“Every one should have a good telescope”

If you’ve spent some time staring up at the stars, perhaps you’ve wondered what you could see through your own telescope. With a good quality telescope, you can get “up close” to the celestial wonders, and add a new dimension to your enjoyment and exploration of the heavens. The critical term is “good quality”. Here is some advice on selecting a telescope, from a man who has purchased, built, and stared through quite a few over the years, and who has no stake in any manufacturer or dealer.

For backyard astronomy, there are four things to consider in selecting your telescope. In order of importance, they are:

1. Aperture: This is the diameter of the main light-collecting element (which may be a mirror or a lens). Aperture is by far the most important attribute of an astronomical telescope. Put simply: Bigger is better. The reason you need a telescope to see most celestial objects is that they are *faint*. A larger collecting aperture gathers more light, so you can see more (and fainter) objects in the night sky. Because this is the most important attribute of any astronomical telescope, you’ll often hear them described by their aperture: a “4 inch” scope has a 4-inch main lens or mirror. The great eye at Mt. Palomar is the “200 inch” telescope. One rule of thumb among amateur astronomers is “buy the biggest aperture that you can afford, and that you are strong enough to carry.” As a practical matter, I suggest going for a 6-inch aperture reflector. It has plenty of light-gathering capability, and if you later decide you’re not really interested, you won’t have mortgaged the house for it. Be prepared to spend $500 for a nice 6-inch reflector.

The telescope is a precision optical instrument. There is only one way for the average consumer to be sure that you’re getting high-quality optics: purchase from a manufacturer with a well-deserved reputation for quality. You probably don’t know who has a good reputation, and the average salesman at a department store doesn’t either. Talk to the people at a specialty telescope shop: they know the market, the manufacturers, the range of products, and the opinions of the experienced amateur astronomers among their customers. In general, you won’t pay a premium if you buy from the specialty shop – there is very little discounting of the major telescope manufacturer’s products.

2. Mounting: Your telescope must be solidly mounted, you must be able to point it accurately, and it must smoothly follow the stars as the Earth rotates. The mechanical quality and stability of the mount is a critical discriminator between “good quality” and “poor quality” telescopes. The mount on which your telescope rides should provide a solid, beefy tripod or pier, and smooth tracking motions – not too stiff, but not loose – and be well-balanced, so that when you let go of the telescope, it stays where you pointed it, without having to clamp down on locking knobs. A tripod with wobbly legs, or loose gears with a lot of backlash, are prescriptions for frustration! If you have a hard time pointing the telescope at a tree a block away, you’ll never get it pointed at the star you’re interested in.

There are two fundamental types of telescope mounts: “equatorial” and “alt-azimuth”. An alt-azimuth mount is simpler for most people to understand and use, since it pans the telescope in natural-feeling “left-right” and “up-down” directions. An equatorial mounts is a little more complicated because it moves the telescope around axes that are angled and oriented to follow the motion of the stars as the Earth rotates. The equatorial mount also tends to be a little more expensive. For your first telescope, either type is fine, as long as it’s sturdy, stable, and well-balanced with the telescope on it.

You can’t take long-exposure astro-photos through a telescope with an alt-azimuth mount. I don’t see this as a drawback – successful high-quality astrophotography will send you into a whole new world of trouble and expense! In the Alt-azimuth category, you’ll see a variation known as the “dobsonian telescope”. Dobsonian telescopes tend to look funny – not at all the stereotypical long tube pointing skyward – but they are a very clever and high-performing design.

Despite their odd looks, the Dobsonian telescopes feature large aperture at modest cost, with a rock-solid mount that makes them a delightful "starter telescope".

3. Reflectors vs. Refractors: Should the main light-collecting optic be a mirror ("reflector" telescope), or a lens ("refractor" telescope)? Each type has its advantages, but for backyard astronomy, the choice is not critical. Refractors tend to have less internally scattered light, and slightly "crisper" images. Reflectors can be made with high quality at "faster" f-ratio, providing brighter images, and are inherently free of chromatic aberration. For backyard astronomical observing, the reflector (mirror) telescope's combination of large aperture at reasonable cost usually wins. The reflector's primary disadvantage is that the images are "upside down" – which is no big deal if you're looking at stars and planets, but can be uncomfortable if you're looking at that bird on the hillside a mile away. Most refractors give "right side up" images, which is handy for terrestrial observing. If your heart is set on a refractor, be prepared to either compromise on aperture (settling for a 3.5" aperture instead of 6" to 8"), or invest a lot more money. A top-quality 6" mirror costs a couple hundred dollars; a top-quality 6" lens costs a few thousand dollars.

A third alternative is the "catadioptric" design, which combines lenses and mirrors to make a telescope that has large aperture, good image quality, and a compact size. The Schmidt-Cassegrain telescopes are the best-known and most-used examples of this technology. They fall roughly mid-way in cost between reflectors and refractors. A nice 8" Schmidt-Cass will cost one to two thousand dollars, depending on the "options and extras" you select.

4. Magnification: This is also known as the "power" of the telescope, and it is a widely misunderstood concept. Put simply: you don't need high magnification to see most celestial objects In most cases, too much magnification will spoil the image rather than enhance it. Don't be misled by advertisements for extremely high-powered telescopes. Most backyard astronomy will be done at relatively low magnification (in the 30X to 120X range). Most astronomical objects (star clusters, nebulae, and nearby galaxies) are *faint*, but they aren't all that *small*. For example, the Galaxy M-31 in Andromeda (a famous nearby galaxy) is a faint oval of light, but its angular size is several times larger than the full moon! Anyone who tries to sell you a 3-inch telescope and advertises 500X or 1000X (or more) is being disingenuous. Trust me, you will not be happy with that instrument!

Don't be dazzled by promises of high magnification. Instead, ask what the aperture is, and test how stable the mount is. Select your astronomical telescope based on (first) its aperture, (second) the stability of the mount, and never by the advertised magnification.

I also recommend that you check out the local astronomy club. The members will be a wealth of knowledge and experience. They can guide you to the "right" telescope for you, and can give you advice regarding local retailers. (Some retailers may offer small discounts to members of local astronomy clubs). You may be invited to a local observing party, where you can look through a variety of telescopes, and get some first-hand experience with several telescopes.

Happy stargazing!