

Telescopes 101

A beginners guide

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Astronomy is a blast.....!

Selection of the right telescope for YOU is the key to long term enjoyment

What Type of Telescope Do I Need?

The type of telescope that you need depends mostly on the observing you want to do.....

- Personal “adult” use with short term “entry level” potential
- Personal “adult” use with long term potential
- Family enjoyment with the kids – adult supervised
- Child use; educational*or just plain fun!*



What Type of Telescope Do I Need?

The type of telescope that you consider also depends on other factors.....

- Cost
- Ease / difficulty of use
- Portability
- Durability
- Types of objects desired (planets, galaxies, nebula...)
- Darkness of local sky



Types of Telescopes

There are generally 3 type of telescopes, and variations thereof:

- Refractors
- Reflectors
- Catadioptric (Cassigrain) Type

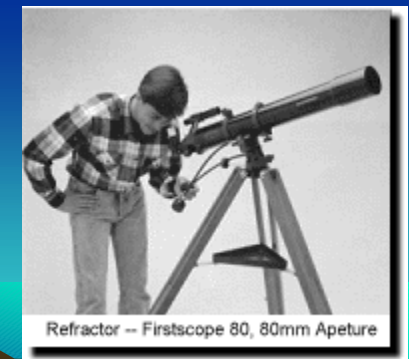
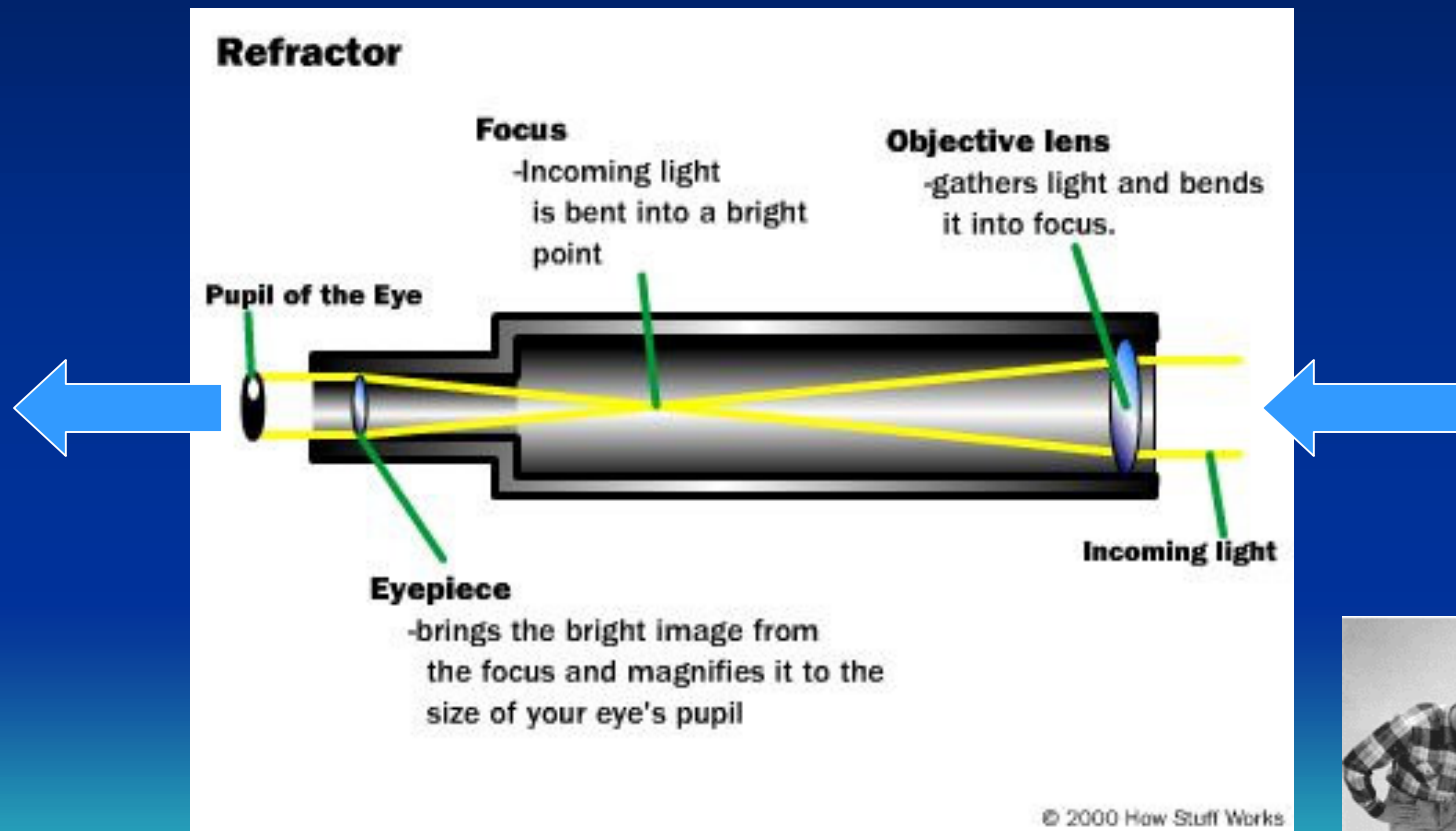
And one perhaps overlooked consideration:

- Binoculars !



Refracting Telescope

light passes in a straight line from the front objective lens directly to the eyepiece at the opposite end of the tube ...



Refracting Telescope

Advantages

- Easy to use and reliable due to the simplicity of design.
- **Excellent for lunar, planetary and binary star observing especially in larger apertures.**
- Objective lens is permanently mounted and aligned
- High contrast images with no secondary mirror or diagonal obstruction.

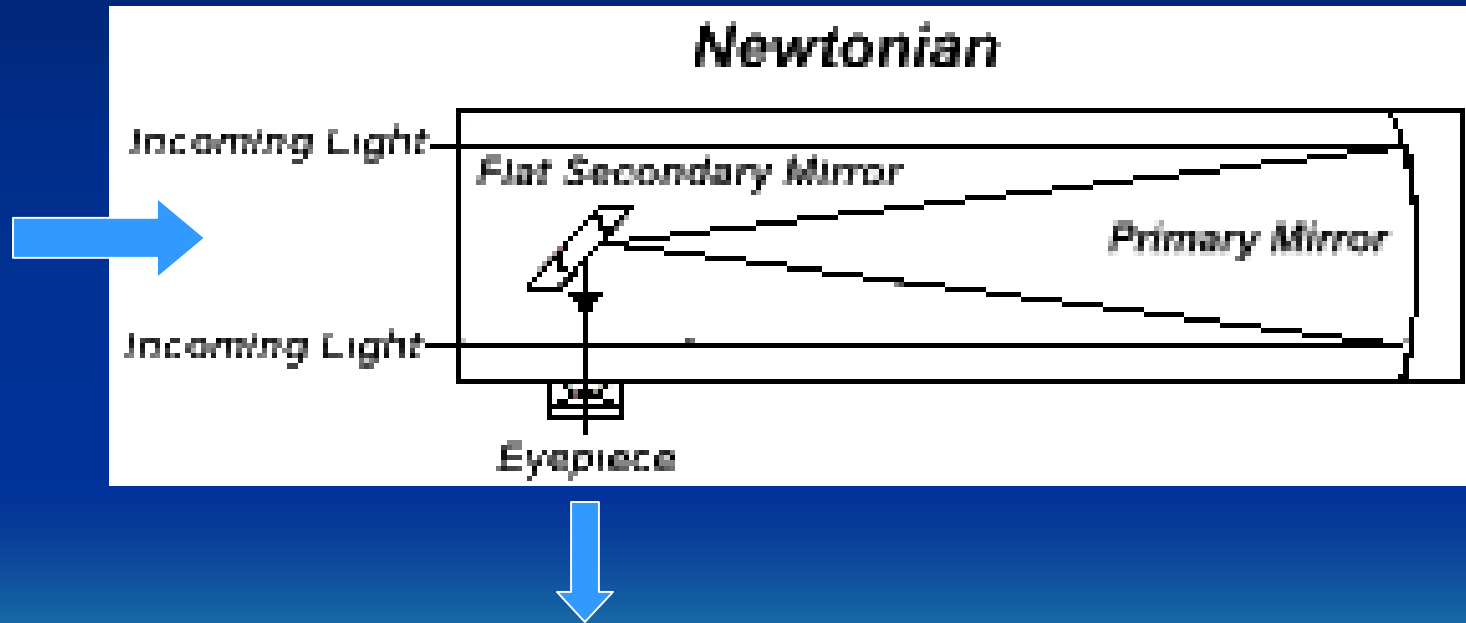
Disadvantages

- **More expensive per inch of aperture than Newtonians or Catadioptrics.**
- Heavier, longer and bulkier than equivalent aperture Newtonians and catadioptrics.
- Less suited for viewing small and faint deep sky objects such as distant galaxies and nebulae because of practical aperture limitations.



Reflecting Telescope

“Newtonians” usually use a concave parabolic primary mirror to collect and focus incoming light onto a flat secondary (diagonal) mirror that in turn reflects the image out of an opening at the side of the main tube and into the eyepiece



Reflecting Telescope

Advantages

- **Lowest cost per inch of aperture** compared to refractors and Catadioptrics since mirrors can be produced at less cost than lenses in medium to large apertures.
- Reasonably compact and portable up to focal lengths of 1000mm.
- **Excellent for faint deep sky objects such as remote galaxies, nebulae and star clusters due to the generally fast focal ratios (f/4 to f/8).**
- Reasonably good for lunar and planetary work.

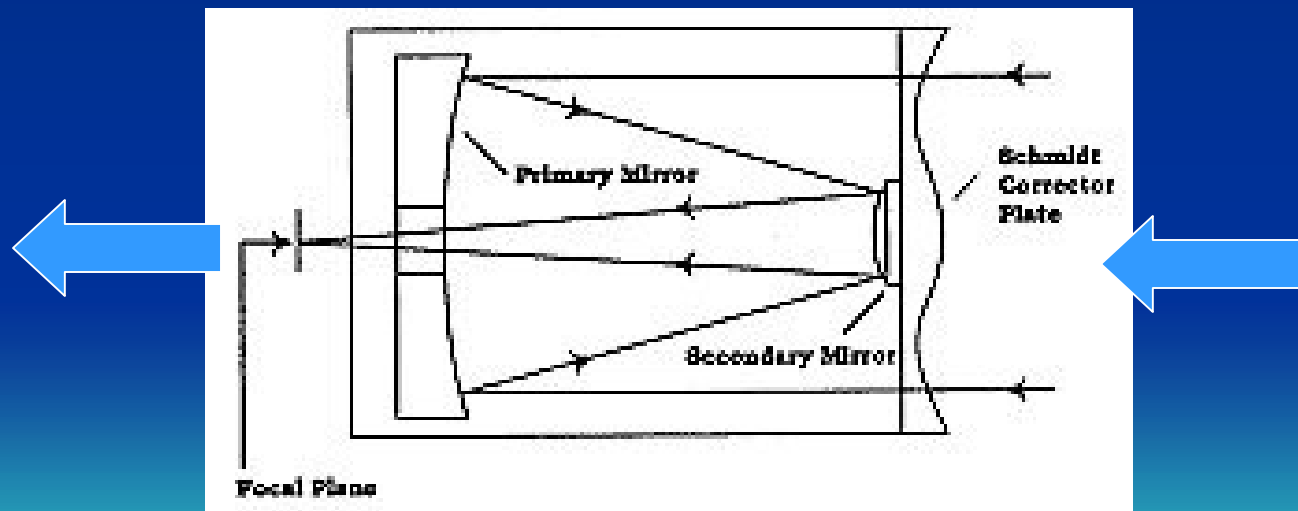
Disadvantages

- Generally not suited for terrestrial applications (whereas refractors are).
- Slight light loss due to secondary (diagonal) obstruction when compared with refractors.



Cassegrain Reflectors (Catadioptric)

- Use a combination of mirrors and lenses to fold the optics and form an image. In a Schmidt-Cassegrain the light enters through a thin correcting lens, then strikes the spherical primary mirror and is reflected back up the tube and intercepted by a small secondary mirror which reflects the light out an opening in the rear of the instrument where the image is formed at the eyepiece. Catadioptrics are the most popular type of instrument, with the most modern design, marketed throughout the world in 3 1/2" and larger apertures



Catadioptric Telescope

Advantages

- Best all-around, all-purpose telescope design. Combines the optical advantages of both lenses and mirrors while canceling their disadvantages.
- Very good for lunar, planetary or deep field.
- Excellent for terrestrial viewing or photography.
- Most are extremely compact and portable.
- Durable and virtually maintenance free.
- **Less expensive than equivalent aperture refractors**
- Most versatile type of telescope.

Disadvantages

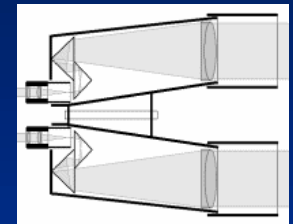
- **More expensive than Newtonians (Reflectors) of equal aperture.**



and yes..... Binoculars !

Advantages

- May be Best all-around, all-purpose choice particularly **if cost is a primary factor**.
- **Allow you to learn to find your way around the stars much more easily than with higher magnification telescopes .**
- Excellent for terrestrial of course
- Great wide field images at low magnification - very good for lunar observing, and star field's, bright nebulas.
- Most are extremely compact and portable.
- Good pair may be a little delicate – recommend tripod for kids.
- 7 x 35 mm is a good start; 7 x 50 mm better for astro viewing



Disadvantages

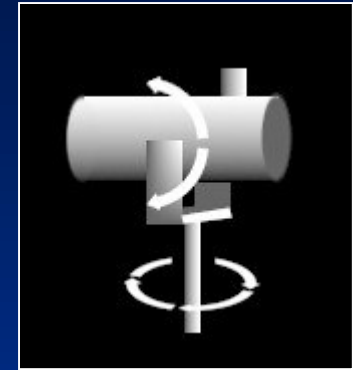
- **May not be able to see quite as much as you want long term.**



Basic Telescope Mounting Types

Alt-azimuth

- An alt-azimuth mount is a simple mount used for moving a telescope along two perpendicular axis of motion. The vertical movement is known as the altitude, while the horizontal motion is called the azimuth.



Equatorial

- An equatorial mount is a mount used for moving a telescope along two perpendicular axis of motion known as right ascension (polar axis) and declination.
- To *point* at a target requires moving the telescope about both axes. To *track* a target, however, requires movement about the polar axis only, at the same rate that Earth spins.



Eyepieces & Magnification

A couple of important notes:

- Magnification or “power” is one of the *least* important factors to be considered when you’re choosing a telescope .
- The telescope’s light-gathering ability, referred to as *aperture*, plays the most prominent role in determining how much you see .

And also:

Never never ever ever.....

- **Never look at the sun with binoculars or a telescope (or anything...)** without proper filters!
- **Doing this WILL cause immediate and severe damage**
 - **Care MUST be taken to prevent this**



Eyepieces & Magnification

Focal Length (F Ratio)

- Focal Length is the distance measured in millimeters (mm) in an optical system from the lens or primary mirror to the point where the telescope is in focus. This point is called the *Focal Point*.
- Focal length is expressed as an f/ratio:

$f/\text{ratio} = \text{aperture of lens} / \text{focal length of lens}$

i.e. 200mm lens with a focal length of 1200mm

$$f/\text{ratio} = 1200/200 = f/6$$

Magnification

- Good for lunar & planetary, but not typically good for deep sky

Magnification =

$$\frac{\text{focal length of telescope}}{\text{focal length of eyepiece}}$$

i.e. 200mm f/6 with 10mm eyepiece

$$\text{mag} = (200 \times 6) / 10 = 120x$$



What Can I Expect to see?

- What you can see largely depends on 3 things:
 - Aperture & type of scope
 - Magnification used
 - surrounding local light pollution

Using a 6" dobsonian; eastern FI; reasonably dark sky; 25mm eyepiece

- Lunar viewing is easy and fun; consider a moon filter to tone the light down.
- Planets can be readily seen, such as the rings on Saturn and even a moon or two. Saturn is the "easy" limit.
- Bright nebula such as the great Orion nebula
- A couple of the brighter galaxies such as M31 (Andromeda)

Note: you will not see color other than some in planets



Choosing Which Telescope to Buy

Source: <http://www.go-astronomy.com/>

Quick and Dirty Rules of Thumb

- First telescope and on a budget? **Buy a Dobsonian reflector.**
- Interested mostly in viewing planets? **Buy a refractor.**
- Interested in viewing galaxies, nebula, and star clusters? Buy the biggest reflector you can afford - this will be a Dobsonian.
- Concerned about portability and weight but want a good all-around telescope? **Buy a Schmidt-Cassegrain telescope.**
- Want absolute quality and money is no object? **Buy an apochromatic refractor.** This should also be your choice if you are serious about astrophotography.



Do's for Buying Telescopes

Source: <http://www.go-astronomy.com/>

- As a first telescope, a 6" or 8" Dobsonian reflector offers great bang for the buck. On the refractor side, an 80mm on a stable mount is also an OK alternative first telescope.
- Plan on spending a **minimum of \$300** for a decent beginner's telescope.
- Get an oversized/overrated mount - telescope mounts **MUST** be sturdy.
- Stick with 1.25" size eyepieces at a minimum, stay away from 0.965" designs.
- Get a size and weight that you don't mind setting up or lugging around to remote sites.
- Select 2 (or 3) quality eyepieces and a Barlow lens. Low-cost but acceptable-quality eyepieces are 3 element Plössls.
- Get a single-power, reflex finder "scope" such as a TelRad.



Dont's for Buying Telescopes

Source: <http://www.go-astronomy.com/>

- [Be cautious of your intent] if buying a telescope from a department store, nature-science store or toy store. These are [usually not as well] suited for astronomy and will end up unused or in the trash.
- Don't buy any telescope that costs less than \$300.
- Stay away from 0.965" size eyepieces - 1.25" eyepieces are a minimum.
- Avoid getting so large and heavy of a telescope that you don't want to use or transport it around.





Have fun and keep looking up !

