Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *Galileoscope.*

Here at Cheap Astronomy we're really not in the business of doing product reviews. But when a 2009 International Year of Astronomy cornerstone project comes along claiming it's produced a cheap plastic, but totally functional telescope for $15 – even we sit up and take notice.

So the bottom line is… it's pretty OK. Kind of fiddly, particularly the construction part – and the whole no mount thing makes us reluctant to offer a glowing endorsement. But with the right sort of distribution strategy to a particular market – notably schools with a reasonable chance of having some spare camera tripods lying around – this cornerstone project could really achieve good things.

As well as purchasing the test version, Cheap Astronomy also bought a 'give unit' – which gets given to someone (like hopefully a school with some spare camera tripods). Here at Cheap Astronomy, we might be cheap, but we're not nasty.

Anyway, here's the review. Firstly cost. We did manage to get a $15 US unit, but they have now upped the unit price to $20 US and of course the real cost includes shipping which, for our unit, was $28. So the real cost can approach $50 unless you are lucky enough to get one from a conference or some other public event.

For comparison, Cheap Astronomy's own Sky Station 1, possibly the cheapest department store telescope in the southern hemisphere, cost around $115 US by today's rates. So, its claim to fame is clearly under threat here. But let's remember it came with a mount, even if a bodgy one. Can you get a camera tripod for $65US to mount a Galileoscope? Well, probably – but first you've got to go out and buy the thing – potentially from a department store and during that trip you might wander past a display of cheap department store telescopes and start thinking – hey why didn't I just grab one of those 3 months ago.

This is the other part of the whole cost-effort equation. Shipping time for the Galileoscope was pretty awful at nearly three months from making the order, although the website suggests this resulted from unexpected high demand around July 2009 – so your experience may be better.

In any case, once you have got it home, things do start looking up – small astronomy joke there. You've still got to put it together, but even Sky Station 1 needed some assembly. With Galileoscope, all the parts were in the box, there were no puzzling components left over at the end and the instructions were almost good.

Here are some pitfalls that we came across. The first thing is to appreciate is that the thing the instructions keep referring to as a focuser assembly – is actually a tube that (ahem) moves in and out so you can, you know, focus. Maybe it's just us, but the *Oh, I get it* moment was a while coming. Second thing is that the hexagonal nut has to sit in its little cavity with a pointy bit pointing up or the two halves of the main scope don't quite fit together. Third thing, if you put the scope together and the focuser tube, that you didn't know

was supposed to move in and out, doesn't move in and out – and you find you have two rubber O rings left over… Sorry, I'll be back in a few minutes.
So anyway, the in-out thing and the rubber rings. Right. The instructions, perhaps unwisely, skipped an optional step here. The pair of bigger rings actually fit into two shallow grooves around the main scope and it's the smaller rings that hold the focus tube together. But look, despite all the rings and the tubes, if you've put it together once the wrong way – dismantling it to try all over again is relatively straight forward and despite everything being plastic nothing ever broke throughout this process. Galileoscope might be cheap, but it's sturdy.

The eyepieces were a whole new area of confusion. The educational value of building your own eyepiece was a bit lost on us and might have been better managed by making them dismantlable for folks who are mad keen to understand it all, leaving the rest of us to get on and look through the telescope.

The instructions are a little over-confident of the average cheap astronomer's visual acuity – since you have to distinguish between flat, concave and convex surfaces of these tiny little plastic lenses so you can install them all in the right orientation. You should be able to achieve this by holding them up to a light source, like a computer monitor screen. The in-the-box instructions are also a little perplexing here since there's a diagram suggests convex lenses are not bilaterally symmetrical – whereas I'm pretty sure they have to be for the optics to work.

In fact, let's go all educational here. Did you know lenses are actually named after lentils since a classic simple lens, which is bilaterally convex, just like the ones in your eyes, are kind of lentil shaped.

A simple lens focuses parallel rays of light in towards a focal point. For example, the little pupils of your eyes collect light from a wide field of view and focus it down to a narrow point where the photoreceptors in your retina can collect that data and your brain can process it back into a huge apparent field of view that you can literally walk around in.

And a telescope? Well, it delivers the same sized image as would normally flow through your pupil – except it delivers a field of view representing a small patch of the sky that has been greatly magnified by stretching out the light path along a focal length much longer that you could ever manage within the confines of your eyeball.

And that was about the limit of the technology available in Galileo's time. All they could build were lens with fairly shallow curvatures, so the only way to get more magnification was to increase focal length. So the telescopes of the day were very long, unwieldy things with very narrow fields of view – nicely demonstrated by the Galileoscope's Galilean eyepiece which delivers, by today's standards – even by Sky Station's 1 standards – an absurdly narrow field of view.

Modern lens technologies have improved on this in two key ways. Firstly, lens making has become a high precision science – enabling hyperboloid and paraboloid surfaces to be created with extreme accuracy so they can deliver highly magnified images via the lens geometry rather than by huge focal lengths. Secondly, we have conquered the issue of chromatic aberration. As Isaac Newton was fond of demonstrating, a beam of light dispersed through glass breaks up into its spectral colours. Newton was convinced that no lens maker could ever conquer this issue and telescope lenses would hence never deliver more than low magnification without chromatic aberration destroying the image quality.

But by the 18th century, Chester Moore Hall found that you could create an achromatic lens by joining a simple convex lens to a concave lens – using different glass types. The convex lens that is used that has greater positive magnification than the concave lens has negative – so the nett result is still a magnifying lens, but with minimal chromatic aberration. The doublet glass objective lens of the Galileoscope is a nice example – and they get you to fiddle about with all those tiny little plastic lenses, to really drive the point home.

And if you were wondering, the lenses in your eyes actually have lots of chromatic aberration – but you never see it because your brain strips it all out during its own image processing.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, www.cheapastro.com. Cheap Astronomy offers an educational website where we might be cheap, but we're not nasty. No ads, no profit, just good science. Bye.