Eye relief

If you wear spectacles then eye relief is important for you. The eye relief of an optical instrument (such as a telescope, a microscope, or binoculars) is the distance from the last surface of an eyepiece at which the user's eye can obtain the full viewing angle. Outside this distance, you will have a reduced field of view.

Exit pupil

The exit pupil width of an instrument is the width of the cone of light that is available to the viewer at the exact eye relief distance. An exit pupil larger than the observer's pupil wastes some light, but allows for some fumbling in side-to-side movement without vignetting or clipping. Conversely, an exit pupil smaller than the eye's pupil will have all of its available light used, but since it cannot tolerate much side-to-side error in eye alignment, will often result in a vignetted or clipped image.

Red light torch

Red light is much less likely to affect your night vision. You can buy red light head torches or hand-held torches from astronomy and other retailers. Or just fit red sweet wrapping over the lens of your own torch.

Turn down the brightness on your mobile phone. Put red film over any computer screen.

The bottom line

Approximate guide prices for Dob, manual, motorised and computer-controlled (GoTo) mounts:–

	90mm	120/130mm	150mm	200mm
Reflector	X	Dobsonian £135	Dobsonian £210	Dobsonian £290
		motor EQ £165	motor EQ £300-600	comp. EQ £800-£1100
Refractor	man. Alt_Az/EQ £140	motor EQ £370	motor EQ £235-£600	X
	motor EQ £240	comp. EQ £770	comp EQ £1300	X
Compound	man. EQ £150	man EQ £394	comp £600–1000	comp. £1500

There are lots of other guides to buying your first telescope on the Internet but chatting with an astronomer and using their telescopes can help you through the decision maze – they have been there too! See our OASI web site for forthcoming Star Parties.

Useful links

This leaflet is available from the OASI web site as a downloadable pdf with embedded web links.

Some reputable makes

Celestron, Meade, Orion Optics, Skywatcher, Vixen

What to look at

The Night Sky this month www.jb.man.ac.uk/astronomy/nightsky/

Printable sky charts skymaps.com/

Children's University of Manchester

Learnastronomyhq.com

Magazines

Astronomy Now

Sky at Night

Local Astronomy Societies

OASI Orwell Astronomical Society (Ipswich) Members are ready to advise and demonstrate their kit. ***Try before you buy!***

Lowestoft & Yarmouth www.lyra-astro.co.uk/i

Athenæum Astronomy Association www.3a.org.uk

Breckland Astro

North Essex Astronomical Society

Norwich Astronomical Society

Dealers

www.altairastro.com 27 Red Lion Street, Aylsham, Norwich, NR11 6ER

www.astronomica.co.uk/

www.astronomia.co.uk/

www.firstlightoptics.com/

www.green-witch.com 2 Bakers Court, Great Gransden SG19 3PF Phone 01767 677025 for appointment 10 am to 5 pm Monday to Saturday.

www.harrisontelescopes.co.uk/

www.opticalvision.co.uk/

www.orionoptics.co.uk/VX/vxrange.html

www.scopesnskies.com/

www.sherwoods-photo.com/astronomical_telescopes.htm

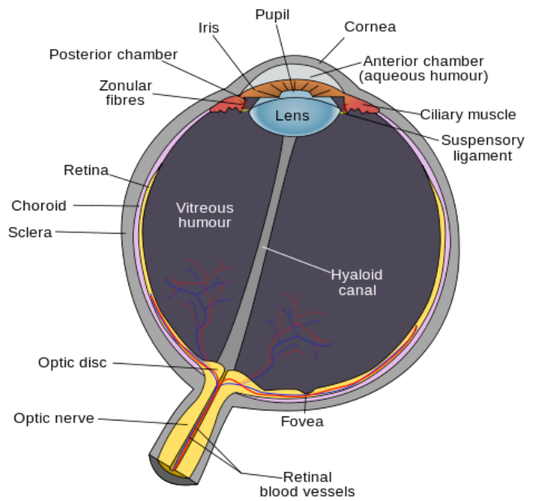
www.telescopehouse.com

www.wexphotographic.com/

Choosing your first Telescope

www.oasi.org.uk

You may have been to one of OASI's Star Parties or attended a school event and were impressed by the array of telescopes. What should you buy? Should it be a telescope?



The Instrument

Avoid department store telescopes!

Before you splash the cash, there are three ways of observing the sky at night.

1. Your eyes

They are a truly wonderful device, but you can learn to get the best out of them. The eye's iris controls the amount of light entering them. As it gets darker, the iris opens up to let in more light, but it takes perhaps 15 minutes for it to fully open when one goes out into a dark night – so give yourself time! Bright lights can quickly cause them to close again so avoid passing cars and if you use a torch (as you will need to) cover the lens with red paper or plastic to give a very low light level.

Get used to looking at the stars and try to pick out the constellations (groups of stars). Use a Planisphere (cost £6–£10) or printed star chart (these can be downloaded from the Internet). Tablets and smart phones have some excellent astronomy apps.

WARNING: NEVER EVER look at the Sun through a telescope or binoculars. The invisible infra red rays (which are only blocked by special filters) will permanently damage your eyes and may blind you. A magnifying glass can set fire to paper – a telescope or binocular lens is no different!

2. Binoculars

You may already own a pair. These can be mounted on a camera tripod using a simple bracket (cost about £11) which will keep them steady and your arms won't get tired. You will see more stars than with just your eyes. Observing objects high in the sky is difficult with a tripod and you will need to resort to lying in a deckchair.

Binoculars are described as, e.g. 8x30, 10x50, 16x70

The first figure is the magnification. But remember: more magnification = more wobble! So 10x50 is a good starter size. Cost about £40 for a Porro prism design (preferable to roof prism models for astronomy). A 15x70 pair will cost about £60.

The second figure is the diameter in mm of the **objective** lens (the big one at the front, nearest the object you are observing). The bigger the objective, the more light is gathered and fainter stars can be seen.

3. Telescope

Astronomical telescopes often come into the category of *try a few times and then never touch again* – usually because they are too big, too heavy, too complicated to set up and use.

They come in three types:

Reflector (Newtonian) – Primary mirror and secondary mirror which reflects the light into the eyepiece.

Refractor – long bodied telescope with a lens at each end. – good for observing planets.

Compound or catadioptric– short bodied telescope. Referred to as Maksutov or Schmidt-Cassegrain.

The telescope mount

A decent scope on a wobbly mount is a waste of money. Expect to pay as much or more for the mount as for the telescope.

There are three types of mount:–

1. Ball and socket

AVOID! These are difficult to adjust and would only support a small telescope.

2. Alt-Az

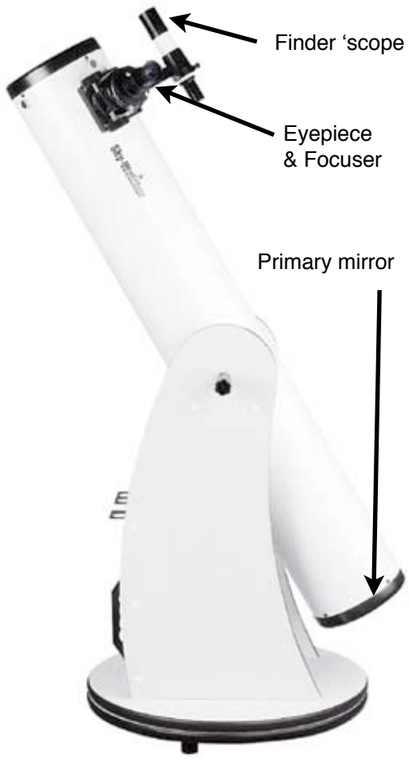
Alt = Altitude (or Elevation degrees above the horizon)

Az = Azimuth (North/South/East/West pointing)

The equivalents on a photographic tripod are Pan (Az) and Tilt (Alt).

Some telescopes can be bought with a Dobsonian mount (often referred to as a "Dob"). The original design was by John Dobson who founded the San Francisco Sidewalk Astronomers.

You can also buy motorized, computer-controlled Alt-Az mounts. NB if you are thinking about astrophotography, Alt-Az mounts will rotate the image over time.



Reflecting telescope on a Dobsonian (Alt-Az) mount

Refracting telescope on a Pan & Tilt (alt-Az) mount

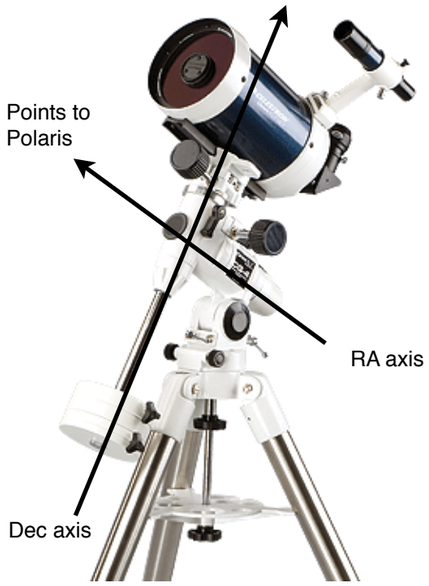
Schmidt-Cassegrain telescope on an Equatorial mount

3. Equatorial

You may have noticed that the stars appear to move across the sky during the night. This is because the Earth rotates once every 24 hours. If you were to take a long exposure photo of the sky it might look something like this. Polaris (the North star) would be at the centre since it is almost directly above the North Pole.

The Equatorial mount solves the problem of tracking the apparent movement of the stars by having its pan & tilt axis adjusted so that you only need to adjust one control in order to follow an object. The setting up takes longer as you have to point the mount to the Pole star.

You can buy manually controlled Equatorial mounts or fully motorized and computer-controlled versions.



Declination and Right Ascension

Some strange terms – Don't panic!

Here is not the place for a full explanation, but briefly the Right Ascension (RA) is measured in units of time – hours, minutes and seconds – and reflects the rotation of the Earth. This is the bit which tracks the object you are observing as the Earth rotates.

Declination (Dec) is how high up in the sky the object is – think of it a bit like Elevation or Latitude.

An object has a fixed Dec and RA, whereas its Azimuth and Elevation change with time. This is because the RA and Dec relate to an object's position at a particular time and date.

Notice that the telescope mount shown here is not horizontal. The arrow shows the RA axis pointing at the Pole star (Polaris) i.e. geographic North. This is a fixed angle depending on the latitude of your observing site. 52º for Ipswich. NB Magnetic North, as indicated by a magnetic compass, is not true North!

The Declination axis is the one with the counterweight attached. This is the one you initially adjust for the object you want to observe and then lock. After that you only need to adjust the RA. The telescope above has motor-driven RA and Dec axes and can be controlled from a computer.

Other stuff – terms you will meet, things you'll need

Magnification

The maximum magnification you can usefully achieve with a telescope is calculated from

aperture (mm) x 2 or **aperture (inches) x 50**.

E.g. A 150mm (6 inch) reflector has a maximum usable magnification of 300.

$$\text{Magnification} = \frac{\text{focal length of the telescope}}{\text{focal length of the eyepiece}}$$

Thus a telescope with a focal length of 1200mm and a 40mm eyepiece will have a magnification of 30, which is Ideal for looking at the Pleiades! An 8mm eyepiece with the same telescope will give a magnification of 150 for a good view of Jupiter and its moons.

Eyepieces

Your telescope is only as good as its eyepieces. Telescopes often come with a couple of eyepieces (e.g. 25mm and 10mm) and possibly a Barlow (a lens which doubles the focal length– and hence the magnification – of your telescope). You can do better. Plossl eyepieces cost £30–40 and are a good start at improving on the included eyepieces.

If you go for a long-bodied reflector (e.g. a 200mm Dob with 1200mm focal length) then a 40mm eyepiece (£40) will give wider views than the often-supplied 25mm eyepiece.