescope are the aperture (diameter of the main optical element) and the focal length (the length of the light path from the main optical element to the eyepiece). So, for example, a common beginner's telescope is a 3" refractor with a 900mm focal length. This telescope has a primary lens 3" in diameter and the length of the tube is (a little more than) 900 mm.

There are several things you need to think about in buying your first telescope.

First, department store telescopes that advertise a 3" refractor or 4.5" reflector as giving 700x are bogus. (700x means that an object's image is magnified in the eyepiece to 700 times the object's apparent size.) In the first place, optically you need at least 14" of aperture (the diameter of the objective, or main, optical element) to get a decently sharp image at 700x--and preferably 20". These are huge and expensive. In addition, there are few sites on earth where the atmosphere is steady enough to allow for observing at anything like 700x. Even in good locations, atmospheric conditions limit usable magnification to 300-350x, regardless of aperture and quality of optics. The rule of thumb is that usable magnification (the highest magnification that produces sharp and pleasing images) is 50x per inch of aperture, assuming conditions and optics are perfect. Personally, I prefer to use 30x per inch of aperture at the maximum. This means that a 3" aperture telescope will produce decent images in the eyepiece only up to 90-150x, and an 8" aperture telescope will produce a reasonably sharp image only up to 400x!

Second, if your site is heavily light-polluted, you have no chance to see faint fuzzies. At a heavily light polluted site, you may only be able to see a handful of bright stars with the naked eye. In the telescope you may get decent views of the sun (with a proper filter), moon and planets. You will also be able to get wonderful views of many open clusters (assuming that you can find them in the bright, light-polluted sky). For the sun and moon almost anything will do and you only need 40x. Planetary observing is very demanding, however. You need aperture (for getting sharp images--see above) and you need focal length (for getting power using an eyepiece that has comfortable eye relief). Planetary viewing also takes patience. At many locations, only occasionally will atmospheric conditions permit good viewing at high magnifications. Often the air is unsteady, producing blurred or jumpy images, especially at high magnifications.

In any telescope you will be able to see color in planets and stars, but anything faint will appear colorless. In terms of planets, only Mars, Jupiter and Saturn offer views that show detail, though you can see phases in Venus and Mercury. Mars is visible for a few months about every year and a half, but rarely is close enough to the earth for you to see fine detail. Jupiter and Saturn are visible for a few months about every 13-14 months.

Third, the sky appears to move because the earth turns, so without a motor-driven mount in an equatorial setup, you will have to keep moving the scope by hand to keep an object in view. This can be annoying at high magnification, especially with a small scope on an inexpensive mount, since it will shake for a while every time you touch it. The corollary to this is that at higher magnifications it can be hard to find stuff. For this reason you also need a finder scope that has very low magnification and a wide field that is attached to the telescope. What I've found that works with a small refractor is a good, heavy tripod with a fluid head and 2-axis motion control. These are not cheap, but make a big difference. Remember: the higher the magnification, the more the image will shake with the slightest touch.

The importance of having a rigid, sturdy mount cannot be overemphasized. Often, beginners will buy a small telescope with an inexpensive mount because they don't want to invest heavily in something that will not end up panning out or will buy a nicer telescope with an inexpensive mount thinking that the "quality" of the optics is the most important thing. This is self-defeating. By buying a wobbly, inexpensive mount, the observer is virtually guaranteeing themselves a frustrating and unsatisfying experience. Not only will it be difficult to point the scope accurately and find the objects they want to observe, but even when they find the objects, it will be difficult

to focus because every time they touch the focuser the image will shake, making it very difficult to tell when proper focus has been achieved.

Fourth, while there is no substitute for dark skies, you can have a lot of fun looking at the moon and planets from the suburbs. For this purpose I would recommend a telescope with at least 4-5" (100-125mm) of aperture and at least 900mm-1200mm of focal length. Meade and Celestron both make decent, compact, versatile scopes in this range at reasonable prices, as do a number of other companies. Meade makes a 5" (125mm) ETX and Celestron makes a Nexstar in the same aperture. Both are computerized and motor driven.

An alternative, that is not motor-driven but can be very economical is a Dobsonian. A Dobsonian is a Newtonian (open tube with parabolic primary and flat secondary) reflector in a Dobsonian mount. Dobsonian telescopes are relatively inexpensive to make, even in large apertures, and can provide wonderful views. They are physically large and a bit unwieldy, but for the aperture Dobsonians produce by far the best value. Something like this might be decent:

http://www.meade.com/lightbridge/index.html

but there are many other choices. A good place to do some window shopping and price comparisons is Orion Binoculars and Telescopes:

http://www.telescope.com

Another place to look of alternatives to mass produced American telescopes is Internet Telescope Exchange, which tends to feature Russian and Chinese products, some of which are quite good:

http://www.iteastronomy.com/

When you have decided what wouid work best for you and are ready to buy, a good place to start is Astromart. Astromart provides a membership classifieds service which allow members to buy, sell or trade equipment on very favorable terms. Auctions are also offered for certain items.

http://www.astromart.com

It is also possible to find equipment on ebay. Recently, out of the blue, I had the chance to bid on a c. 1983 Celestron Orange Tube Comet Catcher *NEW IN BOX! T*he scope was around $400 and came in mint condition, only missing the eyepiece. Subsequent testing suggests that the Comet Catcher will make an excellent portable wide-field imaging system for astrophotography.

One other thing should be stressed. When you buy your telescope, remember that you observe the night sky in the dark. Even in summer, it can get chilly once the sun goes down, especially when you are just standing around. It's not fun observing when you are cold, so invest in cold weather gear. In summer you may get away with a coat, but at other times you may want thermals, heavy coveralls and something for your head and feet. You will look goofy, but in the dark who can tell? Aramark (formerly Wearguard) is a good source for heavy coveralls. Walmart also has them.

Finally, a good place to get the benefit of lots of hands-on experience with a wide variety of equipment and techniques is

http://cloudynights.com/

Here you will find articles, reviews and forums, as well as classifieds. Much of the material, particularly in the reviews sections is top notch. Enjoy!