TAMILNADU MODEL SCHOOL

ASTRO CLUB

TOPIC 3

TELESCOPE AND BINOCULAR

TASS

TELESCOPE AND BINOCULAR

S SAKTHIVEL

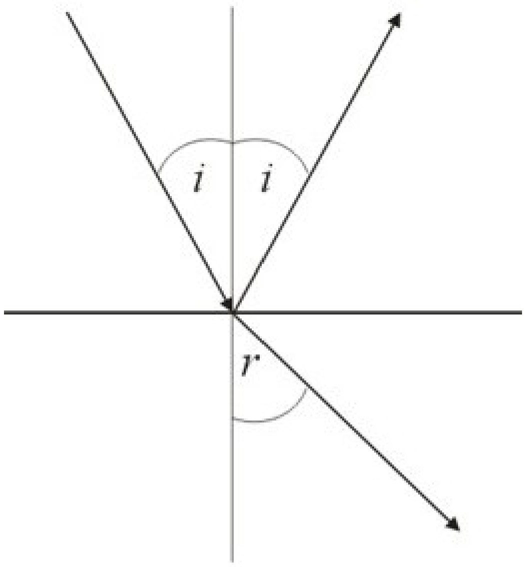
BT ASSISTANT

GHS KATTRAMBAKKAM

Two principles of light

Reflection and refraction

Two laws
Law of Reflection and Snell's law



Law of reflection

Angle of incidence = Angle of reflection

i = r

Snell's Law

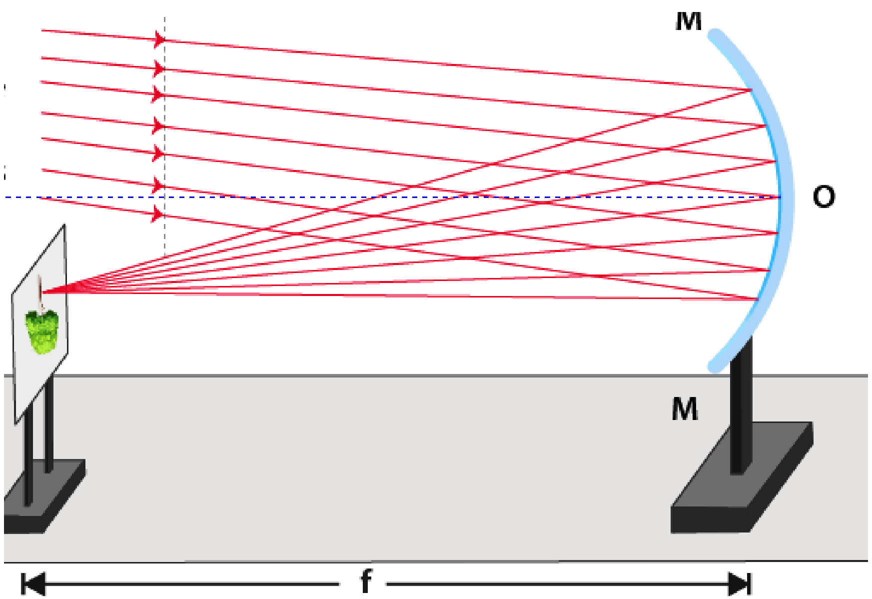
$$n = \frac{\sin i}{\sin r}$$

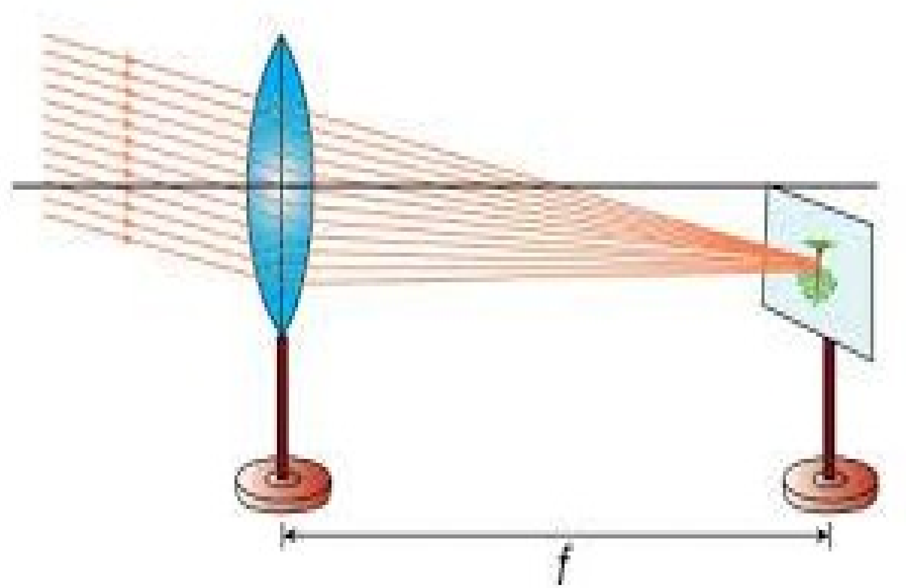
n = refractive Index

i = angle of incident

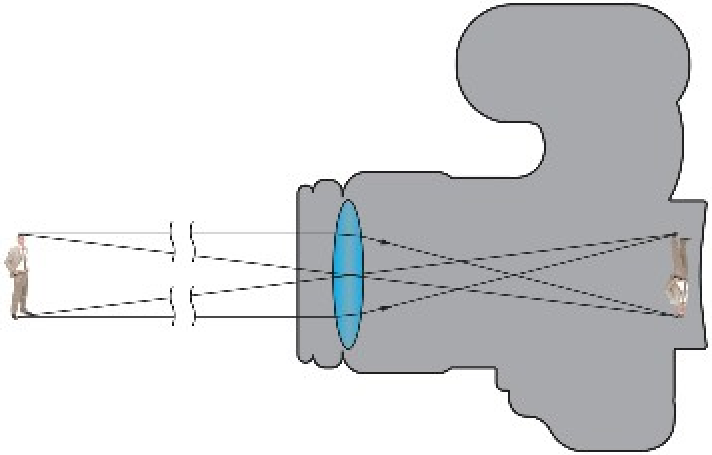
r = angle of refraction

Two devices for image formation
Convex Lens and Concave mirror

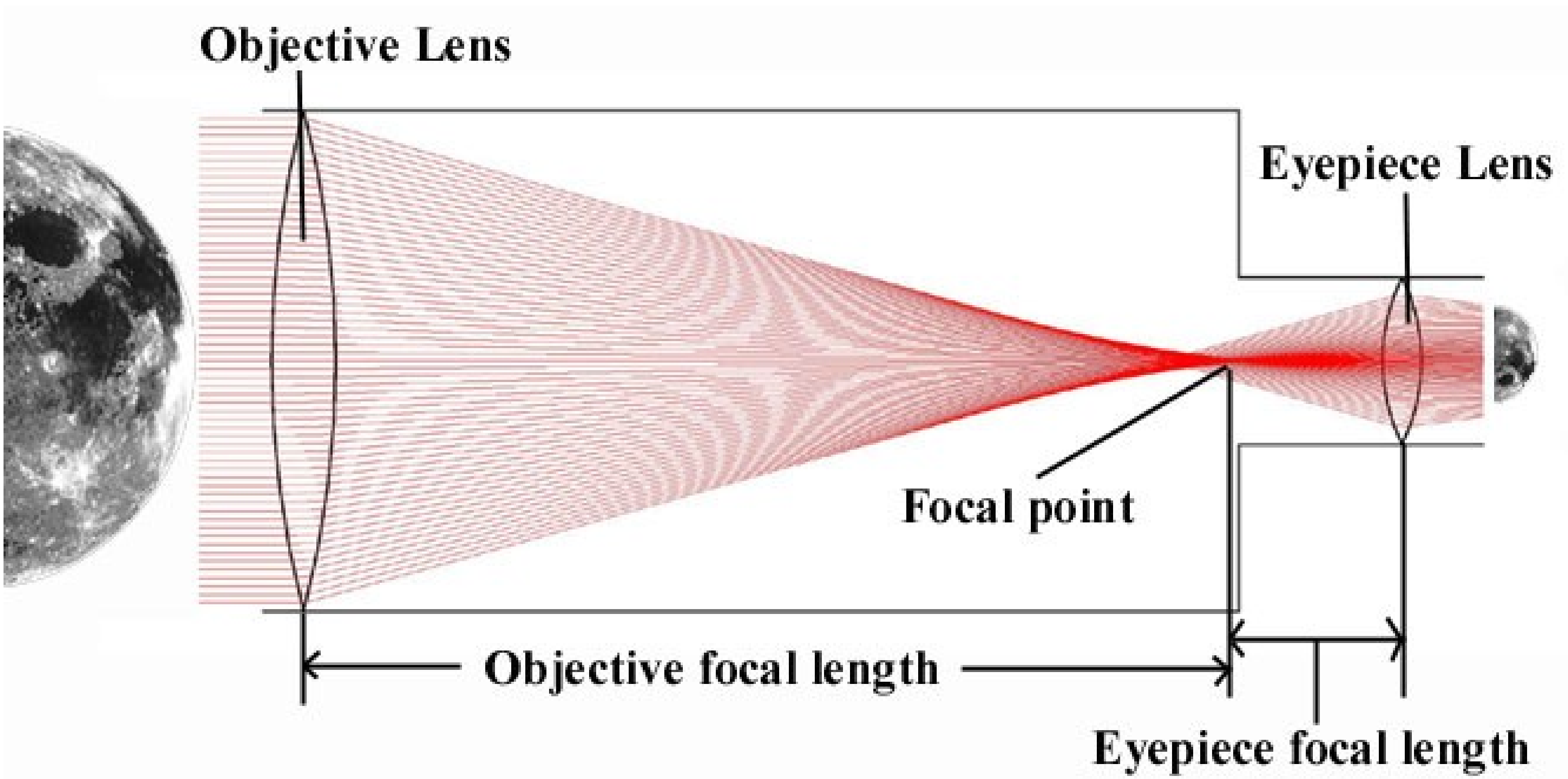




Two ways of using lenses
Camera and Magnifier



Telescope as a combination of Camera and Magnifier

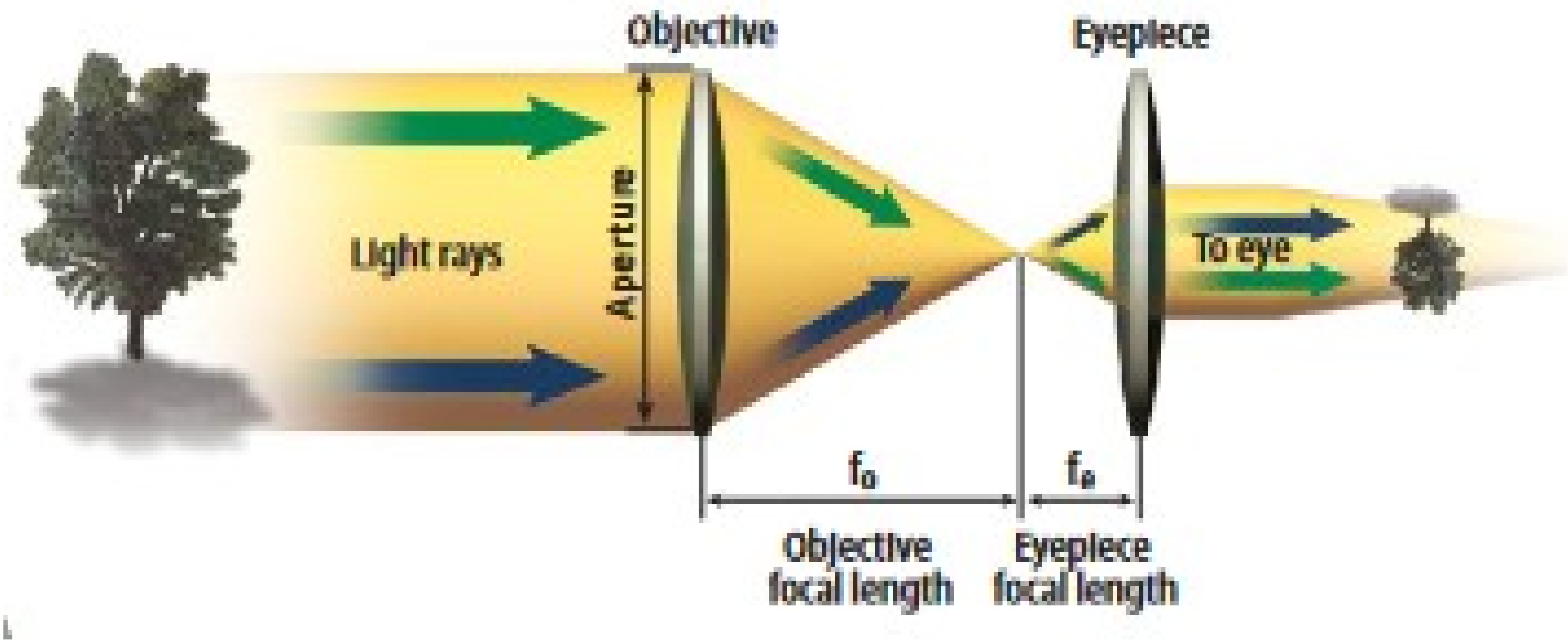


Two numbers to remember
Focal length and Aperture

- 1. **Focal length** of the telescope is the distance between the objective lens/mirror and its focus. (Larger focal length gives bigger image)

- 2. **Aperture** of telescope is the diameter of the Objective lens/mirror. (Larger aperture gives brighter image

Focal Length



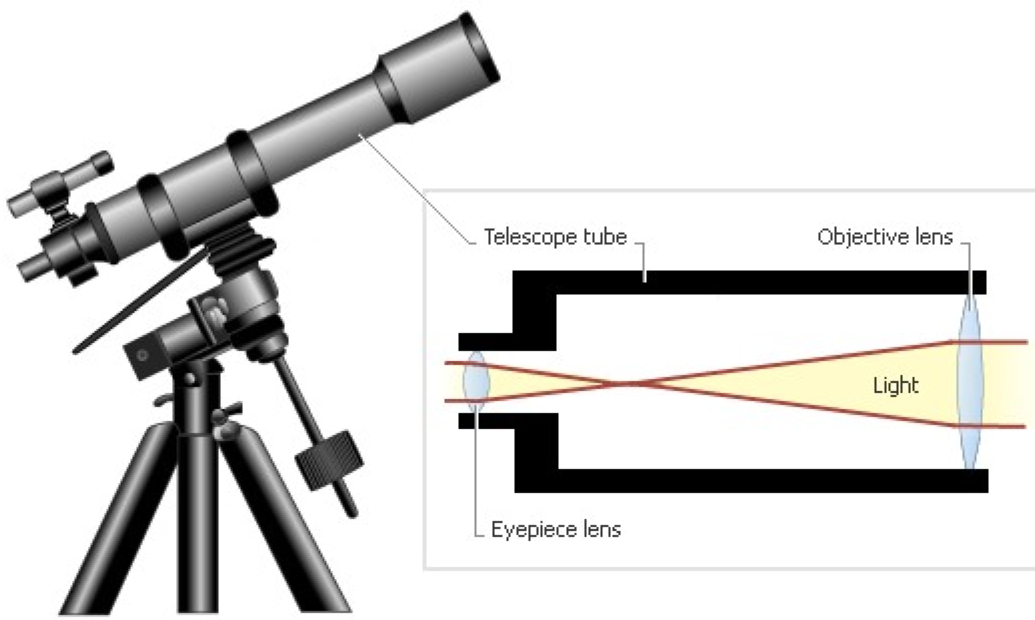
Purpose of a Telescope

- ★ To collect more light
- ★ To provide greater resolution

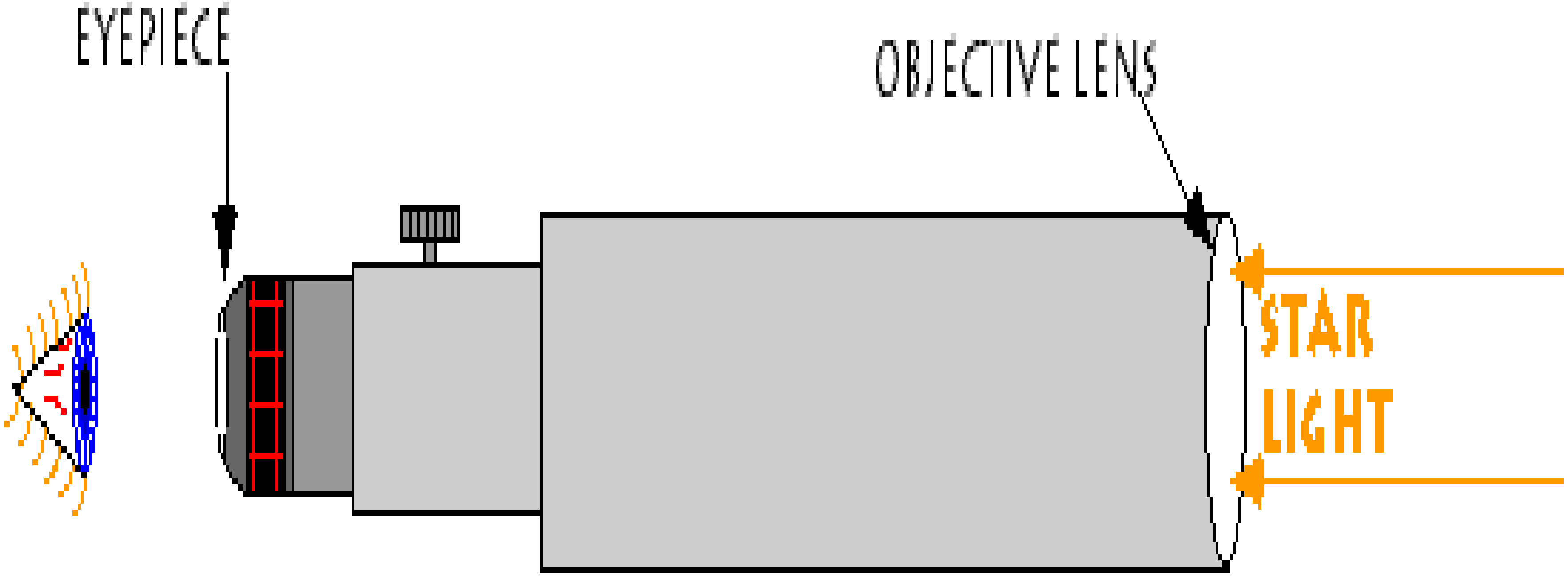
Type of Telescopes

- ★ **Refractors** . . . *Use a combination of Lenses*
- ★ **Reflectors** . . . *Use a combination of Mirrors and lenses*
- ★ **Catadioptrics** . . . *Use a combination of mirrors and lenses*

Refracting Telescopes



Galileo Galilei

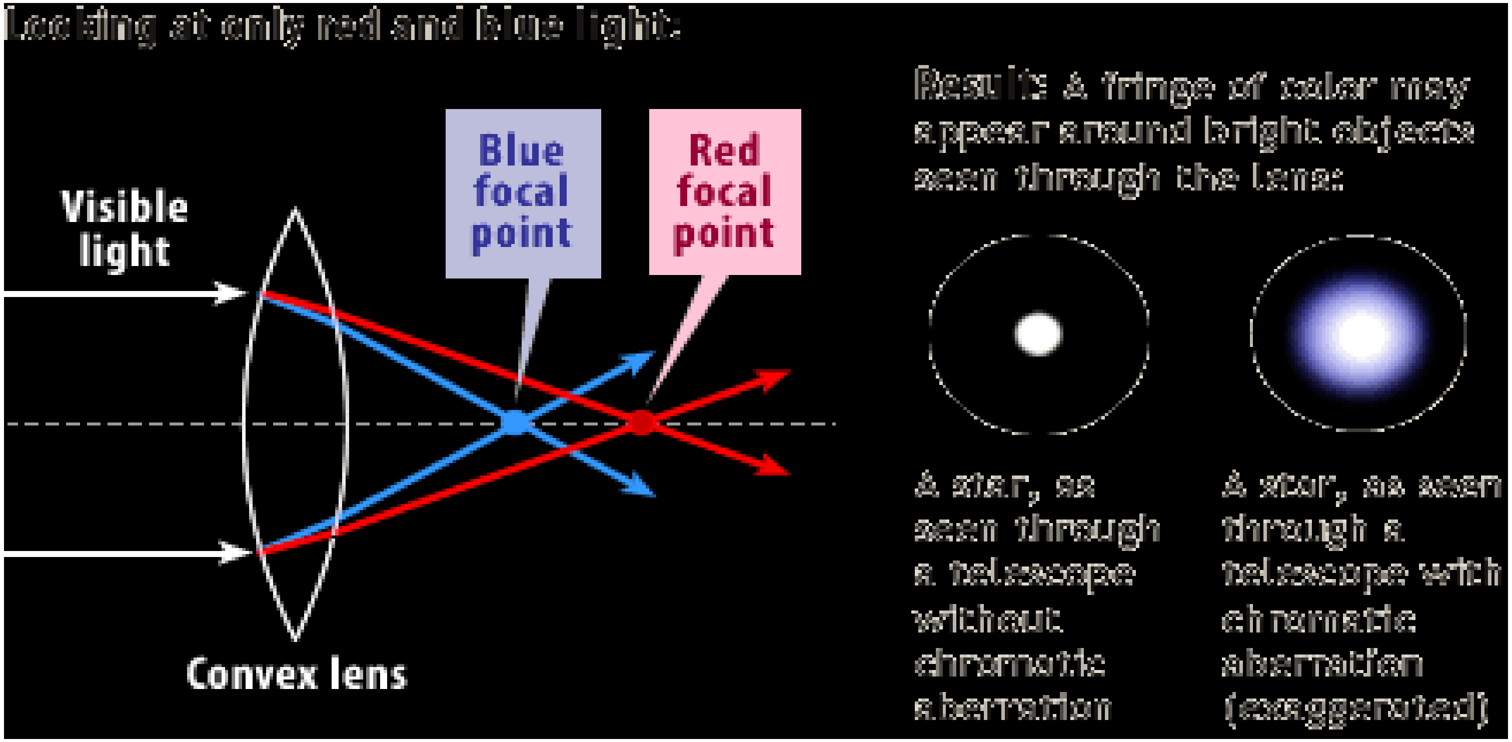


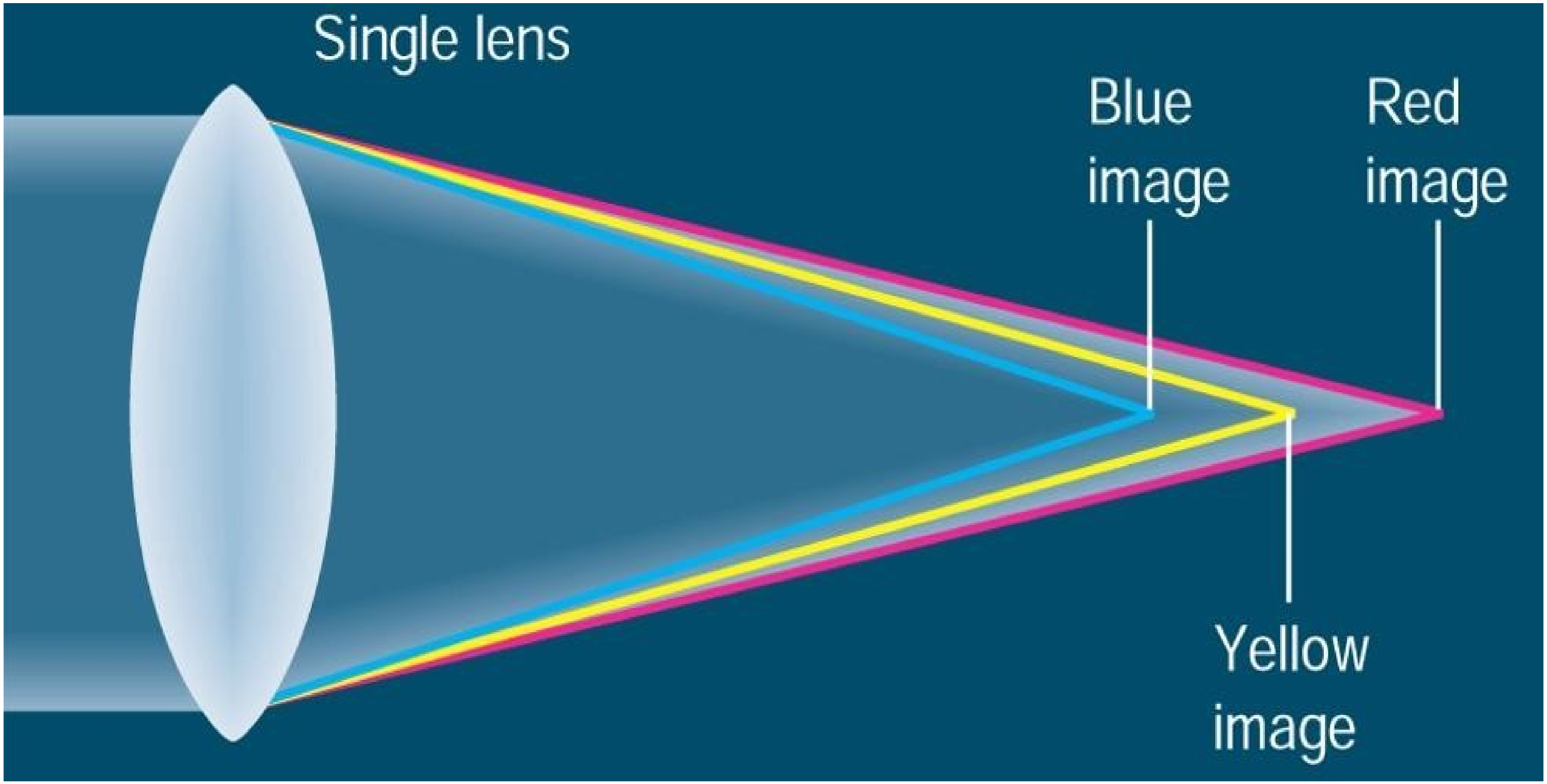
LIGHT PATH FOR A REFRACTING TELESCOPE

- **Advantages**
  - Simplicity of design, require little or no maintenance,
  - Good for distant terrestrial viewing,
  - Offer high-contrast images with no secondary mirror or diagonal obstruction,
  - Sealed optical tube reduces image-degrading air currents and protects optics,
  - Have permanently mounted and aligned objective lenses.

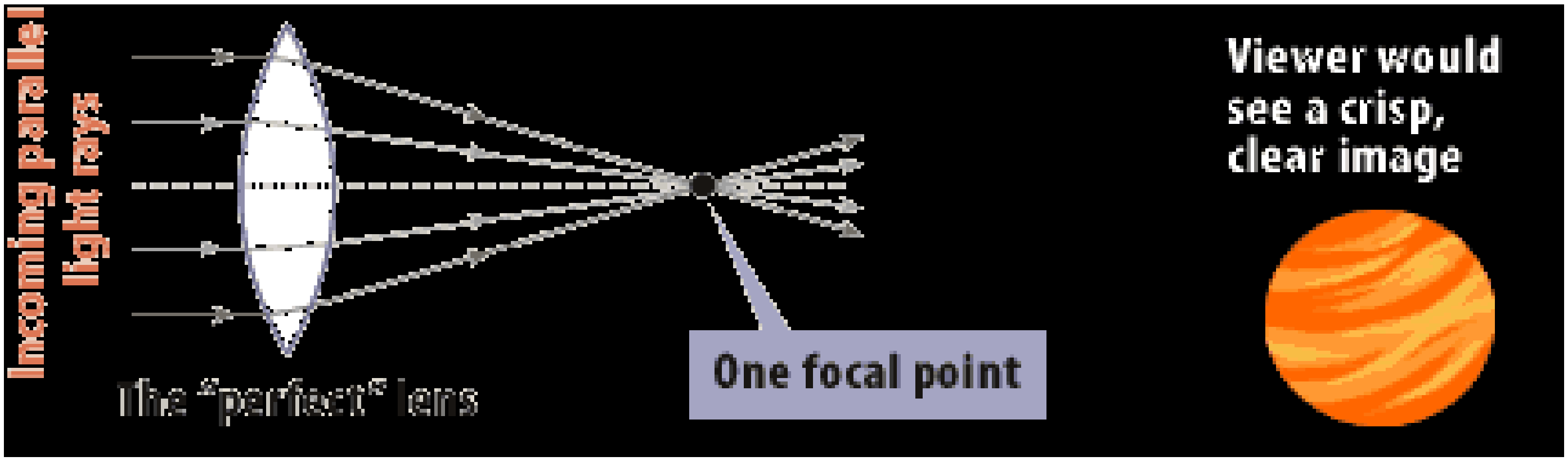
- **Disadvantages**
  - More expensive, heavier, longer and bulkier than equivalent-aperture reflectors and catadioptrics,
  - Less suited to viewing small and faint deep-sky objects because of practical aperture limitations.

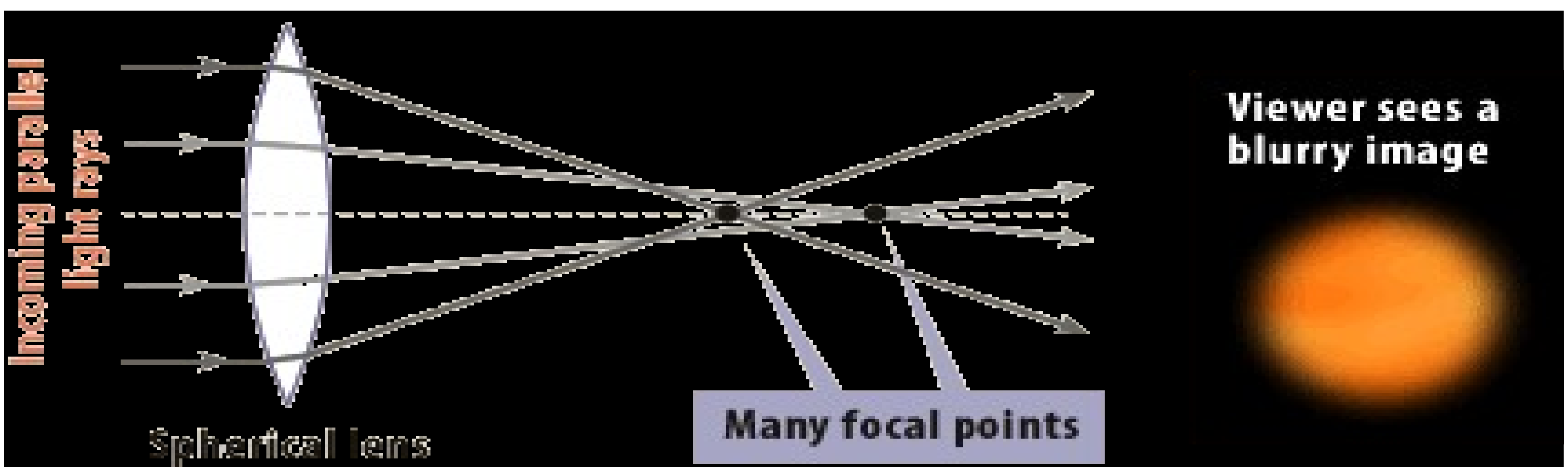
Chromatic Aberration



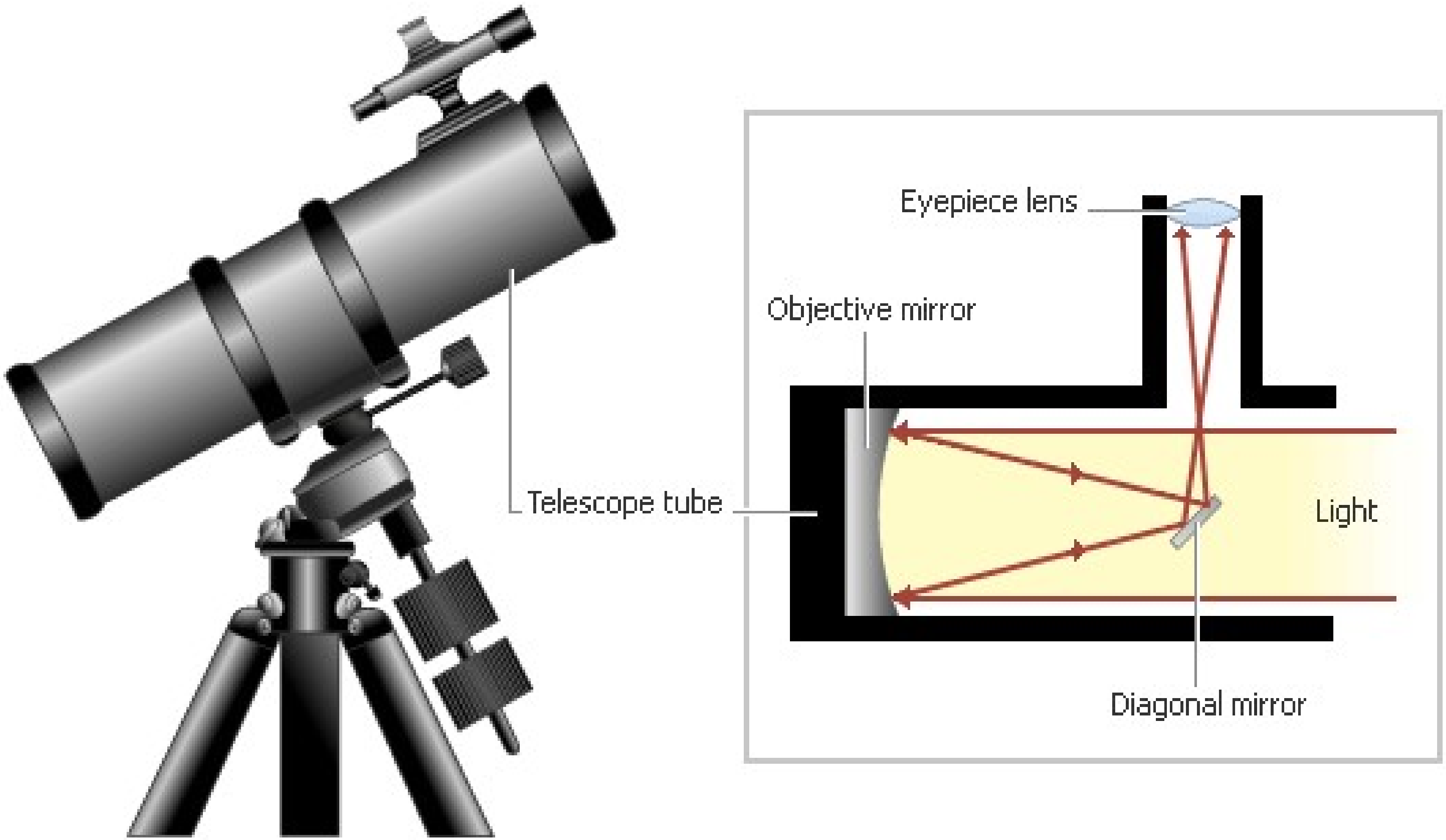

Single lens
Blue image
Red image
Yellow image

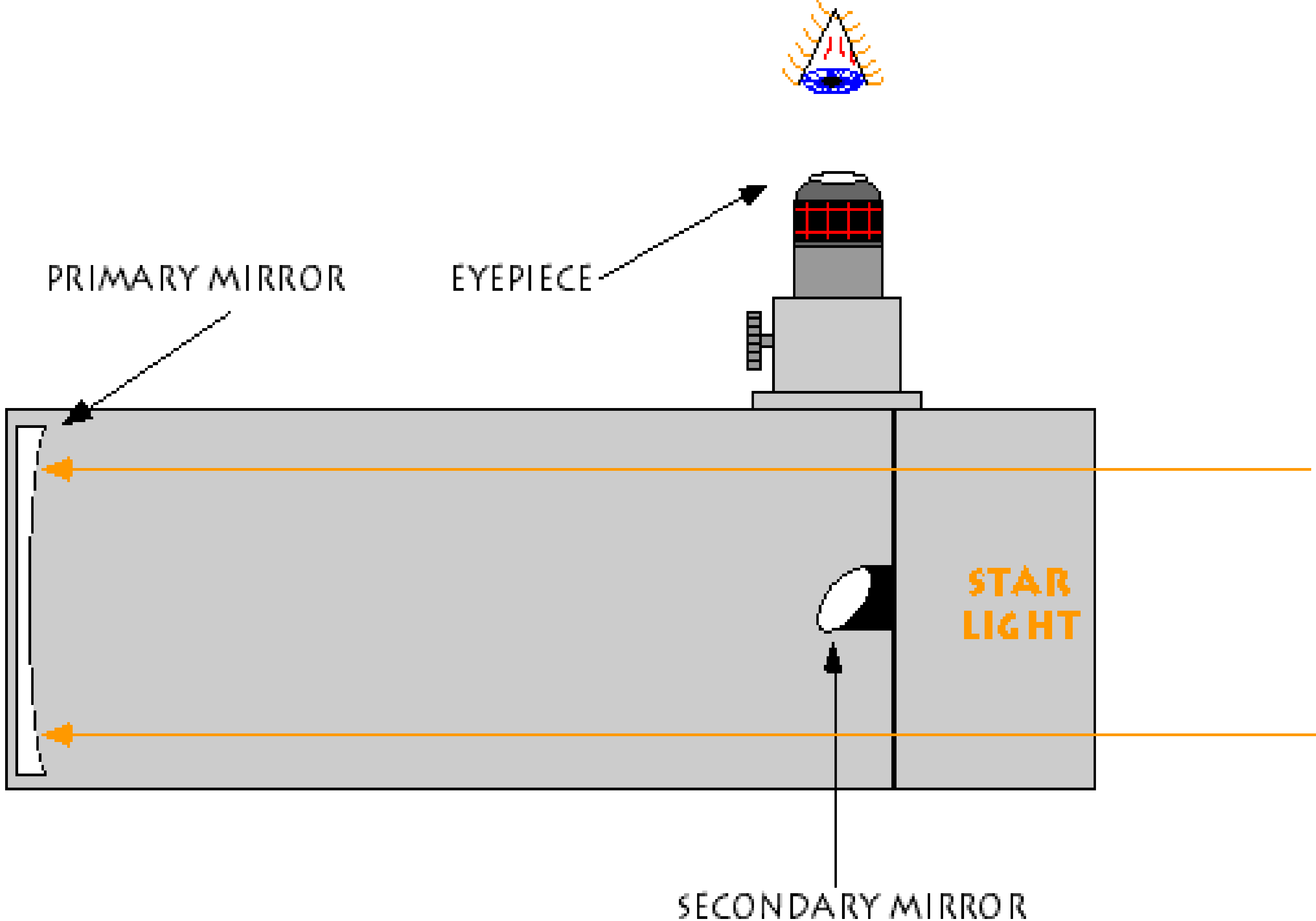
Spherical Aberration





Reflecting Telescopes

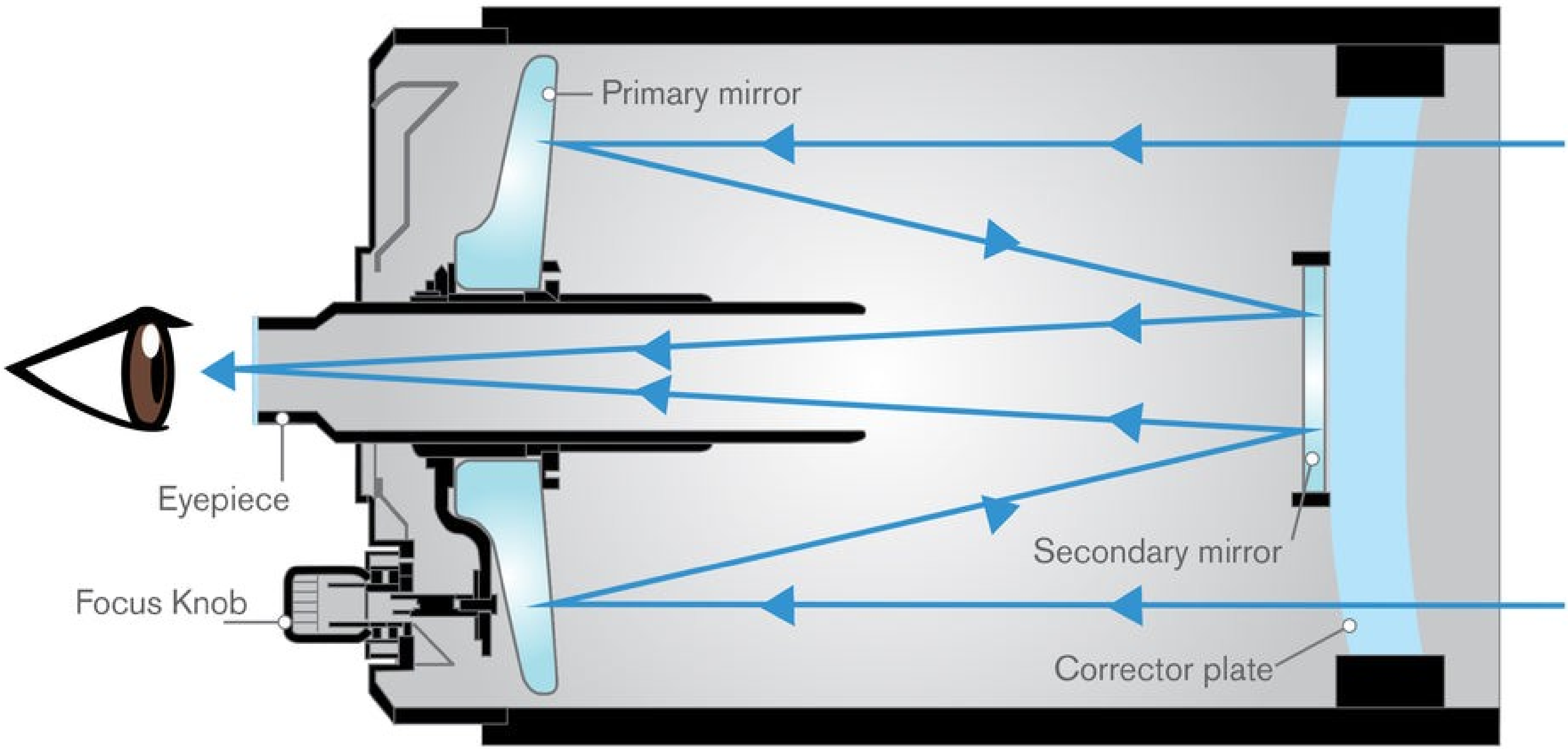


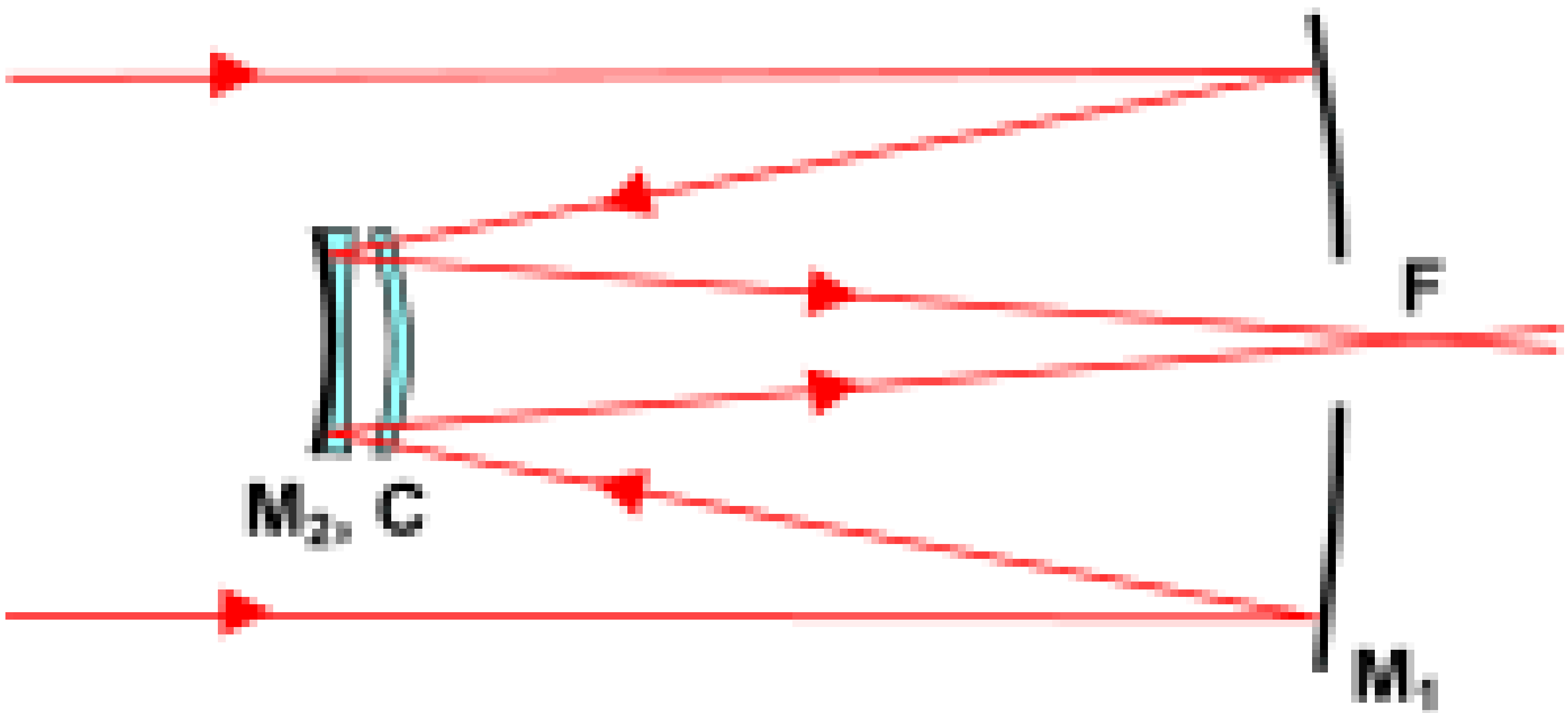


LIGHT PATH FOR A REFLECTING TELESCOPE

- ***Advantages:***
  - Lower cost per inch of aperture than offered by refractors and catadioptrics, since mirrors can be produced at less cost than lenses in refractors in medium to large apertures.
  - Reasonably compact and portable.
  - Excellent for faint, deep-sky objects, such as remote galaxies, nebulae and star clusters, because of their larger apertures.
  - Deliver very bright images with few optical aberrations.
- ***Disadvantages:***
  - Generally not suited to terrestrial observation.
  - Slight light loss due to obstruction from the secondary mirror.

Maksutov-Cassegrain Telescopes





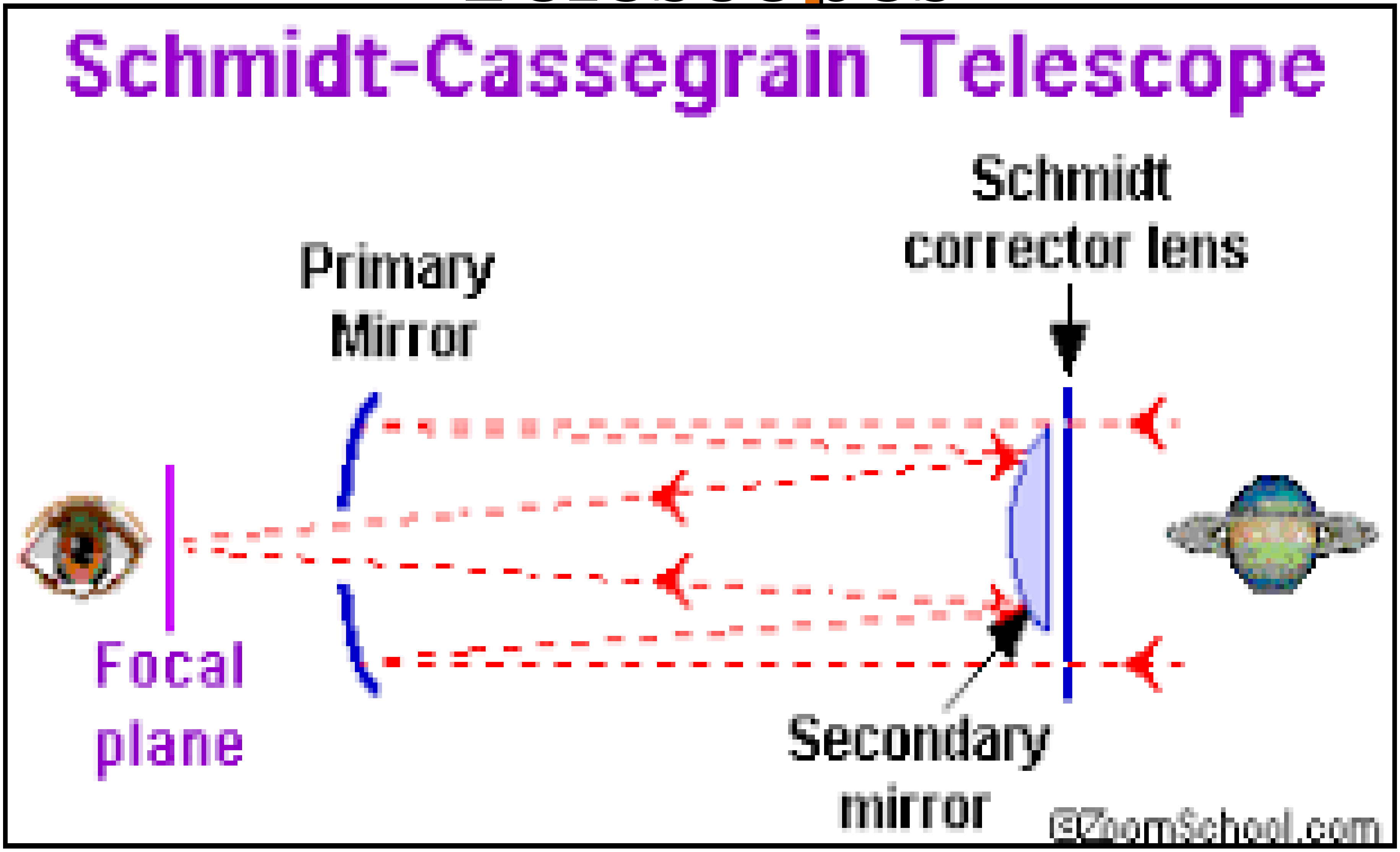
Klevtsov-Cassegrain

Advantages & *Disadvantages*

- ★ The Maksutov is heavier than the Schmidt and, because of the thick correcting lens, takes a long time to reach thermal stability at night in larger apertures.

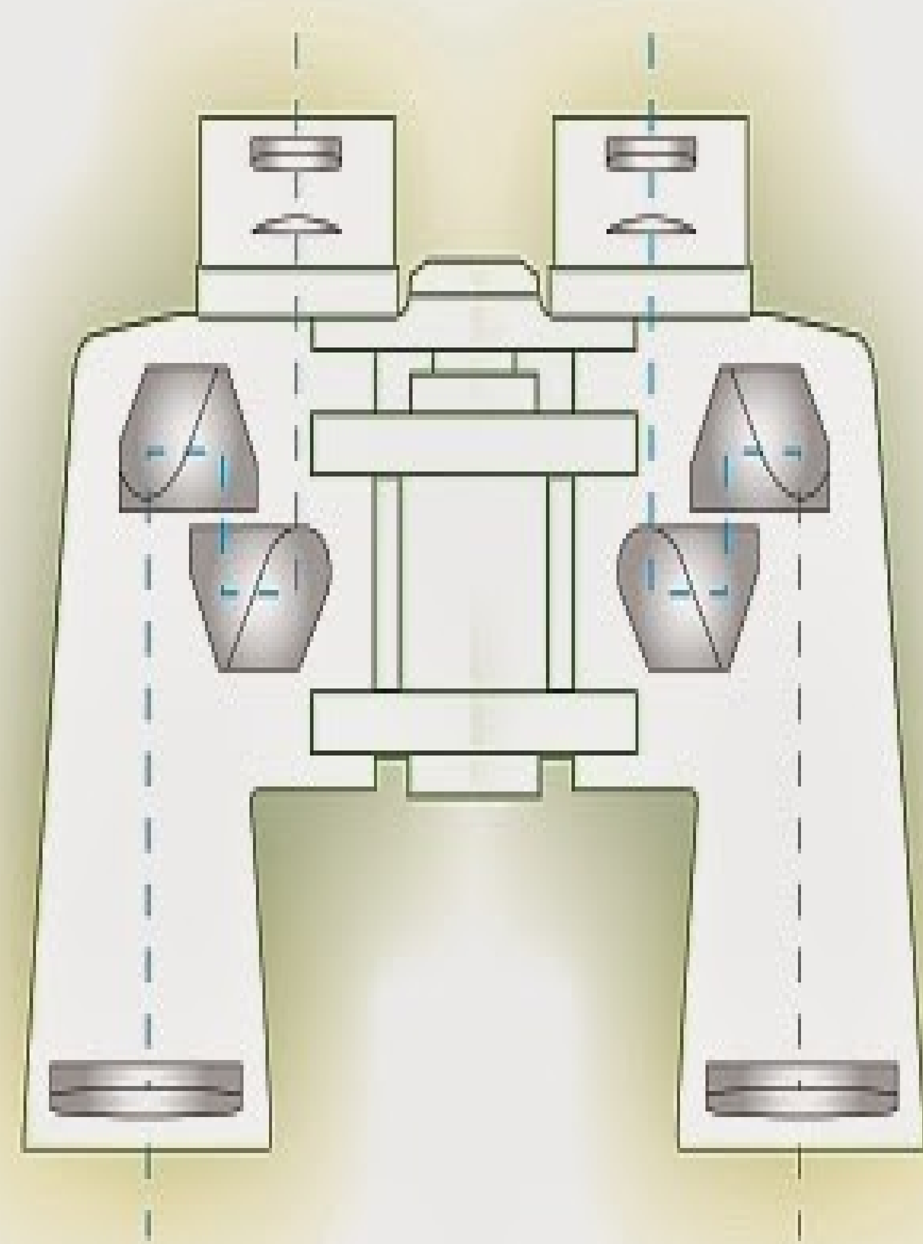
- ★ The Maksutov optical design typically is easier to make, but its corrector lens requires more material than the Schmidt Cassegrain’s

Schmidt-Cassegrain Telescopes

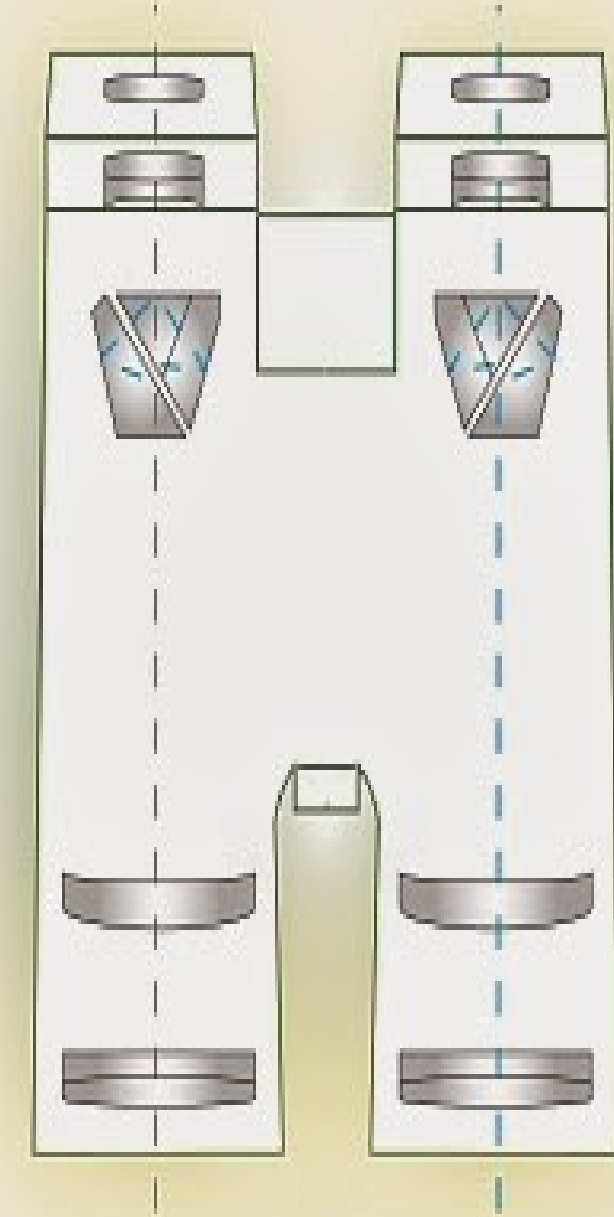


Binoculars

- **The first number tells you the magnification power ---** 8x, 10x 12x etc.
  - An 8X40 pair has an 8x magnification; a 10X40 pair has a 10x magnification and so on.
- **the second tells you the size of the objective lens in millimeters**, -- 21mm to 50mm etc.
  - An 8X40 pair has a 40mm lens diameter; a 10X52 pair has a 52mm lens diameter.
- A bigger objective lens captures more light and produces a brighter and clearer image.



Porro Prism



Roof Prism

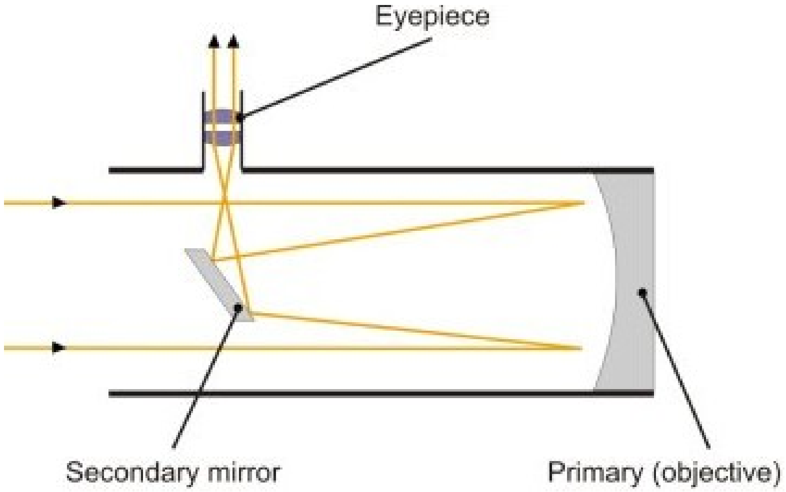
Telescope Mounts

Alt-azimuth mount

Equatorial mount

Dobsonian mount (with telescope)

DOBSONIAN TELESCOPE



GSO 10” DOBSONIAN

Aperture	254 mm (10”)
Focal Length	1250 mm (F/5)
Eye piece 1	30mm (2” 1.7 deg)
Eye piece 2	9mm (1.5” 0.37 deg)
Finder	8x50

Two formulas to remember
Magnification and Maximum Magnification

$$M = \frac{F_o}{F_e}$$

M = power or magnification

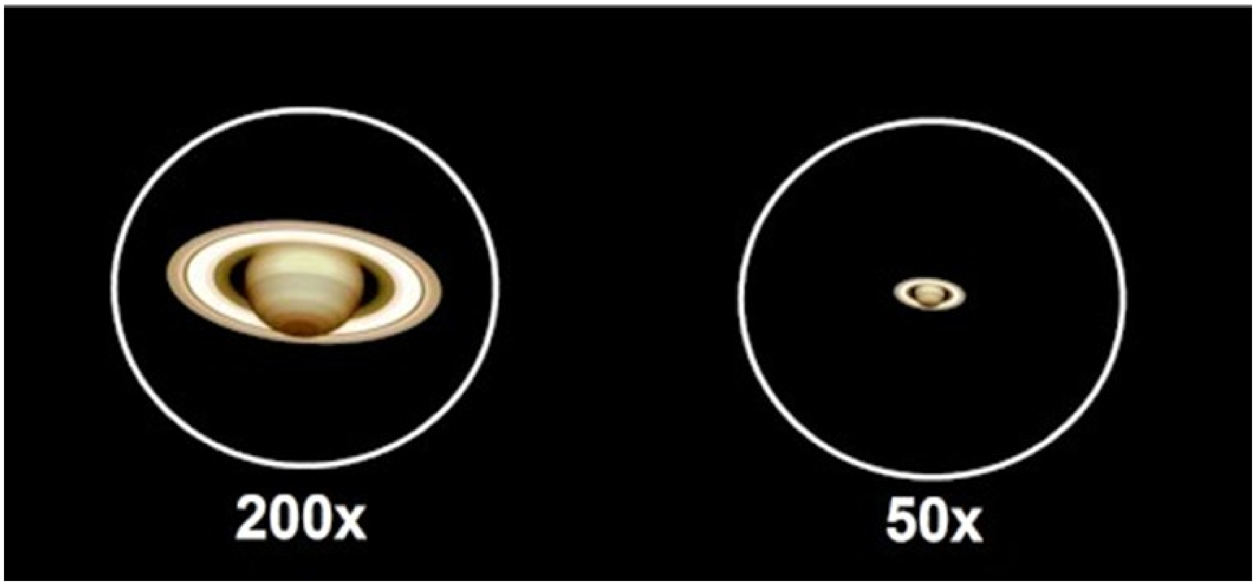
F_e = focal length of the eyepiece

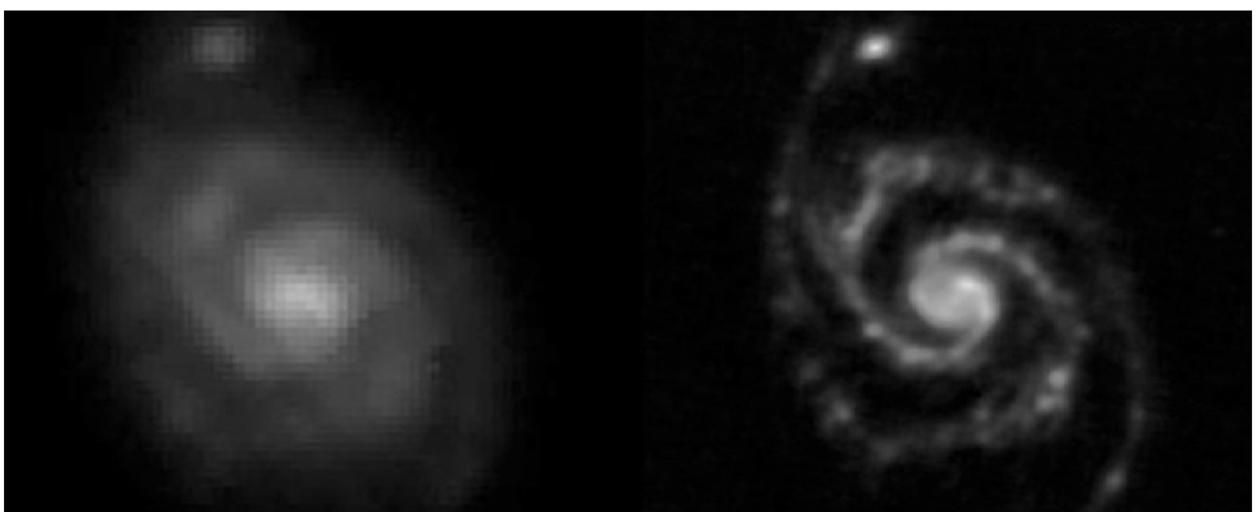
F_o = focal length of the objective

Maximum Magnification = 2 x Aperture in mm

Low magnification	50x
Medium magnifaction	100x
High magnification	>200x

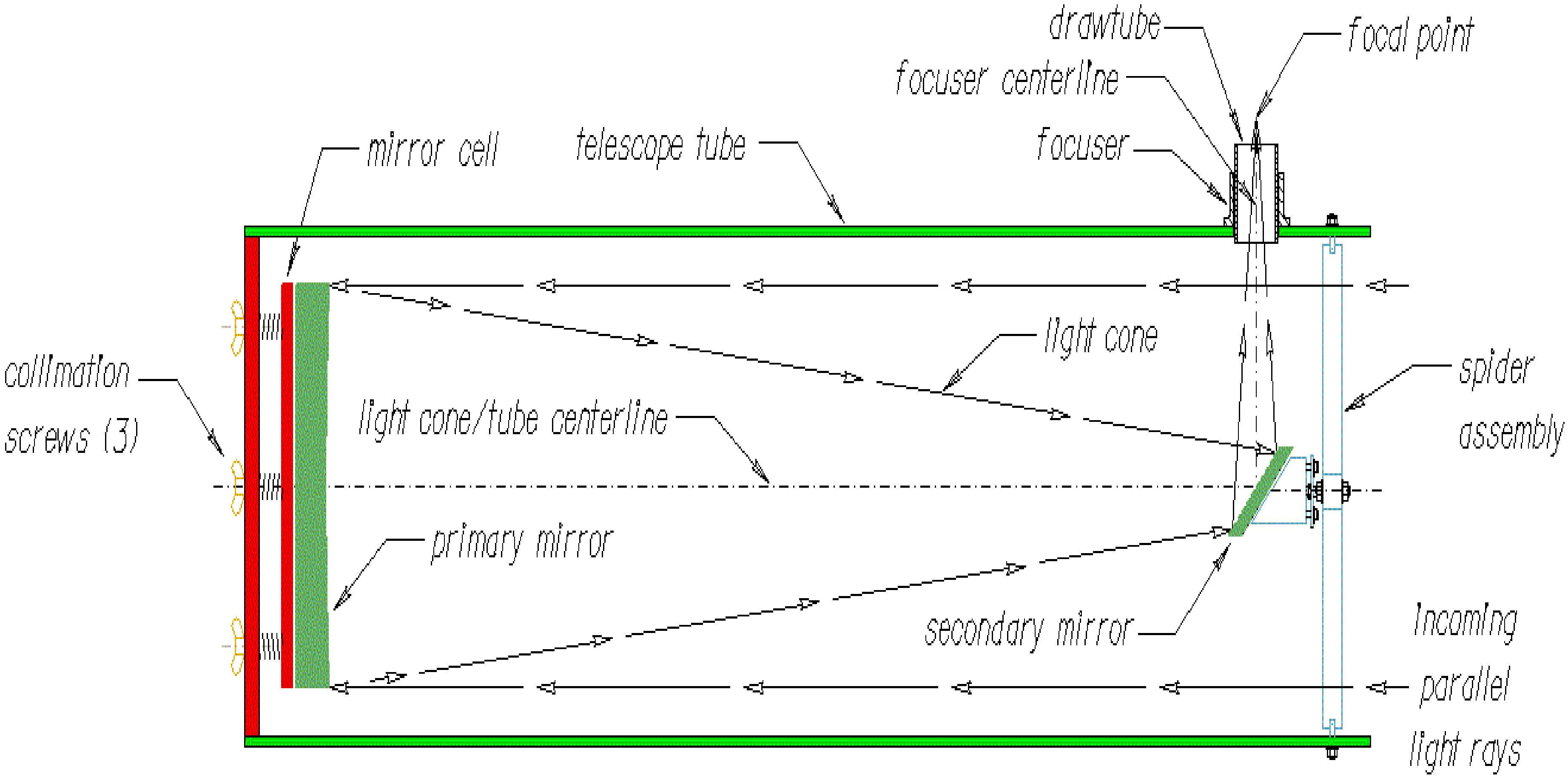
Magnification and Resolution





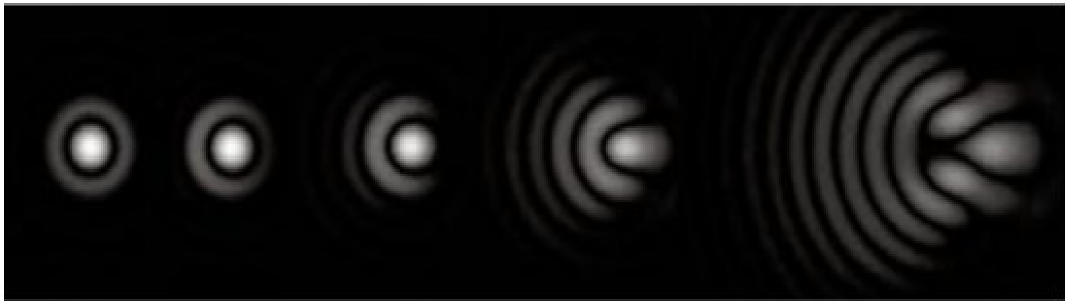
FINDERSCOPE ALIGNMENT

COLLIMATION



Why Is Collimation Needed?

- Components tend to become misaligned because of:
  - Manufacturing tolerances, component flexure, mechanical couplings, vibration and jarring, assembly variation, wear, temperature, scope orientation, etc.
  - Repeated transportation, assembly and disassembly, especially of truss Dobs
- The larger the scope, the more frequently collimation is required
  - Especially true of truss dobs, which must be reassembled for each setup
- The faster the primary's f-ratio, the more critical collimation becomes
- Component misalignment degrades performance
  - Misalignment can cause star image flaring, reduce contrast and even light gathering capability, and make it impossible to bring objects into focus



- Collimation is necessary for good performance – but to new scope owners it seems daunting at first

MY SINCERE THANKS TO
PROF SAKTHIVEL SIR
JAYAPAL SIR

Thank You!

Any questions?