Bear Valley Springs Astronomy Club

Eyepieces

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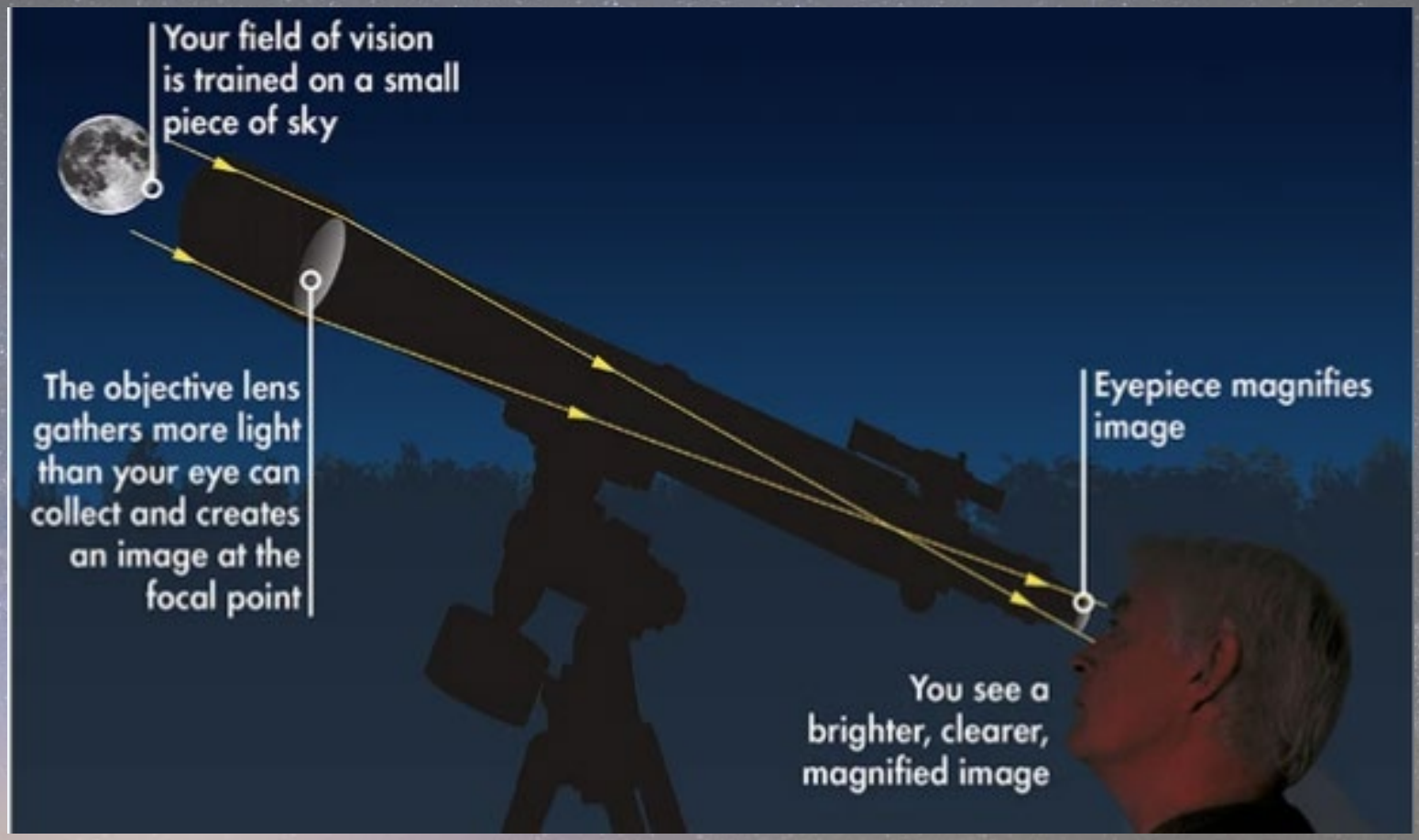
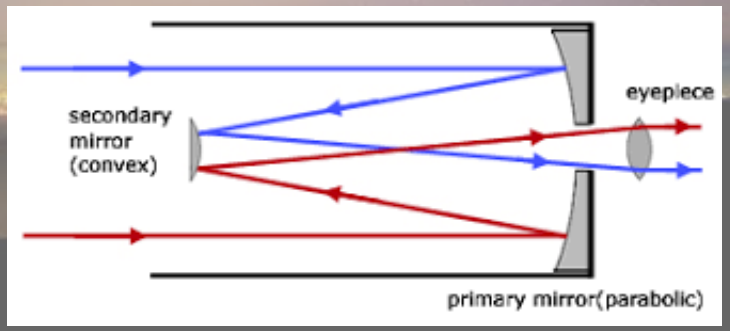
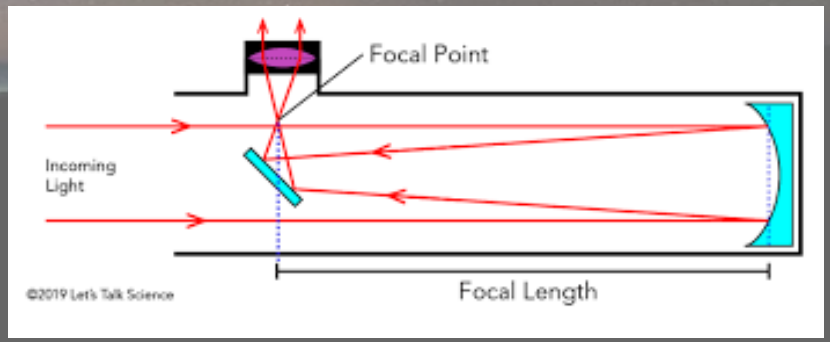
What is an Eyepiece (aka Ocular)?

Eyepieces allow you to focus light collected by a telescope, so you can observe a sharp view of the object or area where the telescope is pointing. It may seem like a small link in the chain, but it has a large effect on your telescope's optical system, and finding suitable eyepieces will greatly enhance its performance


Your field of vision is trained on a small piece of sky
The objective lens gathers more light than your eye can collect and creates an image at the focal point
Eyepiece magnifies image
You see a brighter, clearer, magnified image


secondary mirror (convex)
eyepiece
primary mirror(parabolic)


Focal Point
Incoming Light
Focal Length
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Eyepiece Selection Criteria

-Observing Interest
-Magnification
-Barrel Size
-Field-of-View
-Eye Relief/Exit Pupil
-Types
-Quality/Price

Observing Interest

Very High Magnification (2mm-10mm)

- Planetary Detail
- Splitting Double Stars
- Asteroids and minor planets
- CAVEAT: Long focal length telescopes and great seeing!

High Magnification (11mm-18mm)

- Lunar detail
- Small Planetary Nebulae and Galaxies

Medium Magnification (19mm-35mm)

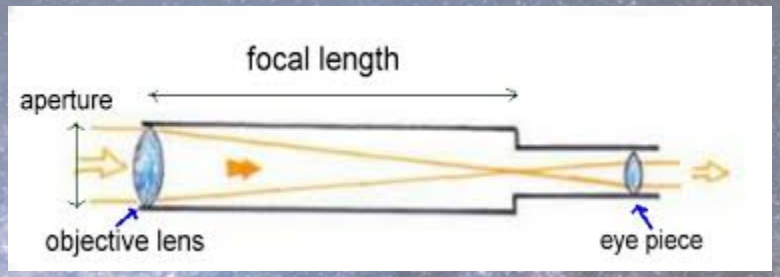
- Globular Clusters
- Galaxies
- Most Nebulae
- Full Lunar Disk

Low Magnification (36mm-70mm)

- Finding your object!
- Large Nebulae
- Large Galaxies
- Milky Way Viewing
- CAVEAT: Best for short focal length telescopes

Magnification

Magnification = Telescope Focal Length (mm) / Eyepiece Focal Length (mm)



A telescope's focal length is almost always printed on it by the manufacturer. It's usually in mm. Eyepieces also!

A Rule of Thumb

Maximum Useable Magnification: ~50x per inch of aperture of the telescope

So for a 4" aperture telescope, if magnifying beyond 200x the view will become unacceptably dim and blurry.

Barrel Size

0.965 in. (24.5 mm) – This is the smallest standard barrel diameter and is usually only found in toy store and shopping mall retail telescopes. And these eyepieces are often plastic. Exception: Antique telescopes.

1.25 in. (31.75 mm) – This is the most common eyepiece barrel diameter. The practical upper limit on focal lengths for eyepieces with 1.25" barrels is about 32 mm, with the exception of some of the more expensive and exotic designs.

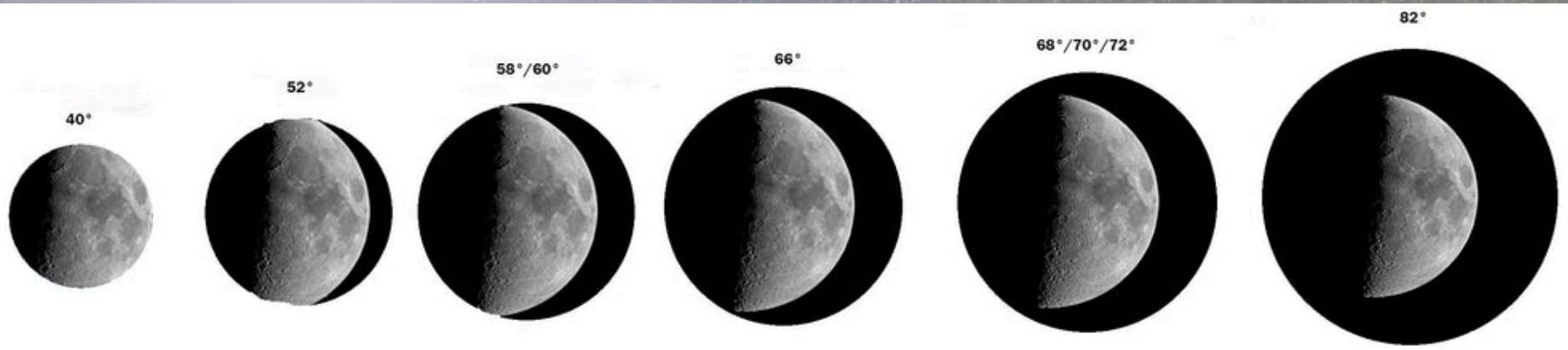
2 in. (50.8 mm) – The larger barrel size in 2" eyepieces helps alleviate the limit on focal lengths. The upper limit of focal length with 2" eyepieces is about 55 mm. The trade-off is that these eyepieces are usually more expensive, will not fit in some telescopes, and may be heavy enough to unbalance the telescope.

3 in. (76.2 mm) – The even larger barrel size in 3" eyepieces allows for extreme focal lengths and over 120° field of view eyepieces. The disadvantages are that these eyepieces are somewhat rare, extremely expensive, up to 5 lbs in weight, and that only a few telescopes have focusers large enough to accept them.

4 in. (102 mm) – These eyepieces are rare and only commonly used in observatories. They are made by very few manufacturers, and demand for them is low.

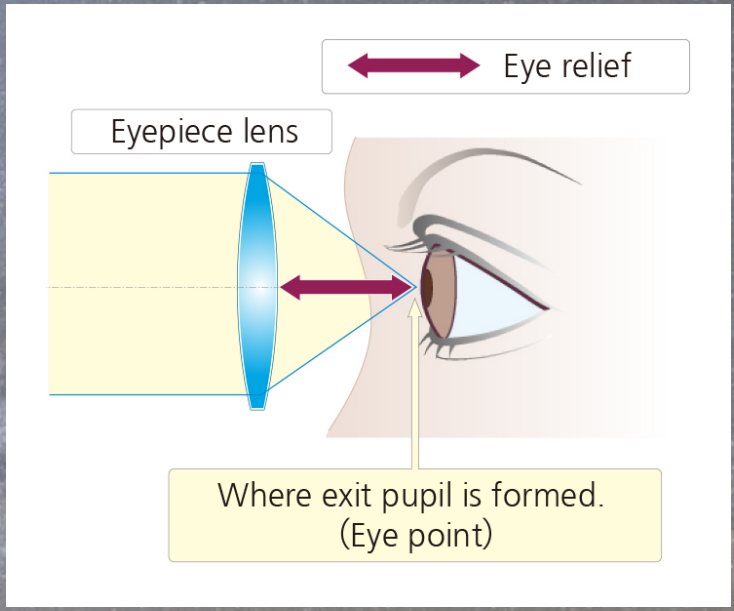
Field-of-View

The **apparent field of view (AFOV)** of an eyepiece is the apparent angular width of sky presented to your eye. The AFOV is a design parameter of each eyepiece, and it's governed by the size of the field stop of the eyepiece. It usually ranges from about 40° to 100°. Eyepieces with a larger AFOV show you much more sky for a particular magnification. That's usually a good thing, especially if you want to view extended celestial sights such as nebulae and large galaxies in a single view. A large AFOV is also a benefit if you have a Dobsonian telescope without a motor drive because an object stays in view longer before you have to nudge your telescope. **But** eyepieces with a larger AFOV are usually larger, heavier and more expensive.



Eye Relief

Eye Relief refers to the distance between your eye and the eyepiece lens when the image appears to be in focus for the eye. Eye relief is traditionally in proportion with focal length: The shorter the focal length, the shorter the eye relief. Some eyepieces have eye relief as short as 5mm!



However, some of the more modern eyepiece designs provide long eye relief regardless of focal length, which is especially beneficial to those who **wear glasses**. If you like to keep your glasses on while using a telescope, a minimum of 15mm of eye relief is recommended.

Exit Pupil

Exit pupil refers to the size of the bundle of light rays coming out of the eyepiece. Exit pupil size can be calculated by:

Exit pupil size (mm) = Telescope aperture (mm) / Telescope magnification

or

Exit pupil size (mm) = Eyepiece focal length (mm) / Telescope f-ratio

In order for all the light rays to enter your pupil, the exit pupil must be smaller than the pupil of your eye. A young person's fully dark-adapted eyes may have 7 mm-wide pupils. As you age, the maximum pupil diameter decreases. For middle-aged adults, the practical **maximum** is closer to 5 mm.

At the other end of the scale, magnifications that yield an exit pupil in the range of 0.5 mm to 1.0 mm, empty magnification begins to set in, depending on the quality of your telescope and your eyes. In other words, this much magnification starts to degrade the image you see.

Types, Quality, Price

Just Plain Bad: Huygens and Ramsden eyepieces are simple, antiquated designs and only found on the cheapest telescopes. (<$40)

Can be Decent: Kellners, for a cheap eyepiece and long focal-length telescope. ($10-50)

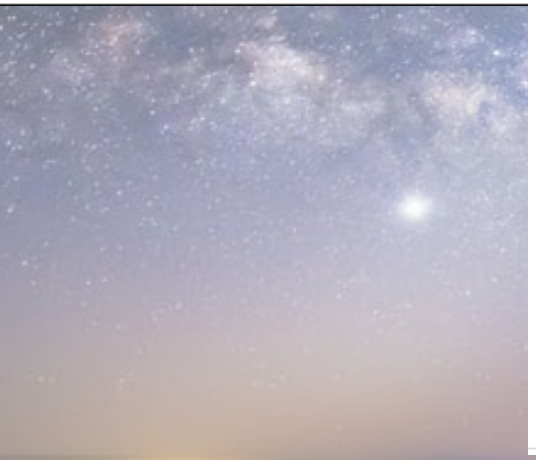
Usually Quite Good: Orthoscopics. Four-element eyepieces with 45 degree field, for planetary viewing. Plossls. Four or five elements, 50 degree field. Quality Plossls (like Televue) can be a good value choice. Many people view with only a good set of plossls. ($45-140)

Excellent: Nagler Televue designs (Naglers, Radians, Delos), Explore Scientific, Celestron X-Cel, Meade MWA , Orion Lanthanum etc. Modern multi-element designs often with argon fill, specialized glass and coatings. ($90-900)

ALL DESIGNS AND MAKES ARE MORE EXPENSIVE IN 2” BARREL SIZE


10X


32MM PLÖSSL

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