

Low-Cost Starter Scopes

Can you get a good beginner's scope for less than \$200 this holiday season? We survey the marketplace to find out. *By Gary Seronik*



Sky & Telescope
photographs by
Craig Michael Utter

Budget Scopes

Bushnell
www.bushnell.com

Celestron
www.celestron.com

Meade Instruments Corp.
www.meade.com

Orion Telescopes & Binoculars
www.oriontelescopes.com

Scientifics
www.scientificsonline.com

I BET MANY VETERAN AMATEURS have been approached with a query like this: "I'm becoming interested in astronomy. What kind of telescope can I get without spending a lot of money?"

With the holiday season approaching, this question is bound to come up often among friends and family — telescopes are hot gift items. What makes it difficult for many of us to answer is that we've been amateurs for so long that we don't spend a lot of time poring over ads for "beginner's" scopes. So my colleagues and I decided to take a fresh look at this segment of the telescope marketplace. The results were in some cases disappointing but in others encouraging.

The Beginner Scope Defined

Anyone one who has paid a recent visit to the local mall knows that there are plenty of telescopes with price tags under \$200, so we set this amount as our upper limit. Conventional wisdom has been that any telescope coming from a department store is best avoided, but we found this generalization isn't as true as it once was. It is still the case that too many substandard scopes pack the shelves of many retail outlets, but the odds of coming home from the mall with a usable telescope are better now than they were even just a few years ago.

To narrow the field, we settled on a set of criteria that we feel define a good beginner's telescope. Our guiding principle is that a first telescope should provide as pleasant and trouble-free an introduction to backyard astronomy as possible. We were looking for an all-purpose telescope — something that can do a bit of everything reasonably well, be it to provide a high-magnification view showing Jupiter's Great Red Spot or a more expansive field that takes in the splendor of the Double Cluster in Perseus.

Here's what we came up with:

A good first telescope comes complete with mount, eyepieces, and finder. Once you get into the hobby, buying extra goodies just becomes part of the deal. But for beginners, each additional purchase amounts to another rung on the ladder they're trying to climb. For this reason, we chose to review only complete instruments.

A good first telescope has at least 70 millimeters (2.8 inches) aperture. As we all know, aperture is king — no other specification has as much influence on the view as the size of the objective lens or mirror. It's true that you can do a lot with a smaller scope — especially a premium-quality instrument — but in our sub-\$200 category, 70 mm represents the point at which the fun really begins. Besides, since you can get something this size or larger for this price, why settle for a smaller scope?

A good first telescope has an altazimuth mount. Most of

us have seen beginners struggle to understand the motions of an equatorial mount or fiddle with setting circles, fearing that knowledge of celestial coordinates is a prerequisite to skywatching. Even though there are some important benefits to an equatorial mount, we feel that the gains don't offset the additional level of complexity that such a setup adds to a beginner's scope. A basic point-and-look mount is simply more intuitive and more likely to result in a positive first experience.

A good first telescope comes with a standard 1¼-inch focuser and at least two good eyepieces. Anyone who has used the legendarily poor 0.965-inch Huygenian eyepieces that were standard fare in beginner scopes a generation ago will understand this criterion. We were looking for scopes that have decent eyepieces that provide a reasonable range of useful magnifications and a good-quality 1¼-inch focuser so that additional eyepieces can be easily purchased later.

Making the Cut

Our survey of the marketplace revealed nearly a dozen telescopes that satisfied our criteria. (Another, the newly announced 135-mm Galileo Dobsonian reflector from Apogee, Inc., also qualified, but it was not yet available at the time this review was being prepared.) Four are from Orion Telescopes & Binoculars: the StarBlast Astro Telescope, the SkyQuest XT4.5 Dobsonian, the SpaceProbe 3 Altazimuth reflector, and the Observer 70mm Altazimuth refractor. Meade Instruments added four more: the 70AZ-A and NG-70 altazimuth refractors, the NGC-70 computerized refractor, and the 76AZ-AD altazimuth reflector. Rounding out our list were the Scientifics Astroscan 4⅞-inch reflector and two more 3-inch reflectors: the Bushnell Deep Space 525×3" (model 78-9003) and the Celestron PowerSeeker 76. We purchased samples of each scope, some from mall stores and some from mail-order companies, to see how well they worked with the needs of first-timers in mind.

The instruments were evaluated with our usual combination of bench and field testing. And though some deep-sky observing was part of the equation, we concentrated mainly on the Moon and planets because we know from experience that these are the objects that captivate beginners first. Further-

Although these 3-inch reflectors look alike, our testing revealed important differences in performance. Shown are (from left to right) the Bushnell Deep Space 525×3", the Orion SpaceProbe 3, the Meade 76AZ-AD, and the Celestron PowerSeeker 76.



The largest-aperture scopes in our roundup were the Orion XT4.5 (center) and StarBlast (left), which featured 4½-inch primary mirrors, and the Scientifics Astroscan, which has an aperture of 4⅜ inches. The XT4.5 and StarBlast ranked 1 and 2, respectively, in our testing. They combine good optics with sturdy mounts and come with excellent documentation. Either would make a fine general-purpose telescope for a newcomer to astronomy.



more, observing low-contrast planetary detail at medium to high magnifications is a very demanding test of a telescope's mechanical abilities and quickly shows up optical shortcomings. There's no getting around the fact that a telescope has to deliver satisfying views of the Moon and planets to be considered a good beginner's scope. Fortunately, such an instrument will also succeed with bright deep-sky objects.

We looked at every aspect of each telescope from overall optical and mechanical performance to ease of assembly and use. We were looking for scopes that were easy to aim and keep aimed and that provided a good view. While all the scopes we examined *work*, we did find that some work better than others.

Optics

The good news is that, by and large, most of the telescopes we looked at had acceptable optics. The best of them clearly showed Jupiter's Red Spot and shadow transits of its moons, major surface markings on Mars, Saturn's rings, and, in general, delivered every-

thing scopes in this size range are capable of.

The 3-inch reflectors all have spherical mirrors, which, with a long focal ratio of f/9.2, produce good views. The 4½-inch Orion StarBlast and XT4.5 Dobsonian both had very good optics. The one reflector that wasn't up to par optically was the Astroscan. We looked at two Astroscan telescopes in the course of preparing this review. The first had poor optics that couldn't produce a sharp image. We spoke to Scientifics' customer support, who quickly arranged to replace the instrument. The new scope arrived out of collimation, but we were able to dismantle it and correct the problem. Unlike most reflectors, however, this isn't a procedure recommended for users. The telescope performed acceptably even though its primary mirror showed the effects of being pinched slightly by the instrument's simple cell. Its 4⅜-inch aperture, however, helped overcome its optical shortcomings to produce views of the planets that were on a par with smaller instruments with better-quality objectives.

The refractor with the best optics was the Orion Observer 70mm. It delivered everything a 70-mm achromat is known for: crisp, high-contrast views *and* fairly pronounced chromatic aberration (false color). The three Meade refractors had optics that scored less well. Our testing revealed some level of astigmatism or significant spherical aberration in the objective lenses of all three, with one, the NGC-70, showing astigmatism severe enough to noticeably compromise its images.

Mechanical Matters

What distinguished the best instruments from the rest was often mechanics — some scopes were much easier to aim and focus than others. Usually this was simply a matter of how well the mount suppressed vibrations. Many scopes were frustrating to use because they quivered whenever the focuser knob or fine-motion controls were touched. Most of the reflectors performed very well and kept the jig-

Budget Telescopes

Manufacturer	Bushnell	Celestron	Meade	Meade	Meade	Meade	Orion
Model	Deep Space 525×3 ²	PowerSeeker 76	70AZ-A	NG-70	76AZ-AD	NGC-70	SpaceProbe 3
Price ²	\$85	\$75	\$80	\$100	\$120	\$200	\$99
Optics type	reflector	reflector	refractor	refractor	reflector	refractor	reflector
Aperture	76 mm	76 mm	70 mm	70 mm	76 mm	70 mm	76 mm
Focal length, f/ratio	700 mm, f/9.2	700 mm, f/9.2	700 mm, f/10	700 mm, f/10	700 mm, f/9.2	700 mm, f/10	700 mm, f/9.2
Finder type	5 × 24	5 × 24	5 × 24	5 × 24	5 × 24	5 × 24	Red dot
Supplied eyepieces	20 mm (35×) ⁴	20 mm (35×) ⁴	25 mm (28×)	26 mm (27×)	25 mm (28×)	26 mm (27×)	25 mm (28×)
	4 mm (175×)	4 mm (175×)	9 mm (78×)	9.7 mm (72×)	9 mm (78×)	9.7 mm (72×)	10 mm (70×)
Weight	7.8 lb	8.2 lb	9.3 lb	7.3 lb	5.7 lb	7.6 lb	8.7 lb

¹ Also available as model 420×3", which has a red-dot finder and different eyepieces. ² Prices are in US dollars, are subject to change, and don't include shipping fees, taxes, or duties.

gles to a minimum. The refractors, however, with their tripod legs fully extended (as required for a comfortable eyepiece height), proved the most difficult to use. The one exception was the Orion Observer refractor, which settled down in about half the time of the others, resulting in a much more enjoyable viewing experience.

For the most part the problems we saw with the mounts on these budget scopes were the result of poor design rather than sloppy execution. For example, the Meade 3-inch reflector (76AZ-AD) is equipped with a gorgeous altazimuth head — a well-made, heavy-duty unit that features smooth-moving fine-motion controls on both axes and a dovetail mounting bracket for the scope. Unfortunately, it is hobbled by the worst tripod we encountered in our tests. The joints connecting the tripod legs to the head flexed madly, and the legs could not be spread out far enough to prevent the top-heavy scope from being prone to tipping over when bumped. This mount would have ranked among the best if only Meade had used the same tripod that comes sup-

plied with its NGC-70 and NG-70 refractors!

The lone computerized mount in our roundup came with the Meade NGC-70 refractor. This is a “push-to” mount whose computer guides you as you manually move the scope toward your target. Although the computer itself worked, the pointing accuracy of the system was only good enough to aim the scope in the general direction of objects, not to reliably place them in the scope’s eyepiece field.

Finders and Eyepieces

One of our pleasant discoveries with this crop of telescopes was the quality of the eyepieces. Two good-quality Plössl eyepieces came with the Orion XT4.5, Astroscan, and Meade NG-70 and NGC-70. But even the lesser-quality eyepieces that accompanied most of the other scopes worked well with the long f/ratios. Only two telescopes were guilty of excessive magnification: the Bushnell and Celestron reflectors. Both used poor-quality 3× Barlow lenses and mediocre 4-mm eyepieces to drive magnifications up to a ridiculous 525×. The maximum usable magnifications for either of these scopes is more like 150×, less than the 175× delivered by the 4-mm eyepiece *without* the Barlow!

As with the eyepieces, the finders used with these scopes were generally better than in the past. The Orion XT4.5 had the best finder — a nice 6 × 26 noninverting finder mounted in a superb spring-loaded bracket. The other Orion scopes were equipped with red-dot finders, and the Astroscan came with a peep-sight aiming device. The red-dot and peep-sight finders work nicely so long as the target is reasonably bright.

The rest of the scopes came with 5 × 24 optical finders that had single-element objective lenses. None of them had apertures that were stopped down (a common practice), but the optics were bad enough that the finders could go only slightly deeper than the naked-eye limit. The better units had two-ring brackets with six adjustment screws. But



The Meade 3-inch reflector came with the nicest altazimuth mount — one that features heavy-duty construction and slow-motion controls for both axes. Unfortunately, this fine system was hobbled by an inadequate tripod that quivered at the slightest touch.



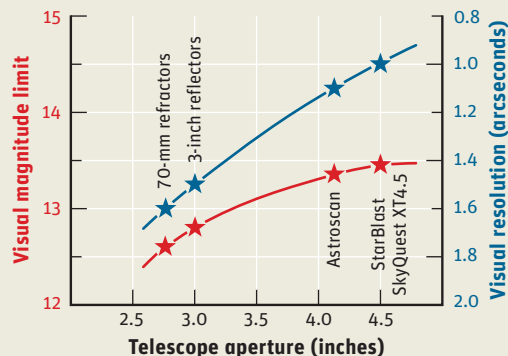
Although largely a thing of the past, two telescopes in our roundup boasted ridiculously high magnifications. Commendably Meade, Orion, and Scientifics all avoided using excessive and impractical power to hype their scopes.

Orion	Orion	Orion	Scientifics
Observer 70mm	StarBlast	SkyQuest XT4.5	Astroscan
\$129	\$169	\$199	\$199
refractor	reflector	reflector	reflector
70 mm	113 mm	114 mm	105 mm
700mm, f/10.0	450 mm, f/4.0	910 mm, f/7.9	445 mm, f/4.2
Red dot	Red dot	6 × 26 ³	Peep sight
25 mm (28×)	17 mm (26×)	25 mm (36×)	28 mm (16×)
10 mm (70×)	6 mm (75×)	10 mm (91×)	15 mm (30×)
7.7 lb	13.0 lb	17.4 lb	10.3 lb

³ Quality finder gives a correct, noninverting view.

⁴ Telescope includes poor-quality 3× Barlow lens.

THEORETICAL PERFORMANCE



Star symbols indicate the relative theoretical performance of the telescopes reviewed here. Resolution is the calculated Dawes limit giving the minimum resolvable separation for a pair of stars of equal brightness. The magnitude limit is for stars observed at 150× under good sky conditions — your mileage may vary.

given the limited field of view (approximately $4\frac{1}{2}^\circ$), poor optics, and the inverted image, we feel these are less-than-ideal aiming devices for beginners.



Six of our test scopes came equipped with 5×24 finders. While their single-element objective lenses produced mediocre views, they did function as adequate pointing devices if mated to a two-ring, six-point mount like this one from Meade.

Documentation

Because we were dealing with scopes that are meant for first-time telescope owners, we paid particular attention to the documentation. Were the assembly instructions clear? Did the manual offer good advice on the basics of using the scope? Did the reflectors come with useful collimation instructions?

Significantly, only the Orion Newtonians came with center-dotted primary mirrors, a collimation tool, and detailed collimation instructions. Given the importance of good optical alignment even with long-focus Newtonians, this was a significant point in favor of the three Orion reflectors.

Conclusions

The results of our tests are summarized in the ratings box below. The overall rating reflects each scope's optical and mechanical performance as well as the completeness of the documentation and the quality of the eyepieces and finders. The scopes are listed in descending order of how well we believe they would satisfy the desires and abilities of a beginning stargazer. So, even if two instruments get the same rating, small differences in overall performance mean the one closer to the top of the list is slightly better than the other.

When it comes to raw performance, the Orion XT4.5 Dobsonian and StarBlast were the hands-down winners. Both provided brighter, more detailed views than the other scopes, largely due to their greater apertures. The XT4.5 was a treat for viewing the Moon and planets, while the StarBlast's wider field of view gave it the edge for deep-sky objects. The one complaint we have with the StarBlast is that the supplied low-power eyepiece doesn't fully exploit the scope's wide-field capabilities. It



Our roundup included four 70-mm refractors (clockwise from upper left): the top-rated Orion Observer 70mm, and the Meade NG-70, 70AZ-A, and NGC-70.

would have been nice if it came with a 25-mm eyepiece, which would provide a field approaching 3° . Both the XT4.5 and StarBlast moved nicely on their mounts and came with excellent documentation.

If you'll be doing a fair amount of daytime viewing, the Orion Observer 70mm refractor is worth considering since it provides a right-side-up (though mirror-reversed) view. But if getting the most scope for the least money is the primary goal, the Orion SpaceProbe 3 Altazimuth reflector has much to recommend it. Simply put, this is a *nice* telescope. It provided sharp images and was a joy to use. Considering it costs less than \$100, it is a true bargain-price ticket to the hobby of backyard observing. *

Associate editor GARY SERONIK began observing more than 30 years ago with a 3-inch Tasco reflector and survived to tell the tale.

S&T RATINGS

Telescope	Rating	Comments
Orion SkyQuest XT4.5 Dobsonian	★ ★ ★ ★ $\frac{1}{2}$	The best of the bunch — solid combination of optics and mechanics.
Orion StarBlast Astro Telescope	★ ★ ★ ★	Particularly excellent for wide-field viewing.
Orion SpaceProbe 3 Altazimuth	★ ★ ★ ★	The best 3-inch reflector — and less than \$100!
Orion Observer 70mm Altazimuth Refractor	★ ★ ★ $\frac{1}{2}$	The best refractor in our roundup.
Scientifics Astroscan	★ ★ ★ $\frac{1}{2}$	Good low-power views, bundled with nice star atlas and guidebook.
Celestron PowerSeeker 76	★ ★	Poor finderscope and meager instructions.
Meade NG-70	★ ★	Shaky mount, below-average optics.
Meade 76AZ-AD	★ ★	Good mount hindered by a poor tripod.
Meade NGC-70	★ ★	Astigmatic objective lens produced below-average images.
Meade 70AZ-A	★ ★	Mount suffers from vibration and aiming difficulties.
Bushnell Deep Space 525x3"	★ $\frac{1}{2}$	Poor finderscope, wobbly mount, and minimal documentation.

- ★★★★ Sensibly perfect. No meaningful improvements possible.
- ★★★★ Any shortcomings will go unnoticed in normal use.
- ★★★ Problems noticeable but do not seriously affect performance.
- ★★ Problems noticeable during normal use — performance compromised.
- ★ Problems so severe that the equipment is virtually unusable.

Ratings are intended to convey the overall user experience.