ASTRONOMICAL LEAGUE

A FEDERATION OF ASTRONOMICAL SOCIETIES
A NON-PROFIT ORGANIZATION

- ★ *To promote the science of astronomy:*
- ★ *By fostering astronomical education;*
- ★ *By providing incentives for astronomical observation and research;*
- ★ *By assisting communication among amateur astronomical societies.*

ASTRO NOTES

Produced by the Astronomical League

Note 19: So, You Want to Buy a Telescope?

One of the most common questions asked of amateur astronomers is advice on purchasing a telescope. Many considerations are necessary to choose a proper instrument. A few of those considerations are detailed here. First, decide what the interest level is (or will be) of the potential telescope user:

Interest Level	**Considerations**
Casual	This includes a child who has completed a science unit on astronomy in school or an adult who has a passing interest and wants to learn a little more. Do not confuse an interest in "space" with an interest in astronomy. If the interest wanes, for what else can the telescope be used?
Special	A bright comet (e.g., Halley), lunar or solar eclipse, close approach of the planet Mars or other transient event might focus an otherwise casual interest. Consider the requirements of the special interest and potential uses of the telescope after the event is past.
General	The user has some knowledge of the breadth of astronomy as a science, maybe from a college or adult education class. There has been some contact with active amateur astronomers, perhaps through a local astronomy club. While there is no specific area of particular interest, the user has had an opportunity to look at astronomical objects through a telescope.
Critical	You have a telescope now, but want another instead/besides that is more appropriate to a particular area of study. Such areas may include deep sky, planetary, solar, photography, photometry or others. If you are in this category, you should know just what you need.

The Powers of a Telescope

The ***objective*** of a telescope is its light gathering element. It may be a concave mirror (reflecting telescope), a lens (refracting telescope) or a combination of the two (catadioptic telescope). The size of the objective is the major characteristic to consider when deciding which telescope to buy.

Light Gathering Power	Most astronomical objects are quite faint. A major purpose for a telescope is to collect as much light as possible and concentrate the light so the object appears brighter. Light gathering power depends on the area of the objective or the square of the objective's diameter.
Resolving Power	The resolution of a telescope provides the ability to see fine detail. Although many factors influence resolution, resolving power depends on the diameter of the objective.
Magnifying Power	This is the commonly associated ability to make distant (small) objects appear nearer (larger). Many astronomical applications use relatively low magnifications. Theoretically, magnification above 50x per inch of objective diameter is useless. Magnifications in the range of 15x - 30x per inch are more commonly used. Therefore, **usable** magnification depends on the diameter of the objective.

Since all three "powers" depend on the diameter of the objective, the general rule for astronomical use is:

Buy the largest diameter objective you can afford.

Telescope Selection

Binoculars	Often overlooked for astronomical use, binoculars provide an opportunity to explore the night sky with low magnification and wide field of view. They are especially suitable for large nebulae, open star clusters and bright comets. Low magnification prohibits their use for planet study. The relatively small size and weight provide excellent portability. You may already own binoculars, purchased for another purpose -- use them for astronomy! The "7x50" models make excellent astronomical instruments and are available in the $50 - $100 range.
Spotting Scopes	Most commonly found with 20x-25x magnification, higher priced models may include variable magnification. 60 - 80mm objective diameters are readily available. Even 20x will require a tripod to steady the image for observing. The table-top tripod usually sold with spotting scopes seldom permit tilting high enough to observe objects in the sky. Plan on a sturdy camera tripod with an adapter to hold the scope. 20x will allow observing lunar craters, phases of Venus, Jupiter's four bright moons, Saturn's ring and its brightest moon, Titan. Do not expect to see detail on planet disks. Some star clusters and nebulae are spectacular in spotting scopes. If astronomical interest wanes, the scope can be used for bird watching, sporting events or hunting. Prices start about $75 and go up to several hundred. Plan on another $50 - $100 for the camera tripod.
Small Refractors (60mm typical)	Widely available in discount and department stores, these telescopes are an amazing value for the money. Since they are designed for astronomical use, their utility for general purpose observing is limited. Images are usually inverted (upside down and/or backward) but this is not detrimental for astronomy. Look for: interchangeable eyepieces to change magnifications; a separate "finder telescope" with "cross hairs" for locating objects; a "star diagonal" for comfortable overhead viewing; a **sturdy** tripod; objective lens at least 60mm diameter. **Beware of**: a draw-tube for changing magnification; a non-optical finder (sometimes just a peep sight or a long plastic tube); a flimsy tripod; claim of high magnification (anything over 100x generally is useless for these scopes). Be especially cautious of solar filters which attach to the eyepiece: if the scope has one of these, throw it away -- it is **not safe**. At magnifications up to 100x more lunar detail can be seen, some planetary features are visible (Mars' polar caps, Jupiter's main cloud belts, gaps in Saturn's ring), many double stars are "split" and a host of variable stars can be monitored. Prices start around $100 and go up, depending on the accessories offered.
Small, Japanese Reflectors	Also found in many discount stores, avoid them. Although usually available with larger objective mirrors than the objective lenses of their refracting cousins, the reflectors are seldom well made. In particular, they are prone to alignment problems and need constant adjustment. They can be so frustrating to use that they often discourage would-be astronomers.
Equatorial Mounting	As the Earth rotates on its axis, the stars (and Sun and moon) rise in the east, pass generally overhead and set in the west. A telescope's mounting must permit movement so the desired object can be tracked as it drifts by. The alt-azimuth and equatorial mountings are available. The alt-azimuth moves up and down in altitude and left or right in azimuth. The equatorial has one axis tilted to match the Earth's axis of rotation and makes tracking of astronomical objects easier. At magnifications below 100x, the alt-azimuth is satisfactory. Higher magnifications usually require an equatorial mounting and it is a must for long exposure astronomical photography. While it may be available for scopes discussed so far, the equatorial mount is usually not necessary for the beginning observer and it may add up to $100 to the telescope cost.
Mirror-Lens Telescopes	Also called catadioptic telescopes, these instruments are mainly for someone with a known interest in astronomy. Objectives range from 3.5 to 14 inches. Generally, the 8-inch size is the best value. The smaller sizes are very compact and may be useful as a travel scope. The larger sizes almost require a permanent observatory for their practical use. If you are considering one of these scopes, you should know what you want and why. Prices for a 8-inch size range from $1000 - $2500, depending on the accessories offered.