Buying A Telescope

To learn more about the various models on the market, it is a good idea to peruse the pages of magazines that are released each month. In each issue you'll find advertisements telling you where to write to manufacturers and dealers for product literature and catalogues. You'll also find independent tests of products conducted by the staff of these magazines. Sky and Space, Astronomy and Amateur Astronomer are examples of such magazines.

Taking the time to research your purchase is a good idea. It's even a lot of fun. But don't agonise over the decision. With the exception of certain department store 60mm refractors, there are few lemons on the telescope market.

- **A Telescope Buyers Top 30 Questions**
- **Buyers Checklist**

It's true that you may, like most backyard astronomers, soon outgrow your first telescope. But here's a word of advice -- long-time astronomers who end up owning many telescopes over the years often find that their first telescope, as basic as it was, was the one that provided them the most enjoyment. The moral: keep your first telescope no matter what telescopes you later buy. You can then always recapture the thrill of your first sight of the universe.

A Telescope Buyer's Top 30 Questions

Buying your first telescope can seem like a complicated affair. There are many models to choose from and many technical terms to contend with.

To help you make the right choice, here are answers to 30 of the most-asked questions from prospective telescope buyers. You will find answers to your questions among them.

How much does the telescope magnify?

Beware of any telescope advertised as "500x" or "high-power." Some manufacturers make it sound as if the more magnification a telescope offers, the better it is. This is not true. Contrary to the claims of department-store catalogues, magnification is not important. Any telescope can be made to magnify any amount. However, the highest power that will still give you a clear view is about **50x per inch of aperture**, making the upper limit for a **3-inch telescope 150x**, and for a **4-inch telescope 200x**. **Beyond this limit, the image will be faint, fuzzy, and disappointing**.

How, Then, Do I Select The Best Telescope?

The key characteristic of a telescope is its aperture -- the diameter of the main lens or mirror. The larger the aperture, the more light the telescope gathers and focuses into the image. This in turn makes for a brighter, and usually clearer, image. Brighter images make it easier to see faint objects like nebulae and galaxies.

Which Are Better – Refractors or Reflectors?

A refractor uses a lens mounted at the front of the telescope to gather and focus light.

A reflector (sometimes called a Newtonian) uses a concave or bowl-shaped mirror mounted at the back of the telescope. Both work well; each has its advantages.

Reflectors generally offer more aperture for the money. (A 4-inch reflector costs around $500 to $700; 4-inch refractors start at $2,500 or more.)

However, refractors usually provide slightly sharper images than reflectors of similar aperture. Amateur astronomers who like to view fine details on planets often prefer refractors; those who like to look at faint deep-sky objects use reflectors. For most first-time buyers on a budget, either an 80mm or 90mm refractor or a 4.5-inch reflector is a good choice.

Both cost between $500 and $1000 and have comparable performance

What Are Schmidt-Cassegrain Telescopes?

A third type of telescope system, called a Catadioptric, uses a combination of mirrors and a refractive corrector lens at the front. The most popular of these hybrid models is the 8-inch Schmidt- Cassegrain. It folds a long focal length into a compact tube, making this type of telescope very portable and convenient to use for its aperture. It is also a good general-purpose telescope suitable for observing all classes of celestial targets.

What Are Apochromatic Refractors?

One of the principal problems with conventional refractors over 80mm aperture is spurious colour around bright objects caused by the inability of the lens to bring all colours to the same point of focus. To greatly reduce this "chromatic aberration," manufacturers have introduced refractors that use 3-element lens systems or special fluorite or "ED" lenses. Called Apochromatic's, these high-end refractors are among the finest optical systems you can buy and have become popular with telescope aficionados. However, a 4-inch "Apo" refractor can cost $2,500 to $5,000, more than what many people wish to spend on a first telescope.

How Much More Will I See With A Larger Scope?

Bigger telescopes can show fainter objects and resolve finer details in bright objects.

For example, a 2.4-inch (60mm) refractor will easily show the cloud-belts of Jupiter, a 4-inch will show structure within the cloud-belts, and an 8-inch will resolve even smaller details.

A 4-inch will show globular star clusters as fuzzy- edged spheres of light, a 6-inch will resolve many globular's into myriad faint stars, and a 12-inch will provide views of these clusters that surpass any photograph.

While a 4-inch will reveal a spiral galaxy as a round glow, an 8-inch will begin to reveal the galaxy's spiral arms.

Will I Be Happy With A Smaller 'Scope?

The fact that bigger telescopes usually show more details and fainter objects leads many people to believe small scopes aren't worth buying. But even an 80mm refractor can show you enough of the universe to keep you entertained for years. For many people it's all the telescope they ever need.
We warn people against buying a telescope that is too large -- yes, there is such a thing. A big telescope, though exciting at first, can quickly become a burden to carry out to the yard or car and to set up. The best telescope is not the biggest, or even the one with the best optics, but the one that you will use most often. Portability and convenience are factors we urge you to consider when selecting a telescope that you'll have fun using.

I Live In The City (Country) Where The Skies Are Terrible (Great). What Type Of Telescope Is Best For Me?

A large-aperture telescope can be useful at any site, but faint deep-sky objects (the kind big scopes are well suited for) won't show up well under urban skies, no matter what size the scope. City observers often spend more time looking at the Moon and planets, for which a 3- to 8-inch telescope is sufficient. Telescopes in that size range are also very portable, important for city observers who need to transport their scopes to better skies.

For most buyers, we feel that a 5-inch refractor, a 6-inch equatorial reflector, an 8-inch Schmidt-Cassegrain, or a 10-inch Dobsonian reflector (see question 16) are the largest telescopes of their types that are conveniently portable.
Only if you live under dark skies, or really don't mind lugging a big, heavy scope around, should you consider anything larger for a first telescope.

What Does Focal Length Mean? And F/Ratio?

The focal length of a telescope is the length of the light path from the main lens or mirror to the eyepiece. In most refractors or reflectors, the focal length is roughly the length of the tube. In telescopes such as Schmidt-Cassegrain's in which the light path is bounced back and forth inside the tube several times, the length of the tube is much shorter than the focal length. Focal lengths of telescopes, as with camera lenses, are usually measured in millimetres.
The f/ratio of a telescope is the focal length divided by the aperture. For example, a 100mm-aperture telescope with a 900mm focal length is an f/9 telescope. A 200mm telescope (an 8-inch) with a focal length of 1,800mm is also an f/9.

What Focal Length Is Best?

The focal length of the telescope is not a critical specification. Shorter focal lengths (400 to 700mm) will give lower powers and wider fields of view with any given eyepiece than will telescopes with moderate (800 to 1,200mm) or long focal lengths (1,300 to 3,000mm). For this reason, short focal lengths are often preferred for low-power viewing of deep-sky targets and Milky Way star-fields.
On the other hand, a long-focal-length scope will give a higher power with any given eyepiece. Since the planets require higher powers (100x to 200x), planetary fans often prefer long-focal-length scopes. But with the use of the appropriate eyepieces, most telescopes can be used at both low and high powers.

How Can A Telescope Be Fast Or Slow?

Sometimes manufacturers give the impression that a "faster" telescope (one with an f/ratio of f/4 to f/6) is better than a "slow" telescope (f/7 to f/16). After all, in many situations faster is better. But in this case it isn't. The term "faster" comes from photography where an f/4 lens will record an image with a faster exposure time than an f/16 lens.
And for those intending to take long-exposure photos through a telescope, faster scopes can be better. But when looking through a telescope, a faster telescope is not any brighter than a slower scope.
For example, as long as both are operating at the same power, the image in an 8-inch f/6 telescope will appear as bright as the image in an 8-inch f/10 scope. The difference is that with the same eyepiece the f/6 telescope will give a lower power and a wider field of view than will the f/10, making faster scopes preferred for deep-sky observing where wide fields are desirable.

What Is An Eyepiece For?

Eyepieces allow you to change magnification. To determine the magnification an eyepiece gives, divide the focal length of the telescope by the focal length of the eyepiece.
For example a 25mm focal length eyepiece used on a 2,000mm focal length scope (such as an 8-inch f/10 scope) will give 2000/25 = 80x. The same eyepiece used on a 1,600mm scope (such as an 8-inch f/6) will give 64x.

What Is The Little Scope For?

Finderscopes are essential accessories. They provide a low power (5x to 8x) and a wide field (3 to 5 degrees) and allow you to aim the telescope easily and centre it on bright planets and stars. Without a finderscope locating even the Moon can be difficult.

Why Are The Images In A Telescope Upside Down?

All astronomical telescopes present images that are either upside-down or flipped left-to-right as in a mirror. To flip the image right-side up would require extra lenses in the light path that would dim the view of already faint astronomical objects or add imperfections like flares and ghost images.

Which Is Better? An Altazimuth Or Equatorial Mount?

Alt-azimuth mounts use simple up-down (altitude) and side- to-side (azimuth) motions to aim the telescope. The best of these mounts are equipped with slow-motion controls to allow you to make fine adjustments to the position of the scope. However, alt-azimuth mounts cannot automatically follow the stars as they appear to arc across the sky from east to west.
An equatorial mount is more complex. It can follow the stars across the sky with a single motion around one axis. If the telescope is equipped with a motor, the telescope will automatically track the stars. This is a nice feature because at

magnifications of 100x or more, the apparent motion of the sky will cause objects to drift out of the field of view in less than a minute.
Having to re-centre the image constantly can be distracting, inconvenient, and can introduce vibration that shakes the image.

What About Dobsonian Telescopes?

A Dobsonian is a Newtonian reflector. Its unique feature is a simple wooden alt-azimuth mount that rides on Teflon pads. The philosophy of the populariser of this type of telescope, John Dobson, was to keep the scope easy-to-build and low-cost. The design also lends itself to relatively large apertures. Dobsonian's cannot track the stars automatically, but their motions are very smooth - it's easy to nudge the scope every so often to re-centre the object.
In most cases the fit and finish of the scopes is nothing fancy -- the mounts are painted chipboard, the tubes cardboard.
General opinion? For the money the quality of construction and optics can't be beat. The 8- and 10-inch models make good starter scopes. The 13- and 17-inch models are best for die-hard deep-sky observers.

I've Heard That You Can Make Your Own Telescope?

The Dobsonian design lends itself to do-it-yourselfers. Plywood for the mount and a cardboard tube like those used for concrete forms are the main ingredients. Few people make their own mirrors these days.
It can be done, but ready-made mirrors from suppliers don't cost much more than mirror- making kits. You'll also need a focuser and cells to hold the main mirror and the small secondary mirror.

What Accessories Do I Need?

Some telescopes come with only one eyepiece. Additional eyepieces for higher and lower powers are the first accessories most first-telescope owners need to buy. An accessory called a Barlow lens can double or triple the power of each eyepiece, but the best Barlow's (the only ones worth buying) cost $80 to $170.
Coloured filters can enhance views of the planets slightly, but the difference is subtle. They are not essential. Nebula or light pollution filters can improve views of some deep-sky objects like emission and planetary nebulae, but they do little to improve star clusters and galaxies. Contrary to what many beginning backyard astronomers believe, these filters are not a cure-all for light-polluted skies.
Computerised digital read-outs to aid in finding objects have become popular telescope accessories in recent years. They work well but are luxury options for those that can afford them.

Are Enhanced Coatings Worth The Extra Cost?

Some telescopes are offered with special lens or mirror coatings as optional extras (Celestron's Starbright for example). These increase the light transmission, making images up to 15 percent brighter. They are definitely worth the extra expense.

Can I Use Setting Circles To Find Things?

Many equatorial mounts are equipped with graduated dials called setting circles. Theoretically, these allow you to find objects by moving the telescope so that the circles' readings match the celestial coordinates (called right ascension and declination) of the object you're looking for. However, in our experience we have rarely seen a novice amateur astronomer (nor many experienced ones!) who have been able to make effective use of setting circles.
Poor alignment of the telescope mount, improperly calibrated circles, and imprecise circle scales usually combine to make circle readings inaccurate. The best method to find celestial targets is to hop from star to star using a good star chart as your guide. Plan on buying such a star chart as an essential accessory.

Can I Take Pictures With This Scope?

Anything you see through a telescope can be photographed, but most objects require exposures of several seconds to an hour or more. Keeping the object perfectly positioned on the film during that time requires a solid equatorial mount and a motor drive. These are essential features if you intend to do Astrophotography.

Can I Use A Spotting 'Scope For Astronomy?

Some spotting scopes (such as those sold for birding) have only a fixed-power eyepiece or a variable zoom eyepiece. These models are unsuitable for astronomy.
Other models use interchangeable eyepieces but must be placed on a solid camera tripod. Because they lack fine slow-motion controls, camera tripods are difficult to aim precisely, a problem at high power.

But I Also Want To Use My Telescope For Nature Viewing

If your interests mix astronomical and terrestrial viewing, we suggest an 80mm or 4-inch refractor, or a small 3-5-inch Schmidt- Cassegrain. Don't buy a Newtonian reflector -- the position of the eyepiece makes a Newtonian awkward for use as a spotting scope.

How Much Should I Have To Spend?

Most feel that $500 - $700 is the minimum for a quality starter scope such as an 80mm refractor or 4.5-inch reflector. The next step up is to a 6-inch equatorially mounted reflector . These sell for $1,050. The next jump up many first-time buyers consider is to an 8-inch Schmidt-Cassegrain ($2,500 to $4,500).
No-frills Dobsonian reflectors defy these price/aperture categories by offering much more aperture for the money (see question 16).

What Does "1/20th Wave-Optics" Mean?

The deviation of an optical surface (lens or mirror) from the ideal shape is often stated as a fraction of a wavelength of light. The smaller the fraction, the better the optics and the sharper the image.

However, to be meaningful for a complete telescope this deviation figure should be provided for the final wavefront reaching the eye, not just for individual lenses or mirrors. When measured in this manner, a telescope with a total error on the final wavefront of 1/4 wave is very good, 1/8 or 1/10 wave is excellent, and 1/20 wave is outstanding but seldom achieved.

Manufacturers have no agreed-upon standard for measuring these values -- one company's 1/20 wave may be the same as another company's 1/10 wave.

What Does Diffraction Limited Mean?

This is another freely used term in telescope advertising. It means that the optics are so good they are limited only by the wave nature of light and not by any flaws in the surface accuracy of the lenses or mirrors. Specifically, it means the final wavefront error is better than 1/4 wave, a figure known as Rayleigh's Criterion.

Again, few manufacturers have the technical equipment to quantitatively support this claim. Most test telescope quality by ensuring units form good star images. Although this is a very sensitive test that will detect small flaws in the optics, it cannot guarantee a numerical specification like 1/4 wave.

Where Can I Buy A Good 'Scope?

It is suggested to shop at a local telescope dealer if there is one near you (check the Yellow Pages under "Telescopes"). If he is doing his job right he will check each scope he sells, provide good service, answer your technical questions, and perhaps allow you to take home a scope on a trial basis. You can at least see what you're getting before you buy it. This peace of mind is worth any extra cost involved.

What About Buying A Used Telescope?

If well cared for, a used telescope should perform as well as a new one. You can find telescopes in the classified adverts in local newspapers and "bargain finders." You should also check with the local astronomy club.

What Telescope Would YOU Buy?

This is impossible to answer. Someone who has been in the hobby for a while and who has already owned several telescopes would not select the same scope a first-time buyer would. Some people prefer the solidness and precision of a fine-quality refractor, others like the aperture and versatility of a Schmidt-Cassegrain, while others prize the light-gathering power and simplicity of a large Dobsonian reflector.

There is no single best telescope. In fact, chances are the first telescope you buy will not be the last. Many backyard astronomers happily own two or three telescopes, each outstanding for a certain type of viewing.

I Have A Child Interested In Astronomy. What Scope Should I Buy? My Budget Is $200.00.

Avoid low-cost 500-power "department store" 50mm and 60mm refractors. Their poor mounts, eyepieces, and finderscopes will almost certainly make these telescopes a disappointment. The better 60mm refractors on alt-azimuth or equatorial mounts with slow-motion controls and a decent 6x30 finderscope can serve as starter scopes if your expectations are well tempered. Acceptable models are available from astronomical dealers (such as those who advertise in astronomy magazines) and local telescope stores.

But the truth of the matter is that for $200 (a common budget of parents with young astronomers), there are few telescopes on the market that can be endorsed. Instead, many astronomy educators usually recommend a pair of 7x50 binoculars combined with a set using telescope-pointing positions. For this you use setting circles for R.A. and Dec. to find celestial coordinates for stellar objects which are given in star charts and reference books.

of introductory books and star atlases, a package that will cost around $200. Binoculars can reveal a surprising number of celestial objects (craters on the Moon, the moons of Jupiter, deep-sky objects such as star clusters and nebulae). A year spent exploring the sky with binoculars and a star chart can teach any novice astronomer, young or old, an immeasurable amount about the sky, the identity of stars and constellations, and the locations of celestial targets.

If your prospective astronomer is still interested in the hobby after a year of binocular stargazing, then purchase a decent telescope for $500-$700. At that point you will be more confident that your money will be well spent.

Conclusion

Astronomy is a fascinating lifetime hobby enjoyed by everyone from young to old alike, by people from all walks of life and with varied interests.

You can observe or photograph the cosmos on a casual or serious basis, undertake scientific study or marvel at the wonderment of our existence. Astronomy can be a fun and relaxing way to soothe our minds and bodies from our hectic everyday life. It is a way to enjoy nature, being outside and marvelling at the night sky.

Astronomy is fun and easy to learn! You don't have to be a scholar in physics or maths to enjoy our universe. Besides binoculars or a telescope one requires star maps or books listing the location of various objects in the sky. Now even computerised telescopes are available making it very easy to observe numerous objects in an evening.

Much useful information for all levels of interest is available from amateur astronomy clubs, college astronomy professors, libraries, planetariums, telescope dealers, internet and other hobbyists.

A basic understanding of telescope and astronomical terminology is useful and this reference briefly covers some of the items that will be helpful to get you started.