"Astronomy compels the soul to look upwards

and leads off from this world to another."

-Plato

So you are interested in buying a telescope for yourself or as a gift for a family member this Christmas? Well there are a few things to consider (and ask yourself) if you are to get the maximum out of your hobby. Amateur astronomy has a legendary reputation for being at once the most rewarding and frustrating of hobbies. It takes hours of dedication often under the coldest skies and at the most inconvenient hours, yet it is more than worth it.

So there are many questions to ask yourself before you buy a telescope:

- **-Am I new to astronomy?**
- **-How much do I want to spend?**
- **-What objects do I want to explore in the night sky?**
- **-Do I want a challenge? Or a more convenient experience?**
- **-What items should I buy with my new telescope?**

How much!?

Telescopes are not cheap items and that is for a good reason. A tremendous amount of work goes into the manufacturing of good telescopes from mounts, to optics, to mirror polishing and much more. When you buy a telescope, you are buying a lot of hard work and expertise.

Would Binoculars be a better option?

So what do you want to spend? If your idea is to spend under €200 euro, then a telescope may be the wrong option. If on a budget, why not consider a good pair of binoculars. Yes, I know what you are thinking: why on an article called "A Telescope for Christmas" is he advising me against buying a telescope?

The simple answer to that question is related to how much enjoyment you will get from a small, cheap toy shop telescope. Much like your eyes, a telescope depends on its light gathering ability to perform well. If your new telescope has a very small aperture, then you will not be able to gather sufficient light to get a good image through the eyepiece. Increasing optical power with such a scope will only make the problem worse.

A telescope under €200 euro will not satisfy your astronomical hunger and you may soon find yourself storing it in the attic, never again to point it at the night sky. Telescopes purchased from toy shops are usually basic refractors (light is gathered through an objective lens and focused with an eyepiece, without employing mirrors). Refractors are wonderful telescopes but the ones in the toy shop are just that- toys.

A telescope will be advertised in terms of its aperture. This measurement will be shown in either mm's or inches. Those toy telescopes are often advertised as having up to two or three inch apertures. However, said scopes are usually opportunistically presented. This measurement does not take into account the actual width of the telescope beneath the objective lens. Very often the objective lens on such telescopes will indeed measure the advertised width, but underneath, the main body of the tube will expand into this space and reduce the aperture. When all is said and done, one is left with as little as one inch of aperture. This is a disaster and will do more to put you off astronomy than expand your interest.

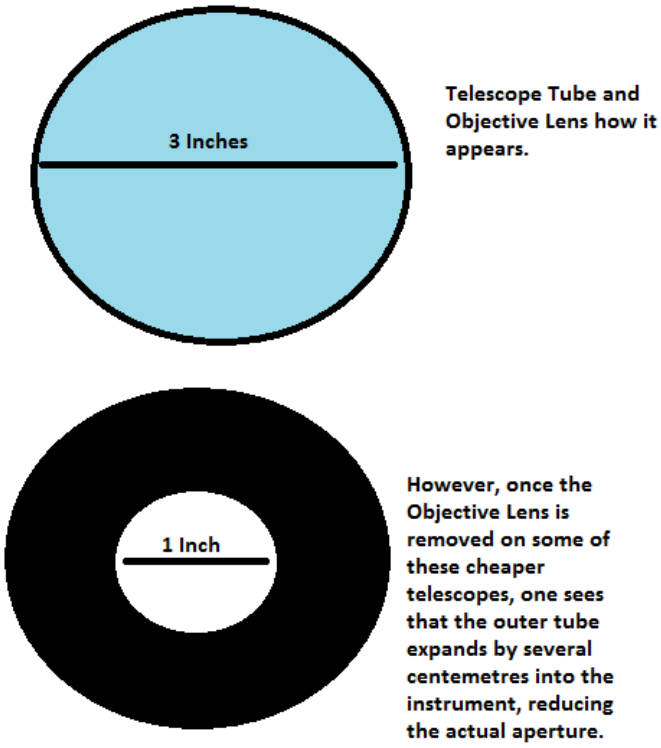

Image: How some cheaper telescopes can be wrongly advertised

Binoculars have many advantages too: As already stated, they are a **cost effective** option; depending on size, they are usually **light and portable**; they offer a **wide field** view making it easier to pinpoint objects which are difficult to find, and to learn the basics, like constellations, some deep sky objects and lunar geography.

So if you have under €200 euro to spend, it is best to avoid the disappointment that such telescopes will bring. Take a look in most large pharmacies and visit some of the websites I have posted at the end of this article, and you are bound to find a pair of binoculars in your price range that are suitable for astronomical observations.

While I will not go into much detail here on binoculars here(I have prepared a basic guide here on the subject), I will note a few things to consider when buying binoculars:

1: Cost: Try for middle of the road. Not toy shop, but no need to spend what an average telescope

would cost- look to spend between €70 and €150.

2: Magnification: The magnification of a pair of binoculars in denoted by two numbers. One number indicates the power of magnification, while the other tells you the diameter of the objective lens. For example, a pair of binoculars advertised as 7x10, will magnify the targeted object seven times, while the ten indicates that the objective lens of the binoculars is 10 millimeters. As with a telescope, the larger the objective lens the more light gathered and the higher the quality of the image seen, but a larger objective lens will usually mean a larger and heavier pair of binoculars. ***For use in astronomy, binoculars should have a magnification over 7, and additional power would be advised. The diameter of the objective lens (the second number) should be between 30 and 70 (higher numbers will mean more expense and weight, while lower numbers may not allow for sufficient light gathering ability).***

3: Weight: Some large binoculars seem great on paper, but they will be heavy and difficult to hold, and if you are to go into the cost of sourcing and buying a binocular stand, you might as well consider a telescope. Extremely high magnification may also make life difficult when trying to focus on one object. If you opt for a large and expensive set of binoculars, a tripod may be necessary.

Some Binocular Options

Helios Solana Range (€50 to €60 depending on magnification)

This range from Helios allow for a great deal of choice over many affordable price brackets. Ranging from price between €50 and €60, many magnification options are available. While these binoculars are perfect for terrestrial viewing, their magnification power also allows for astronomical viewing.

"All models feature quality BK-7 prisms and all optical surfaces are fully coated, providing very good optical performance.

"Overall these binoculars offer construction and performance which belie their modest prices.

All models are fitted with a tripod adaptor bush and supplied with neck strap and soft case."

-KTEC Telescopes

Celestron Skymaster 15x70(approx. €130)

Brought to you by the always dependable Celestron, this affordable option comes endorsed by a Sky At Night group test. The model offers a large aperture, while avoiding the excessive weight that sometimes makes binoculars of this size awkward. For their size, they are light and portable and can also be mounted on a tripod. They are perfect for those who want a middle-priced binocular option.

As with any binoculars that exceed x10 magnification, a tripod is advised for steady and stable use of these binoculars.

TS Optics 20x80 LE Series Binoculars (Approx. €170)

While you will find binoculars in a higher price range, anything higher would put you in telescope territory. These are binoculars with massive magnification specs. and a huge aperture. These binoculars have a wide field view and allow you to look at deep sky objects like galaxies and nebulae. ***As with any binoculars that exceed x10 magnification, a tripod is advised for steady and stable use of these binoculars.***

These are not a cheap option and they may not be very easy to use, especially without a tripod, but they are of an excellent quality and will give breathtaking views of the night sky and some of its more

inconspicuous objects.

I have over €200 to spend and I am sure I want a telescope!

So if you have over €200 and want to buy a telescope, then you have a lot of options. Firstly, and this is important, **stick to the known, loved and tested brands.** As I mentioned earlier, those companies that design and manufacture telescopes do so with a tremendous amount of work and dedication. Buying from one of the main telescope manufacturers is no guarantee that you will instantly fall in love with your purchase, but it does mean that the instrument you have bought will be as described and fit for the purpose intended.

Most countries will have at least one dedicated astronomical shop selling everything from telescopes and binoculars, to eyepieces and star charts. Salespeople in said shops should be able to assist you in deciding which telescope is right for you.

Unfortunately, these shops can often be either too far away, or more pricey than online stores. If either or both is the case for you personally, then the main brands to stick to are as follows:

Celestron

Meade

Sky Watcher

Altair

TS Optics

Star Wave

While there are other dependable brands available, all those listed offer well designed and constructed instruments, varying in cost and intended use.

So how do I pick one?

In the first part of this guide, I put some questions to you with regard to the money you are to spend, your experience level, what you want to get from the telescope and others. Most of these questions apply when purchasing a telescope.

While we have ruled out those telescopes costing less than €200, we must now set an upward bracket. Understandably, if you are buying this gift for a child or to see if you enjoy the hobby at all, then you

may not want to spend a huge amount.

Those who are more serious about building on this hobby may set a higher price bracket. The good news is, one can find a telescope within their price bracket that should adequately provide for their needs.

In order to list a few buying options, I would like to go into some small detail about telescopes in general. I hope this will help clear up some mild confusion when reading the specifications of each mentioned telescope. Once that is out of the way, I will then list three telescopes, one of each type, ranging in price, but within budget for a beginner.

Types of Telescope

Telescopes come in a wide variety of designs, each with their own advantages and uses. On a most basic level, you must ask yourself "what do I want to look at"?

Refractor Telescope

If your thing is the Moon and planets, then you are a planetary observer and usually the most suitable type of telescope for this viewing is a **refractor**. This is the kind of telescope that probably first springs to your mind. Visually, a refractor has a long and slender tube, with at eyepiece at the end.

Refractors are so called, because they work by refracting light through an objective lens, which is then focused by an eyepiece.

Due to the fact that a refractor is designed with a closed tube, this type of telescope will not require as much maintenance as those that have open tubes, like a reflecting telescope.

Some refractors suffer from Chromatic Aberration, whereby colour distortions appear on the viewed image. This is most noticeable when viewing a bright object like the Moon, when a purple/blue ring appears to encircle the Lunar disc.

- Image: A Refractor Telescope

Reflecting (Newtonian) Telescope

The reflecting telescope was invented by British mathematician Isaac Newton, in the hope of correcting the aberrations which were common in reflecting telescopes. The **Reflector** employs two mirrors (a primary and secondary) to reflect the light which passes down the telescope tube. Light reflects off the curved primary mirror, back up the tube and onto the flat secondary mirror. This light is then reflected off the secondary mirror at a 45 degree angle onto a focuser and viewed through an eyepiece.

If you are interested in looking further afield in the night sky, then a reflector may be a better option for you. These telescopes, while offering a very satisfactory view of the Moon and planets, also allows the amateur to look at deep sky objects like nebulae, star clusters and galaxies.

There are many advantages to reflecting telescopes:

-Chromatic Aberrations are corrected

-Per inch of aperture, they tend to be cheaper than other types of telescope

-They are also cheaper to produce as only one major surface needs to be polished and ground(the primary mirror).

-Image: A Reflecting Telescope

<u>The Cassegrain Telescope</u>

Most telescopes in the starter price bracket will either be refracting or Newtonian telescopes, but a

third design may also find its way into your price range. The Cassegrain Telescope is not in itself a different type of telescope; rather it is a variant of reflector.

This type of telescope is the most used by professional astronomers and has certain advantages due to its smart design. Much like a Newtonian, a Cassegrain works by bringing light down through the tube to a concaved primary mirror, but instead of the light being reflected off a 45 degree flat secondary mirror and focused by an eyepiece, the light bounces off a convex secondary mirror and passes through a hole in the primary mirror, where it is then focused by an eyepiece.

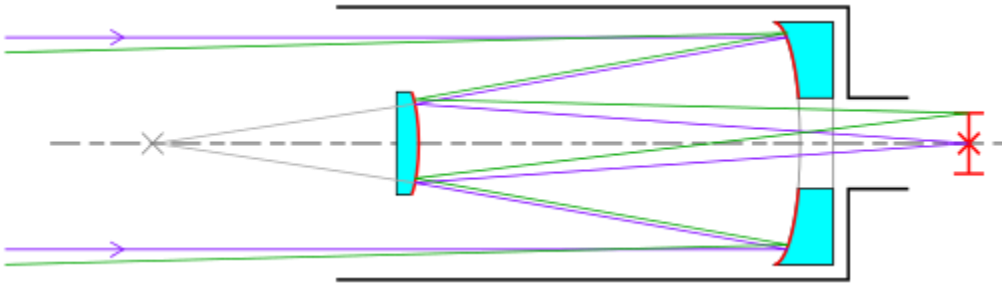

Image: The path of light from an object, through a Cassegrain Telescope

All About Mounts!

Image: An Equatorial Mount

Image: An Altazimuth Mount

For a few reasons, what you put your telescope on is just as important as the instrument itself. It must be solid and sturdy, ensuring that the telescope is safe on top; it may be a simple structure, or it may be computerised; it may have an equatorial tracking mount, or a more straight forward mechanism. The

type of mount you choose may influence how easily you take to observing.

If you stick to the known and trusted brands I have listed, chances are you will get a tripod and mount with your telescope which is suitable and sturdy enough for the instrument. So, while the strength and stability of a mount may be an issue with some manufacturers of cheaper telescopes, buying a refutable brand will put that worry to bed.

So what's next to think about? Well as an amateur astronomer for six years now, I remember just how hard it was in the early days to find an object through the eyepiece of the telescope. Even a blazing bright planet like Jupiter or Venus may be extremely difficult to get on target. The best spotting nights are those under cold winter skies, with a stable atmosphere above you. Standing under the frost is not always that appealing and, if you are not intending on doing a lot of research into navigating manually around the night sky, then you may be best off buying a telescope that comes with a **computerised mount**.

Computerised mounts come with a catalogue of stars, planets and deep sky objects pre-programmed into the handset. All one has to do is align the telescope manually with two or three bright objects*, enter the date and your location, and the telescope will automatically align itself. Once that is done, you select any catalogued object on the handset and the telescope will automatically find it in the sky. It is hard to express just how much this simplifies the process for the beginner. An added advantage is being able to maximise your time spotting. If all you have is a few minute break at a time between clouds, then a computerised mount allows you to spend your time looking at an object, not panning anxiously while watching the clouds close in.

*Alignment procedure may vary by brand and instrument.

Another factor to consider is the mechanism on which your mount is designed. There are two primary mount designs available; **Altazimuth** and **Equatorial.**

The Altazimuth Mount is a simple design. "Altazimuth" is a conjunction of two other words- alt or altitude (up and down bit) and azimuth or the horizontal measurement (moving parallel to the horizon). It moves along two axes, vertical and horizontal. In other words, an altazimuth mount moves in two directions by individual, manual inputs- up and down; left and right. Unlike an equatorial mount, an altazimuth mount does not track objects as they move across the sky and must be manually altered to remain fixed on a selected object.

An advantage to the altazimuth mount is its simplicity. It is very much the point and shoot of the telescope world, allowing you to more easily fix your scope on an object. You are more likely to find this type of mount on a less expensive telescope. When listed online or in classified ads, an altazimuth mount will often be abbreviated as **AZ.**

The Equatorial Drive Mount is a little bit more advanced than the altazimuth and offers a greater deal of precision when tracking an object. Given that this mount rotates parallel to the Earth's axis of rotation, it can remain fixed on one object as it moves across the night sky with minimum input required by the

observer.

While it may be a tad more confusing for beginners, this type of mount offers more convenience when it comes to astrophotography. Photographs of stars, galaxies and other deep sky objects are usually captured with an equatorial mount, as it compensates for the movement of the Earth through long camera exposure times. A camera set up on a fixed tripod or laying on the ground, will leave distinctive star trails on long exposures. While this effect is often intended, it can also be frustrating for those looking to get a still image of an astronomical object.

When advertised, an equatorial mount will be abbreviated as **EQ**.

Eyepieces and Maximum Useful Magnification

This subject is of great importance when buying a telescope. One must take into consideration both the eyepieces used and their power, along with the Maximum Useful Magnification of a selected telescope.

Eyepieces

The eyepiece is the part of the telescope you look into in order to see an image of the object you have set your telescope on. The eyepiece focuses the light from the planet or star you are looking at, and gives a clear picture. Your telescope will usually come with at least two eyepieces. These two eyepieces will often be designed to give you two fields of view, one wider (say a x20) and one more powerful with a smaller field of view (say x10).

It is worth noting now that the amount of magnification offered by an eyepiece depends on the telescope and one eyepiece will not magnify to the same power on two different telescopes. You can find the magnifying power of an eyepiece by dividing the focal length of the telescope by the focal length of the eyepiece. For example, if the focal length of the telescope in question is 500mm and the selected eyepiece is 20mm, then the eyepiece will magnify by 25 times.

$$\frac{\text{Telescope Focal Lenght}}{\text{Eyepiece Focal Lenght}} = \text{Magnifying Power of Eyepiece}$$

While these two eyepieces will satisfy your immediate needs, they will not usually be of a very high quality, and you may want to upgrade or order another, higher quality eyepiece when you buy your

telescope. More expensive eyepieces will contain higher standard lenses, leading to more crisp images.

Conventional lenses form the basis of the industry, but most astronomical shops and websites will also sell lenses to double or treble magnification (**Barlow Lens)**, and **filters** that are suited to different types of observation. Some filters will help bring out the colours of certain planets, reduce the glare of the Moon to allow for more obscure details to be seen, or give greater detail and contrast when viewing nebulae.

Image: A Filter Designed for Lunar Observation

A Barlow lens will, as I have already said, increase the magnification of your standard eyepiece by certain powers. Barlow lenses look like elongated eyepieces. There is a cavity on top of the Barlow lens so you can sit your eyepiece into it. Once secured, the Barlow will improve your magnification. However, this must be done within the focal limits of your telescope and over magnification will always produce blurring.

Image: A Barlow Lens **Image: An Eyepiece being loaded into a Barlow Lens**

<u>Maximum Useful Magnification</u>

Any telescope will have a magnification limit, determined usually by its aperture and focal length. While one can of course add stronger eyepieces and Barlow lenses to infinity, eventually they will surpass the

telescope's **Maximum Useful Magnification** and the image will become dim and blurred.

While there are more precise equations to figure out the exact Maximum Useful Magnification of a telescope, they are considered too much hassle for anyone just getting started. Instead, there is a general rule of thumb- **The Maximum Useful Magnification of a telescope can be found by multiplying the telescope's aperture in millimeters by two. So a telescope that has an aperture of 90mm, will have a maximum useful magnification of x180. So that 90mm telescope will not be able to magnify beyond 180 times. Any eyepiece that pushes such a telescope to above x180, will produce a blurred image.**

Solar Observing

For some amateur astronomers the idea of staying up all night in the cold is not all that appealing, while to others the night may not be enough, and they may want to expand their viewing into the day.

Studying the Sun is a wonderful way of really getting up close with a star. Solar astronomy allows one to see remarkable stellar features like sun spots, prominences and even transits of planets like Venus and Mercury across the Solar disc.

Image: A Solar Filter

But, before I go any further , **NEVER! EVER! POINT A TELESCOPE OR A PAIR OF BINOCULARS DIRECTLY AT THE SUN, UNLESS IT IS A DESIGNED SOLAR TELESCOPE, OR YOU HAVE EQUIPPED YOUR TELESCOPE WITH AN APPROPRIATE SOLAR FILTER! I CANNOT STRESS THAT ENOUGH. YOU WILL CAUSE SUBSTANCIAL AND IRREVERSIBLE DAMAGE TO YOUR EYE(S).**

Okay, now that the warning is out of the way, how does one safely look at the Sun? And "safely" is the key word here. Some cheaper telescopes may come with a solar filter. Do not look at the Sun with this. Discard this filter and buy one from a refutable producer.

A safe Solar Filter will always go over the front of the telescope tube, **never the eyepiece!** Solar filters come in a variety of sizes to fit a variety of telescope designs. So we are back to that old chestnut, the aperture. Measure the aperture of your telescope in inches, or look it up if it has not yet arrived. Once done, then buy a solar filter that is closest to the aperture of your telescope, but slightly larger.

Another option, but one only to be considered if you wish to devote yourself exclusively to solar

astronomy, is to by a solar telescope. These are not cheap instruments and one would have to be looking to spend above €500 to get a good one. While I will not include one in this article, Lunt and Coronado both offer good solar telescopes.

A few Telescopes to consider if you are starting out

Between €200 and €550: This budget will offer the starter a very good leg onto the amateur astronomy ladder. If you research the companies I have mentioned, you will find many options within this price range. I will however list a few here for your convenience.

Celestron Astromaster 90 AZ (€240)

- Quick and easy no-tool setup
- Permanently mounted StarPointer
- Erect image optics - Ideal for terrestrial and astronomical use
- Quick release dovetail attachment - no tool setup
- Pan handle Alt-Az control with clutch - for smooth and accurate pointing
- Rugged pre-assembled tripod with 1.25" steel tube legs - Provides a rigid and stable platform
- All coated glass optics for clear, crisp images
- Deluxe accessory tray for convenient storage of accessories
- TheSkyX – First Light Edition" astronomy software with a 10,000 object database, printable sky maps and 75 enhanced images

Celestron AstroMaster 130 EQ (€280-€300)

- Motor Drive for the automatic tracking
- Quick and easy no-tool setup
- Permanently mounted StarPointer
- Erect image optics - Ideal for terrestrial and astronomical use
- Quick release dovetail attachment - no tool setup
- German Equatorial Mount with Setting circles - to accurately locate and track sky objects
- Rugged pre-assembled tripod with 1.25" steel tube legs - Provides a rigid and stable platform
- All coated glass optics for clear, crisp images
- Deluxe accessory tray for convenient storage of accessories
- "TheSkyX – First Light Edition" astronomy software with a 10,000 object database, printable sky maps and 75 enhanced images

From experience, I know that this is a fantastic telescope. This is an excellent starter telescope and will allow a novice to enjoy a great variety of objects, from lunar and planetary targets, to deep sky objects like nebulae and galaxies.

Sky Watcher offer excellent instruments at great prices!

Skywatcher Skymax 127 SynScan AZ Goto (approx. €550)

This telescope is part of the Sky Watcher range of affordable, entry level instruments. It is a Maksutov-Cassegrain telescope. While I went into further detail on the Cassegrain telescope earlier, this type of scope packs a punch for its relatively small size. Due to the design of the Cassegrain, with a convex secondary mirror, the focal length of the telescope is increased far beyond the physical length of the telescope itself.

The Skymax 127 is a bit more expensive than the two previous options, but the increased focal length offered by the Cassegrain design, the additional portability offered by the telescope's smaller size and the computerised mount all make this telescope an excellent option for those just starting out in amateur astronomy.

Magnifications (with eyepieces supplied): x60, x120, x150 & x300

Highest Practical Power (Potential): x254

Diameter of Primary Mirror: 127mm

Telescope Focal Length: 1500mm (f/11.8)

Eyepieces Supplied (1.25"): 10mm & 25mm

x2 Deluxe Barlow Lens (1.25") with camera adaptor

6x30 Finderscope

90° Star Diagonal (1.25”)

SynScan™ AZ GoTo Computerised Alt-Azimuth HD Go-To Mount

Power Requirement: 12v DC 1Amp Power Supply (Tip Positive) or AA Batteries (not supplied)

Stainless Steel Tripod with Accessory Tray

55% more Light gathering than 102mm