

How to Choose Your First Telescope

By: The Editors of Sky & Telescope | December 15, 2016

You'll get lots of hype when trying to pick a telescope. But by knowing just a few basics, like the types of telescopes described here, you'll be able to choose the one that's right for your observing interests, lifestyle, and budget.



With a little guidance, you can pick a high-quality telescope that can last a lifetime.

S&T: Craig Michael Utter

A telescope is a popular gift, especially so during the holidays. It can be a portal to the universe and provide a lifetime of enjoyment.

But there's no one "perfect" telescope — just as there's no such thing as a perfect car. Instead, you should choose a telescope based on your observing interests, lifestyle, and budget. Many (arguably most) good starter scopes cost \$400 or more, though some superb choices are available for under \$250.

So here is a guide to help you make sense of the "universe" of telescope models available today. Armed with these few basic types of telescopes, you'll have a good idea what to

look for (and what to avoid) when scouring the marketplace for your new scope. Get the one that's right for *you!*

The telescope you want has two essentials: **high-quality optics** and a **steady, smoothly working mount**. And all other things being equal, big scopes show more and are easier to use than small ones, as we'll see below. But don't overlook portability and convenience — the best scope for you is the one you'll actually use.

Aperture: A Telescope's Most Important Feature

The most important characteristic of a telescope is its *aperture* — the diameter of its light-gathering lens or mirror, often called the *objective*. Look for the telescope's specifications near its focuser, at the front of the tube, or on the box. The aperture's diameter (D) will be expressed either in millimeters or, less commonly, in inches (1 inch equals 25.4 mm). As a rule of thumb, your telescope should have at least 2.8 inches (70 mm) aperture — and preferably more.



Dobsonian telescopes, which are reflectors with a simple mount, provide lots of aperture at relatively low cost.

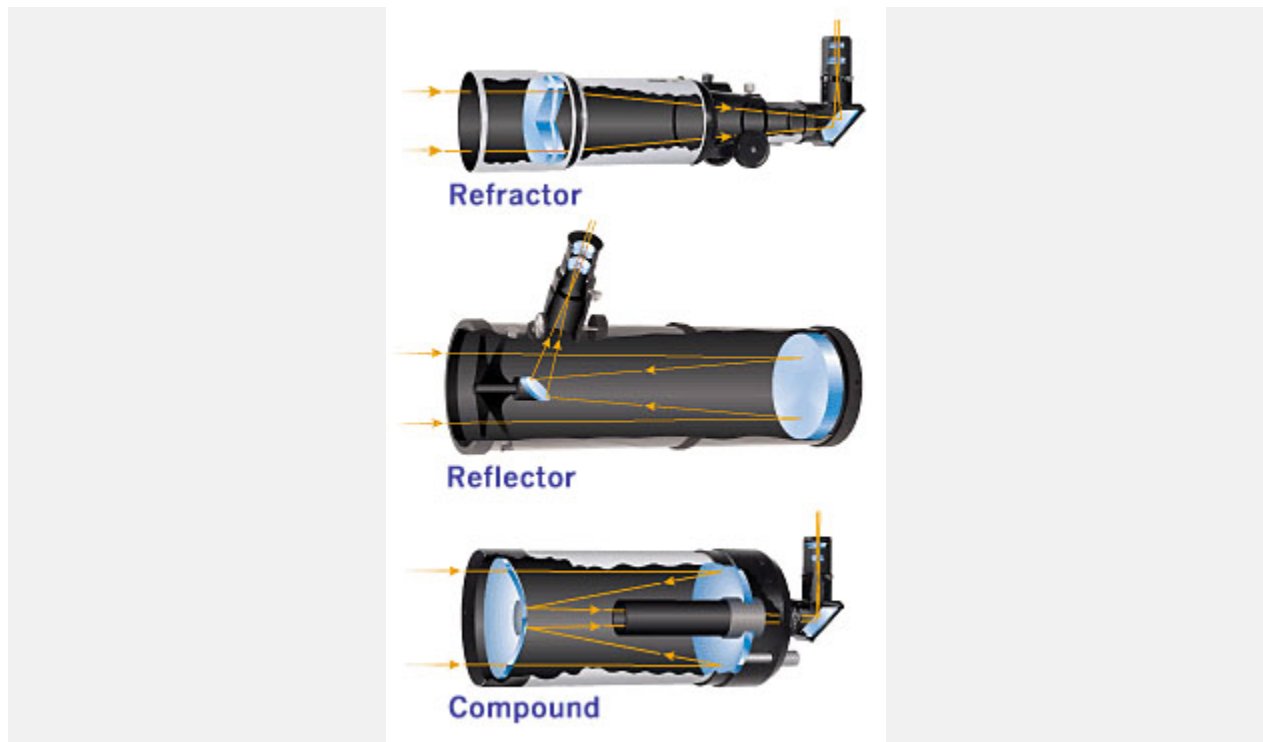
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A larger aperture lets you see fainter objects and finer detail than a smaller one can. But a good small scope can still show you plenty — especially if you live far from city lights. For example, from a dark location you can spot dozens of galaxies beyond our own Milky Way through a scope with an aperture of 80 mm (3.1 inches). But you'd probably need a 6- or 8-inch telescope (like the one shown at right) to see those same galaxies from a typical suburban backyard. And regardless of how bright or dark your skies are, the view through a telescope with plenty of aperture is more impressive than the view of the same object through a smaller scope.

Avoid telescopes that are advertised by their magnification — especially implausibly high powers like 600 \times . For most purposes, a telescope's maximum useful magnification is 50 times its aperture in inches (or twice its aperture in millimeters) . So you'd need a 12-inch-wide scope to get a decent image at 600 \times . And even then, you'd need to wait for a night when the observing conditions are perfect.

Types of Telescopes

You'll encounter three basic types of telescopes:



The three basic telescope designs use different optics to achieve the same result: making distant objects look bigger and brighter than they appear to your eye. See the text for links to animations that show how light passes through the optics of each design.

S&T: Gregg Dinderman

- *Refractors* have a lens at the front of the tube — it's the type you're probably most familiar with. While generally low maintenance, they quickly get expensive as the aperture increases. In refractor lingo, an *apochromat* offers better optical quality (and is more expensive) than an *achromat* of the same size. [Watch an animation of light passing through a refractor.](#)
- *Reflectors* gather light using a mirror at the rear of the main tube. For a given aperture, these are generally the least expensive type, but you'll need to [adjust the optical alignment](#) every now and then — more often if you bump it around a lot — but that adjustment (called *collimation*) is straightforward. [Watch an animation of light passing through a reflector.](#)
- *Compound (or catadioptric)* telescopes, which use a combination of lenses and mirrors, offer compact tubes and relatively light weight; two popular designs you'll often see are called Schmidt-Cassegrains and Maksutov-Cassegrains. [Watch an animation of light passing through a compound telescope.](#)

The objective's *focal length* (F or FL) is the key to determining the telescope's magnification ("power"). This is simply the objective's focal length divided by that of the eyepiece, which you'll find on its barrel. For example, if a telescope has a focal length of 500 mm and a 25-mm eyepiece, then the magnification is $500/25$, or $20\times$. Most types of telescopes come supplied with one or two eyepieces; you change the magnification by switching eyepieces with different focal lengths.

The Mount: A Telescope's Most Under-Appreciated Asset

Your telescope will need something sturdy to support it. Many telescopes come conveniently packaged with tripods or mounts, though the tubes of some smaller scopes often just have a mounting block that allows them to be attached to a standard photo tripod with a single screw. (Caution: A tripod that's good enough for taking your family snapshots may not be steady enough for astronomy.) Mounts designed specifically for telescopes usually forgo the single-screw attachment blocks in favor of larger, more robust rings or plates.



For all their apparent diversity, telescope mounts boil down to two basic types. An "alt-az" mount (*left*) permits the scope to move up-down and left-right. It's quick to set up and intuitive to use. An equatorial mount (*right*) can track celestial objects by turning just one axis and can be more easily motorized — but to work properly it must be aligned with Polaris, the North Star.

S&T: Craig Michael Utter

On some mounts the scope swings left and right, up and down, just as it would on a photo tripod; these are known as altitude-azimuth (or simply *alt-az*) mounts. Many reflectors come on an elegantly simple wooden platform, known as a *Dobsonian*, that's a variation of the alt-az mount. A more involved mechanism, designed to track the motion of the stars by turning on a single axis, is termed an *equatorial* mount. These tend to be larger and heavier than alt-az designs; to use an equatorial mount properly you'll also need to align it to Polaris, the North Star.

Some telescopes come with small motors to move them around the sky with the push of a keypad button. In the more advanced models of this type, often called "Go To" telescopes, a small computer is built into the hand control. Once you've entered the current date, time, and your location (and many newer models don't even require you to do that), the scope can point itself to, and track, thousands of celestial objects. Some "Go To"s let you choose a guided tour of the best celestial showpieces, complete with a digital readout describing what's known about each object.

But Go To scopes aren't for everyone — the setup process may be confusing if you don't know how to find the bright alignment stars in the sky. And lower-priced Go To models

come with smaller apertures than similarly priced, entry-level scopes that have no electronics.

Remember . . .

Any telescope can literally open your eyes to a universe of celestial delights. With a little care in selecting the right type of telescope for you, you'll be ready for a lifetime of exploring the night sky!

If you still have questions or need more details, check out these additional resources:

- [Detailed advice for choosing a telescope](#) (online article)
- ["What to Know Before You Buy"](#) (PDF) from *SkyWatch 2010*
- [Guide to Buying Your First Telescope](#) (from *Sky & Telescope's* Skywatching Video Series)
- [Comparative review of three telescopes](#) (PDF), each around \$200
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