

Welcome to Astronomy Workshop

Sponsored by
The Saint John Astronomy
Club

What we will cover

- How to use your telescope
- Telescope designs
- How to choose the right telescope for you
- Accessories and their use
- What you need to observe or take pictures
- How to use a planisphere
- What is in the night sky each month

Astronomy Workshop

Your First Telescope

- Astronomy is an **immensely rewarding adventure** full of **exploration and discovery**. Planets, stars, nebulae and galaxies are **awaiting to inspire you**. Buying your first telescope is not always easy. We'll take a look at the ***four most common type's of telescopes*** and how they work to give you a better idea of **what may be best for you**.

Who invented the telescope?

- Galileo Galilei
- Sir Issac Newton
- Copernicus
- Hans Lipperhey

Galileo Galilei



Date of birth : 1564-02-15

Date of death : 1642-01-08

Birthplace : Pisa, Duchy of Florence, Italy

History of the telescope

- In the early 1600's Dutch lens grinder **Hans Lipperhey**, applied to patent a device to make distant objects appear closer. **Thus was born the refractor telescope.**
- In 1609 **Galileo Galilei** heard this device was real and decided to improve on the design. The first devices were only about **3x power** but Galileo's early attempts gave **8x power viewing**. This is where the first real **evidence of mountainous regions** on the moon was observed and also was responsible for discovering Jupiter's four moons know today as the **Galilean Moons**.

Who can name the four Galilean Moons ?

The Four Galilean Moons

- **IO**
- **CALLISTO**
- **EUROPA**
- **GANYMEDE**

Galileo's telescope design

designed 8x, 20x and finally 30x power



Re-creation of Galileo's telescope



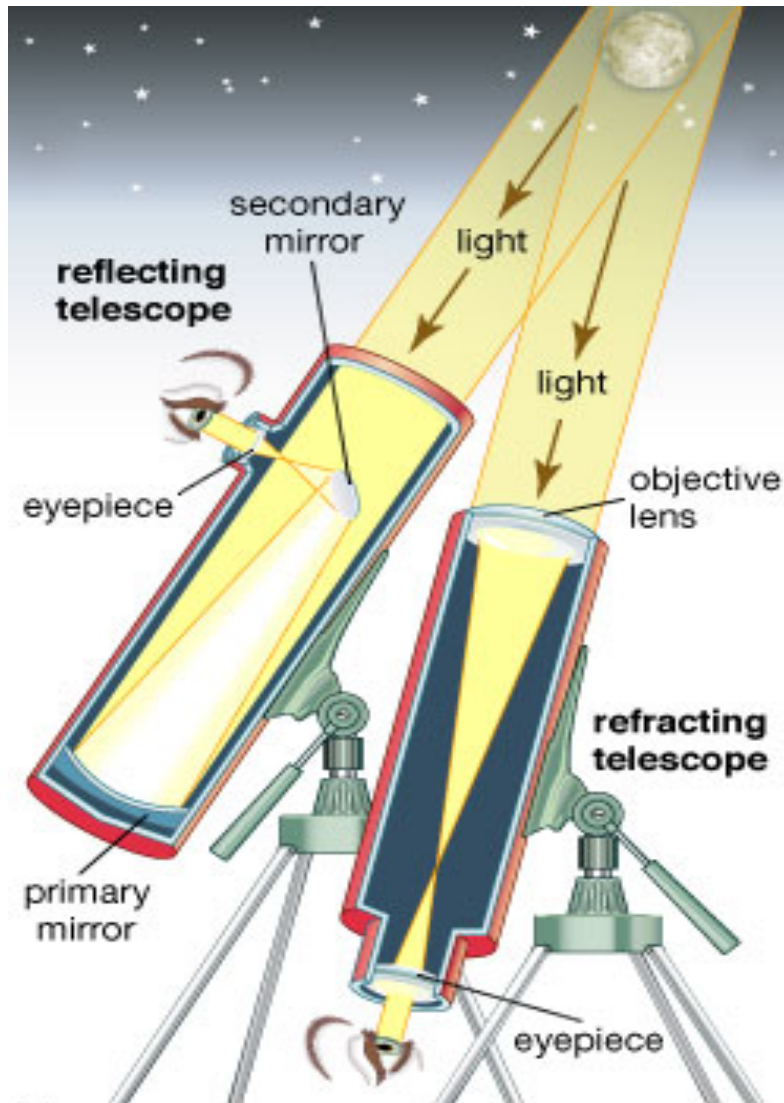
Today's Telescope Designs



Light paths/optics

- <http://www.stargazing.net/naa/scope2.htm>

Reflecting/Refractor light paths



Refractor design (Galilean)



Sir Isaac Newton

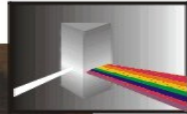
World's Greatest
1000



Creation Scientists
2000

SIR ISAAC NEWTON

1642 - 1727



**Physics • Optics • Mechanics
Astronomy • Mathematics**

- Co-inventor of calculus
- Law of universal gravity
- Three laws of motion
- Reflecting telescope
- His *Principia* the most significant science work
- Wrote more on theology than on science

“Most scholars who have studied the question have judged Sir Isaac Newton to have been the greatest scientist who ever lived. . . . This man of giant intellect was also a genuine believer in Christ. . . . He wrote strong papers refuting atheism and defending creation and the Bible.”

— Dr. Henry M. Morris



“I have a fundamental belief in the Bible as the Word of God, written by men who were inspired. I study the Bible daily.”

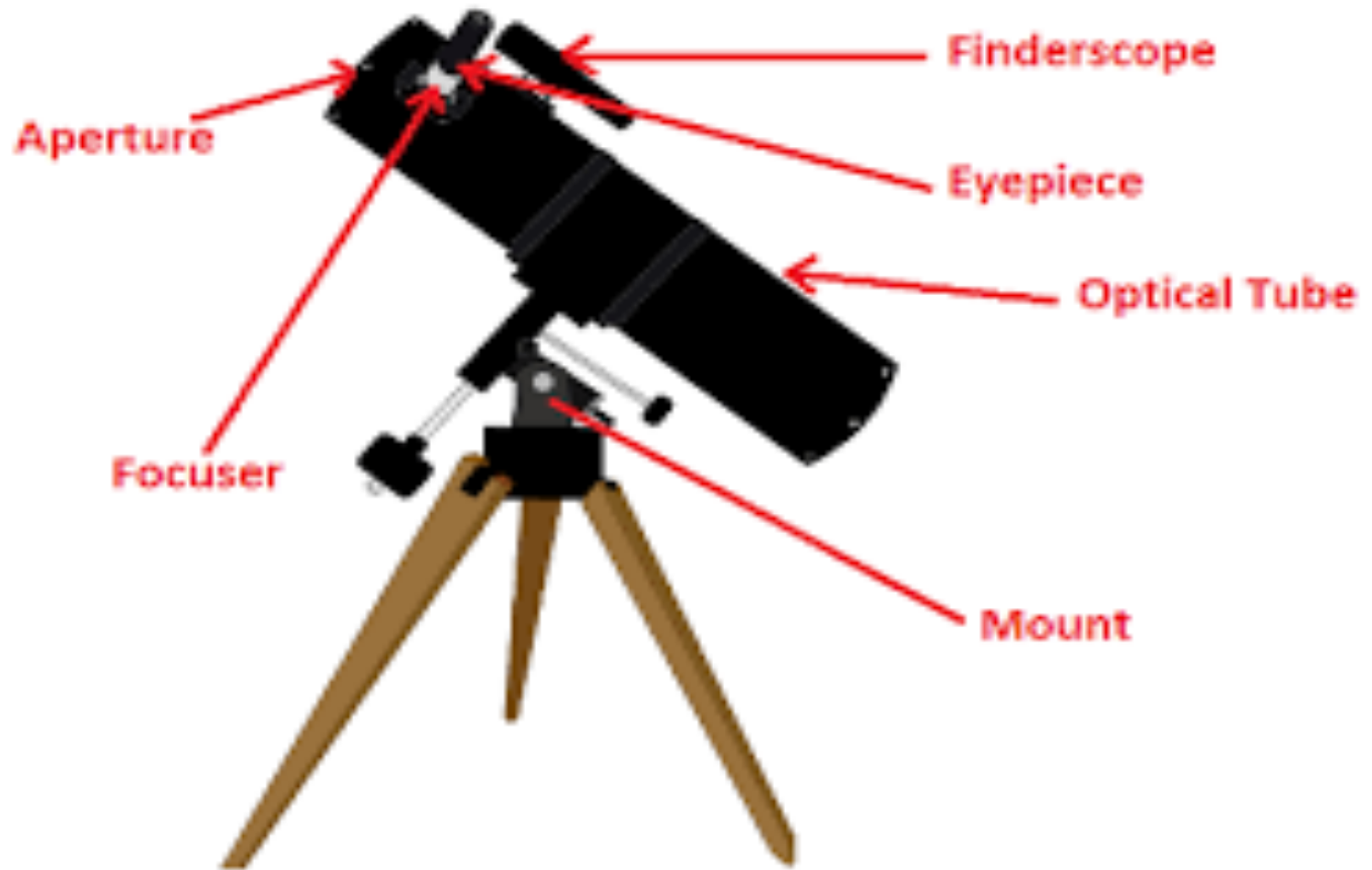


“All my discoveries have been made in an answer to prayer.”

— Sir Isaac Newton



Newtonian (Sir Issac Newton) Reflector design



John Dobson

The Dobsonian Design



John Dobson



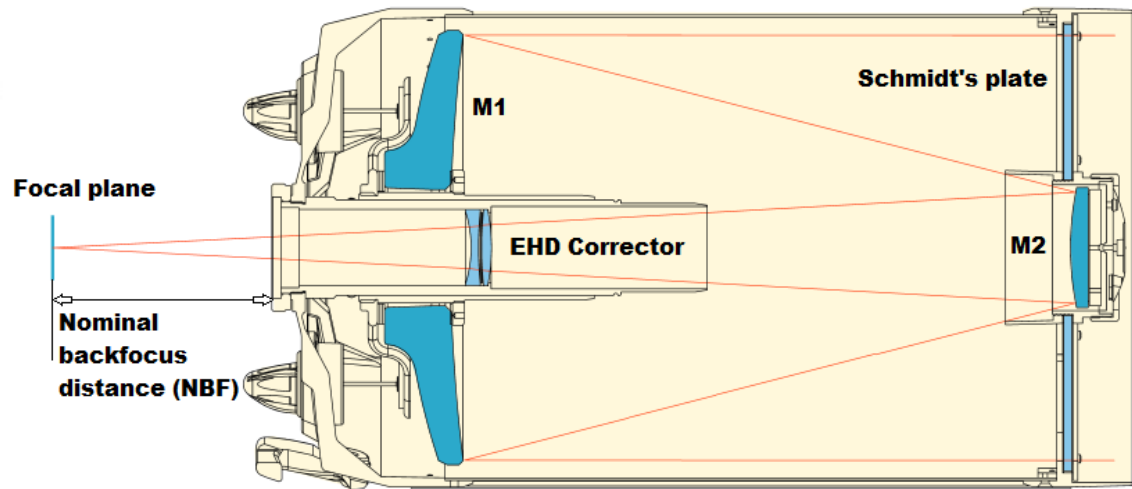
John Dobson in 2002.	
Born	John Lowry Dobson September 14, 1915 Beijing, China
Died	January 15, 2014 (aged 98) Burbank, California, U.S.
Nationality	American
Occupation	Vedantan monk (1944–1967), lecturer/popularize r of amateur astronomy ^[1]
Known for	Dobsonian telescope , sidewalk astronomy

Today's Dobsonian Reflector



Skywatcher 12" Dobsonian

Schmidt-Cassegrain Design Catadioptric



Very compact design with long focal length

What are the **pro's** and **con's** of each telescope design

- Refractor
- **Pro's** Classic design, No obstructions, good contrast, No collimation(usually), No thermal degradation. Excellent for imaging
- **Con's** Expensive per aperture, Larger scopes very long, Chromatic aberration in less expensive models.

Newtonian / Dobsonian

- **Pro's** Inexpensive to manufacture, largest aperture, no chromatic aberration, various designs available, Dobsonian design as well.
- **Con's** Requires collimation, open design requires maintenance, very large to handle on mounts, must choose focuser based on observing or imaging, coma(imaging)

Schmidt Cassegrain

- **Pro's** Very compact, very practical handling, portable, viewing is always comfortable, very flexible with accessories, sets up very quickly (fork mount)
- Con's** Can be very expensive, long cooling time, larger primary mirror, requires collimation(not as much as Newtonian)

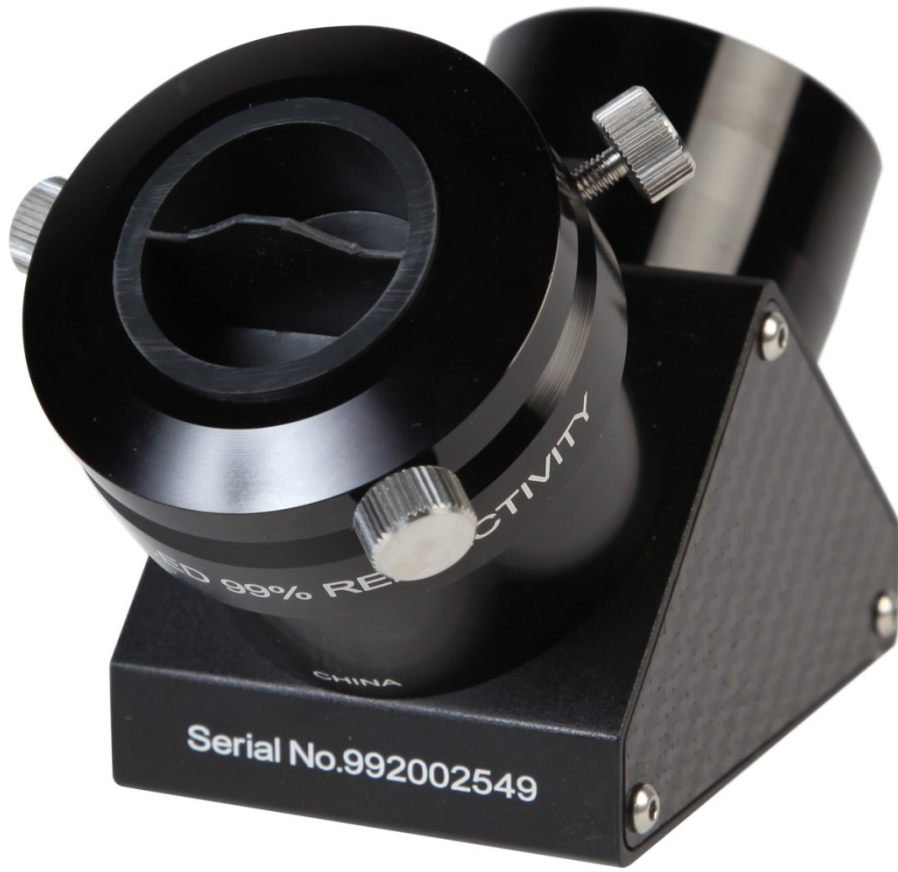
Accessories for your OTA



Eyepieces, diagonals, finder scopes, solar filters



Star Diagonals

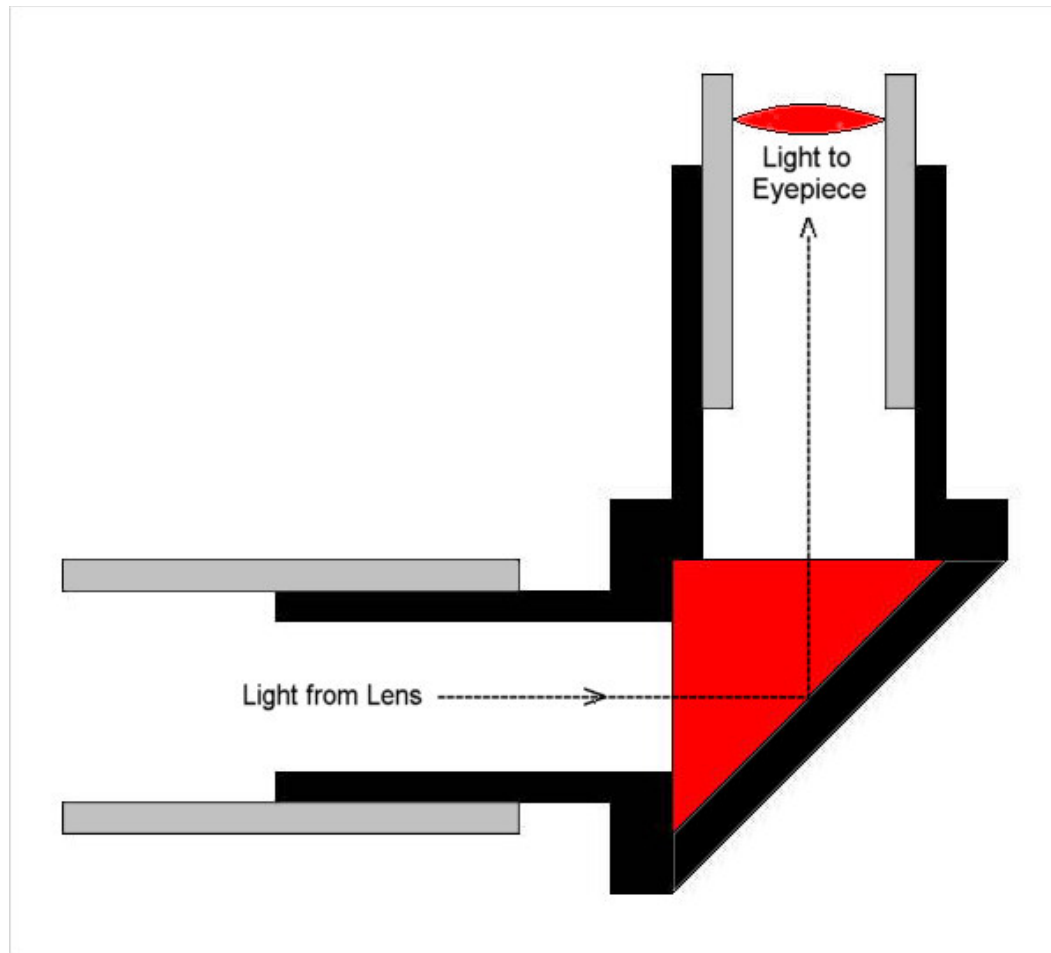


Required for refractors and SCT's **for view comfort**

What is a star diagonal?

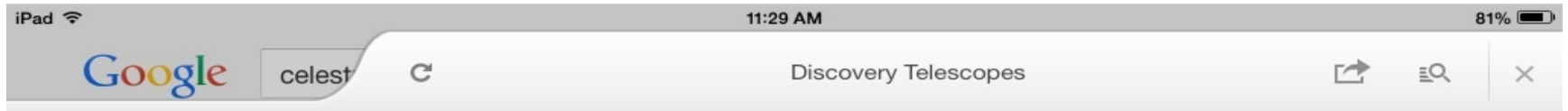
- **Mirror (reflective) diagonals:** These diagonals (often called Star diagonals) use a [mirror](#) set at a 45° angle inside the diagonal to turn the telescope's image at a 90° angle to the rear cell. Mirror diagonals produce an image in the [eyepiece](#) that is correctly oriented vertically, but is reversed left-to-right horizontally. This causes image reversal, the view in the eyepiece is flipped left-right. **The major advantage to mirror diagonals** is that **they cost less to produce** to a **high degree of optical accuracy** compared to a prism and that **they do not introduce any color errors to the image**. The major disadvantage of mirror diagonals is that unless the reflective coating is properly applied they can scatter light rendering lower image contrast compared to a 90-degree prism. **Also they deteriorate with age as the reflective surface oxidizes**. The **newer Dielectric mirrors** have largely solved the deterioration problem, and if properly made the **Dielectric mirrors scatter less light** compared to conventional mirrors.

The path of light



Allows much more comfortable views

Flexible diagonals



Diagonal: 2"

This high quality 90-degree multicoated mirror diagonal allows you to take advantage of the wider field of view provided by 2" eyepieces. A much higher quality than standard diagonals, it fits all rear cells of Schmidt-Cassegrains (comes standard with CGE 1400).

Includes an adapter to accept 1 1/4" eyepieces and an adapter to use with refractor telescopes.



Diagonal, Mirror - 2"

Item #93519

Finderscopes



Eyepieces

- **What Type of Telescope Eyepiece Should You Buy?**

What sort of eyepiece, then, should you use? A casual inspection of most publications advertising optical accessories will reveal a plethora of types — almost as many varieties as telescopes, it seems! Choosing the right one for you depends on several factors: the **objects you wish to observe**; how tolerant you are of **optical imperfections**; whether you want **narrow or wide fields of view**; whether or not you wear glasses; and (**as always**) how much you are **prepared to spend**.

Which One?????



Eyepiece Designs

- **Eyepiece Types**
- Some names, like **Ultrawide**, give a clue to an eyepiece's principal characteristics. Others have classic names like **Kellner**, **Orthoscopic**, **Plössl**, and **Erfl**, or more specific modern variants like **Nagler** and **Lanthanum**. [Optical aberrations](#) (deviations from the "ideal" form) are better corrected in some designs than others, but like everything in life, the higher the price, the better the quality.

Cost effective eyepieces

- Even so, eyepieces with desirable characteristics still can be obtained at reasonable cost once you know **what to look for**. At the budget end of the market, three-element (meaning they have three lenses inside) eyepieces labeled Kellner or "MA" (**modified achromat**) can turn in a good performance with scopes of long focal ratio, such as **Schmidt Cassegrains** and traditional **refractors**. **They do not work well with telescopes of short focal ratio.**

Meade MA(modified achromats)



Kellner

The 3-element Kellner gives sharp, bright images at low to medium powers. Best used on small to medium-size telescopes, Kellners have apparent fields around 40 degrees and good eye relief, though short at higher powers. Good, low-cost performer design.

Intermediate eyepieces

- For optically "**fast**" Newtonians and the like, better results will be obtained with four-element designs, such as the slightly out-of-fashion but otherwise desirable **Orthoscopic**, or the **Plössl**. The latter is a good all-rounder, particularly when **antireflection multicoated**. A Plössl can deliver well-corrected, wide fields of view with good eye relief — meaning **the eye can be positioned at a comfortable distance behind the rear lens and still see the whole field of view**. It is worth pointing out that observers who wear glasses to correct for simple long- or short-sightedness (no astigmatism) **don't need to use them at the telescope; a twist of the focuser will remedy that**.

Plossl



Plossl

Today's most popular design, the 4-element Plossl provides excellent image quality, good eye relief, and an apparent field of view around 50 degrees \diamond . High-quality Plossls exhibit high contrast and pinpoint sharpness out to the edge. Ideal for all observing targets.


Premium/wide field eyepieces

- **High-power lunar and planetary viewing** entails the use of **short-focal-length eyepieces**. This has spawned the development of six- to eight-element designs that combine comfortable eye relief and wide apparent fields. They may feature **exotic rare-earth glass elements to reduce optical aberrations still further**. Many regard these Lanthanum and Ultrawide designs as the **pinnacle of eyepiece evolution**, but for many people the price will be a barrier — and their physical size and weight may be an issue for delicately balanced small scopes.

Premium Wide Angle



Ultrawide Types

Various improved designs incorporating 6 to 8 lens elements boast apparent fields up to 85-100 degrees  - so wide you have to move your eye around to take in the whole panorama. Light transmission is slightly diminished, but otherwise the image quality in these eyepieces is very high. So too is their price.

Coatings on Lenses

- Optical coatings in lenses are almost always made of Magnesium Fluoride (MgFL). They are applied in a vacuum chamber. A single optical coating should have a very subtle blue color when you look at the lens surface at an angle. Multi-Coats will have a green or even purple tint when you examine the surface.
- In all, there are several accepted classifications for optical coatings:
- **Coated** means that at least one air-to-glass surface in the optical system has an optical coating.
- **Fully Coated** means that all air-to-glass surfaces in the optical system have an optical coating.
- **Multi-Coated** means that at least one air-to-glass surface in the system has an optical multi-coat. The rest should have at least a single optical coating.
- **Fully Multi-Coated** means that all air-to-glass surfaces in the system have mutli-coatings.

Barlow Lenses

While the Barlow is not strictly an eyepiece, an **enormously valuable accessory**. A Barlow is inserted into the telescope's focuser before the eyepiece and **doubles (or triples, in some instances) the magnification**. At the expense of a small loss of light, this very useful device can double your eyepiece investment **by making each perform at two powers**. Give some thought to staggering the focal lengths so that they are not simple multiples of one another: a 10 mm eyepiece is largely redundant if you use a 20 mm and a Barlow.

Barlow lenses



- **Barlows Save You Money**
Used with a 2x barlow, your 40mm eyepiece effectively becomes a 20mm eyepiece. In a telescope with a 1000mm focal length, the 40mm eyepiece yields 25x magnification alone and 50x magnification when used with a 2x barlow. A 10mm eyepiece yields 100x alone and 200x with a barlow. **So a barlow lens essentially doubles the number of eyepieces in your collection-a great money-saving strategy.**

What do the numbers mean on my telescope?

-

Specifications of the Firstscope 80 EQ Refractor:

Aperture 80 mm

Focal Length 900 mm

Focal Ratio f/11

Computer Control - no

1.25" Eyepieces: Focal Lengths 20 mm and 10mm

Magnification Levels: 90x and 45x

Finderscope: Star Pointer

Tripod: Aluminium adjustable

Mount: equatorial

Weight: 24 lbs.

Multi coated optics

Can be used for both terrestrial and astronomical viewing

Aperture

- **Aperture 80mm**

The diameter of the objective lens is 80mm, which is 3.1inches.

- The objective lens is the large lens that captures light and focuses it into an image. **The bigger the objective**, the **more light the telescope can gather** which in turn means that **fainter objects can be observed**. The size of the objective determines what magnification the telescope **can achieve without losing resolution**. A quick rule of thumb is 50 times the diameter of the objective in inches. So, you could reasonably expect this telescope to magnify images ~ 150 times (50×3.1) before resolution is affected.

Focal Length

- **Focal Length**

The focal length is the focal length of the objective; **the distance needed by the objective to bring all the light collected to a focus.** So for this telescope, an image is formed 900mm from the objective lens. **You will need this number when you are working out magnification** - more on this under *eyepieces* .

Focal Ratio

- **Focal Ratio f/11**

Sometimes known as the f/number. Focal ratios are the focal length divided by the diameter, hence for this telescope: $900\text{mm} / 80\text{mm} = 11$, written as f/11.

- A quick rule of thumb is:

f/10 and higher: smaller field of view; good for looking at the moon, planets and double stars

f/8: intermediate and good for general all round viewing

f/6 and below: wider field of view; good for deep sky objects

Magnification Formula

- **Magnification**
- The magnification of an astronomical telescope changes with the eyepiece used. It is calculated by **dividing the focal length of the telescope** (usually marked on the optical tube) **by the focal length of the eyepiece** (both in millimeters). Thus:
- $\text{TELESCOPE FOCAL LENGTH} / \text{OCULAR FOCAL LENGTH} = \text{MAGNIFICATION}$
- **For example, a telescope with a 1000mm focal length using a 10mm ocular is operating at 100x magnification ($1000/10=100$).**

Focal Ratio (F5, F7, F10 ect)

- **Focal Ratio (f/stop)**
- The focal ratio, or f/stop, of any lens system (including telescopes), is computed by dividing the focal length by the clear aperture (usually expressed in millimeters). In other words, the focal ratio is the ratio of the focal length and clear aperture. Thus:
- **TELESCOPE FOCAL LENGTH / CLEAR APERTURE = FOCAL RATIO**
- For example, a telescope with a focal length of 1000mm and a 100mm (4") clear aperture has a focal ratio of f/10 ($1000/100=10$).

Field of View FOV in Degrees

Moon in 114/900 and 9mm (100x Magnification)

40° Kit-Eyepiece
(or Ortho)



52° Plössl



58°/60° HR Planetary/BST/TS ED



66° Gold-Line



68°/70°/72° Erfle (GSO/Swan/Hyperion)



82° Explore-Scientific/Luminous/Lacerta



What do the numbers mean?



Know the Numbers

When shopping for a binocular, buyers will find binoculars are categorized by a set of numbers, such as [7 x 35 mm](#); read "seven by thirty-five millimeters." Other binoculars might range from a tiny 3 x 14mm to giant battleship binoculars that are 40 x 178mm. These two numbers represent magnification and objective lens diameter. These two aspects are important to understand when selecting binoculars.

Binoculars



Magnification:

Consider this general rule about optics: **low magnification provides a wide field of view** and is easy to hold steady. So although a magnification of 10, 12 or higher is available, 6, 7, and 8-power binoculars are easier to use and in many cases more practical.

Lens Diameter:

The second number in a 7 x 35mm pair of binoculars indicates the lens diameter. **The lens determines how much light is gathered, and therefore determines the brightness of viewing.** The bigger the lens means the greater the light capacity, and the brighter the view. However, the bigger lens means a bigger and bulkier binocular. Generally, lenses below 30mm are defined as mini binoculars.

Binocular Types

- There are **four main types of binoculars**: two types of standard sizes and two types of smaller sizes. Understanding these main types will help buyers to narrow their search to the type binocular that fits their needs, budget, and preference.
- **Mini Binoculars**
- These are **the smallest category of binoculars**. As discussed above, these generally include objective lenses not larger than about 1 inch in diameter, and they have the straight-line roof prism design. Mini binoculars are designed specifically for travel, and therefore are foldable, lightweight, and highly versatile. **Because of their relatively small objective lenses, mini binoculars are generally not intended for high-resolution activities, such as bird watching.**
- **Compact binoculars** are slightly larger than mini binoculars, but smaller than regular size. These binoculars utilize the **Porro prism**, which makes them bulkier than mini binoculars, but they still have an objective lens that is the same size as the mini version. Compact binoculars are popular for sporting events or as a general-purpose travel binocular. **Compacts provide a good trade-off between weight, performance, and cost.**
- **Standard Porro Prism Binoculars**
- This is where most standard binoculars fall. These have a **larger objective lens**, and are a general binocular for use in everything from **sporting events to hunting** and are moderately priced and high quality, available in a wide range of specifications.
- The standard **Roof Prism binoculars** are a more **professional-level binocular for advanced applications, such as for serious bird watchers**. These binoculars have a sleek, straight-line style, the finest optical glasses, and multi-element eyepieces. **They provide a bright, sharp, and high-resolution image that is higher quality than other binoculars.**

Planispheres



With
Chris Curwin

Now the Hands On!!



www.shutterstock.com · 252958750

Eyes on Eyepieces

First Step: Align Finder Scope with Main Scope

- Step 1: Set up scope
- Step 2: Remove Cover (lol)
- Step 3: Choose a still target (if star use Polaris)
- Step 4: Select low power eyepiece
- Step 5: Point scope at target (center in FOV)
- Step 6: Using finder, center target with knobs
- Step 7: Look through eyepiece for accuracy
- Step 8: Use higher power eyepiece and repeat

Acclimate Your Scope



Carton 100 mm F13
Refractor (1980's)

Paul Owen
Mar.19/ 2015

Why are my views blurry ?

-

TUBE CURRENT

Tube currents are temporary aberrations that can sometimes be a great problem. Cooling down a telescope (to the outside temperature) before a viewing-session should not leave much room for this problem. Some telescopes (closed Catadioptrics, SCT/MCT) sometimes need a long cooldown or even don't reach equilibrium due to a fast cooling from evening-temperature to night-temperature.

Collimation



Balance Your Scope



Why do I need to Balance

- **Balancing the Telescope:**

To **eliminate stresses** on the Equatorial mounts and to **ensure smooth, judder-free motion** of the telescope the instrument needs to be balanced about both the declination and polar (right ascension) axis. This is especially important if you propose to use a motor drive **for astrophotography at a future date.**