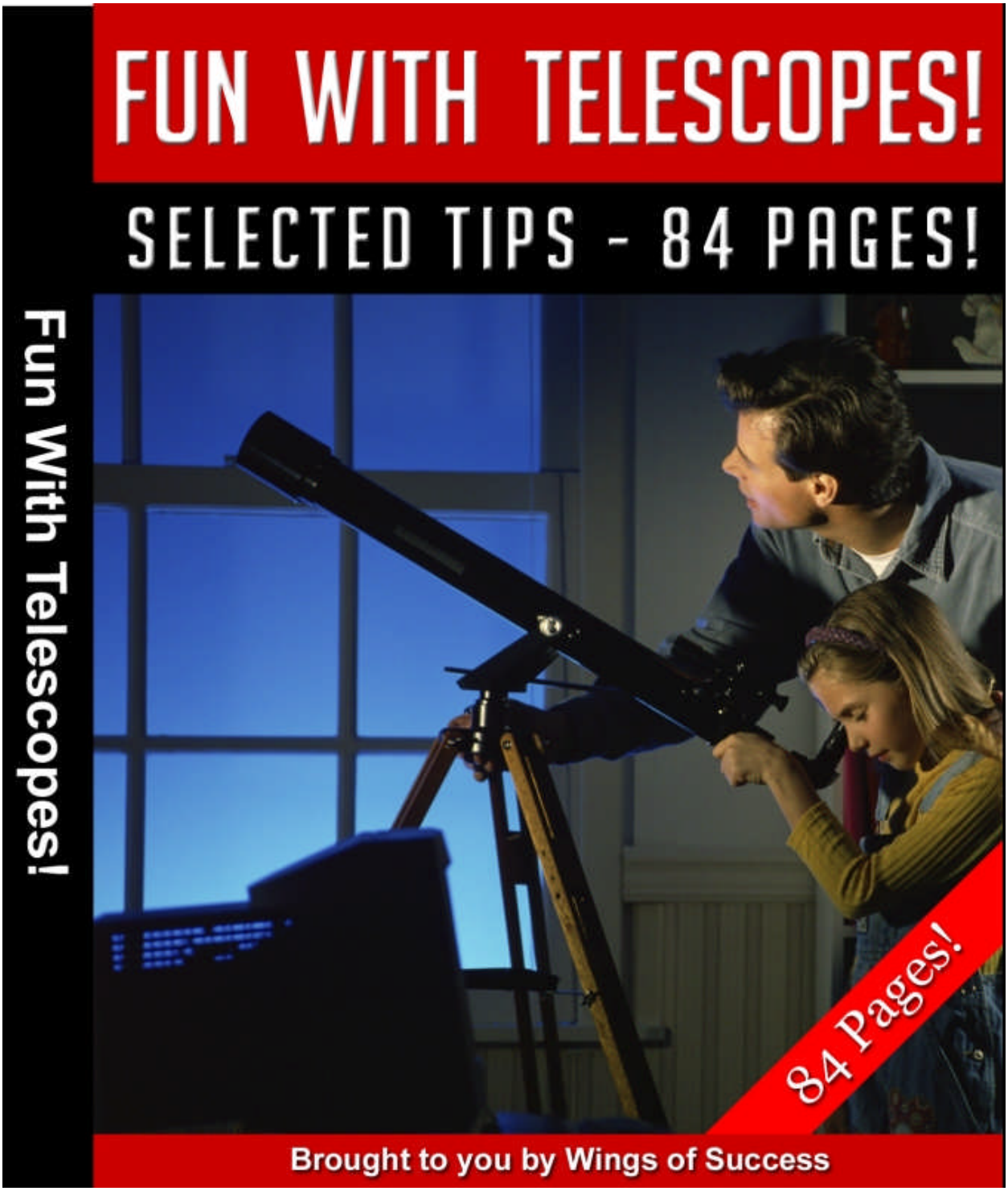

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History Of Telescopes

In 1609, an Italian mathematician named Galileo Galilee peered through an odd new device he had invented to look at the stars in the night sky. Suddenly, this well known and familiar place revealed itself as a barely exposed mystery. It was then that Galileo knew this was a ground breaking device.

The moon is a gray-white orb to the naked eye. Looking through this new instrument, Galileo was able to see shadows and bright spots on the surface of the moon. He could see that the moon also had mountains and valleys.

At the time, the planets were thought to be odd stars that “wandered” the sky. Through Galileo’s device, he could see that the planets were accompanied by moving pinpoints of lights which were moons of their own!

Galileo quickly published his discoveries in a bulletin he titled “Message from the Stars”. His claims, at first, were met with wonder and excitement. He presented his new device to the leaders of the time including the Catholic Church in Rome.

Eventually this device would be named “telescopio”. In Greek, telescopio means “to see at a distance”. This would eventually evolve into the word telescope, but it certainly was an apt name for this new invention.

Galileo’s telescope was a simple instrument compared with the ones we use today. It was a tube with two lenses: the convex primary lens that curved outward and the concave eyepiece lens that curved inward. He built the device after hearing about the newly invented spyglass which was an instrument used by the military to peer into enemy camps.

This first telescope used the same principle that all telescopes would eventually rely on. That principle held that the combination of the two lenses gathered more light than the human eye could collect on its own. The lenses would focus that light and form an image. Because the image was formed by the bending of light, or refraction, these telescopes came to be known as refracting telescopes, or simply, refractors.

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Galileo's best telescope magnified objects about thirty times. Because of flaws in its design such as the shape of the lens, the images tended to be blurry and distorted. However, the early telescope was good enough for Galileo to explore the sky.

Even though the introduction of the telescope was met with excitement, as his investigations progressed, Galileo began to make enemies. Some people argued that the telescope made people see illusions. Others claimed that the planets' details couldn't be seen with the naked eye and therefore didn't matter.

The hostility arose from a dispute about the way the universe worked. After all, this was a radical new concept that refuted the accepted norm of how people looked at the world. Remember at one time, people thought the world was flat until Christopher Columbus provided proof that it wasn't!

At the time, one belief about the universe was outlined by the astronomer Ptolemy a long time prior. His belief was that the Earth was the center of the universe and that everything revolved around it. Another astronomer, Copernicus, put the sun in the center of the universe.

The politically powerful Catholic Church promoted the belief that the Earth was the center of the universe. They also believed that the celestial bodies were perfect spheres – smooth and round devoid of any mountains or valleys. You can imagine the controversy the telescope generated with the new theories Galileo was putting forth.

In fact, Galileo was uncovering evidence supporting the Copernican theory. For instance, he saw that Venus has phases just like the moon which showed that the planet was moving around the sun and not the Earth. Also, he could see that Jupiter's moons were clearly moving around Jupiter and not Earth.

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The Evolution Of The Telescope

Back in the early 17th century, a mathematician in Italy called Galileo Galilee devised a new instrument which he used to peer at the night-time sky and found that he could make far-away objects like stars and the moon seem much closer with this new device. Galileo realized that his invention - which we now know as the telescope - had the ground-breaking potential to reveal the secrets of the universe by revealing things not apparent to the naked eye. This was the origin of our modern-day telescopes.

Even the crude telescope created by Galileo is based on the same scientific principle our modern telescopes use - which states that two lenses can collect more light than that gathered by the naked eye, then focus the collected light onto one point so that an image can be seen through the lenses. Since light is "bent" or "refracted" to show this image, such telescopes were eventually named refracting telescopes (or just refractors, for short.)

Refracting telescopes are not the only types of telescopes that have evolved from Galileo's prototype. Telescopes slowly evolved as the technology behind them became more advanced. You may discover that telescopes were made into bigger versions since astronomers wanted to peer more deeply into the mysteries of the night-time universe. At one point, telescopes were even made to somewhat ridiculous proportions as part of this developmental trend. Modern advancements in telescopes can be attributed to the growing needs of professional astronomers, and the government of many countries, as well as commercial users for better telescopes. For instance, the Hubble telescope of NASA is so strong that you can see images that are actually many hundred light-years away from the earth.

Telescope manufacturers then took development one step further by incorporating cameras into new telescope designs. You can attribute the up-to-date pictures of other galaxies you can see nowadays to this advancement. Try looking at the Milky Way as captured by these new telescopes and you will find yourself bowled over with the sight.

Even if you are simply a hobbyist who just likes to look at the stars at night, you will be glad that Galileo stumbled upon the principle of making telescopes. And since telescopes also allow us to study the universe surrounding us as if we were in the midst of it all because of the advancements of telescope technology, we now know much more than ever before.

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Historical Timeline For Telescopes

It seems all the technology for telescopes started back in 2560 BC. Artisans in ancient Egypt polished rocks, glass, and semi-precious stones to make eyes for the sarcophagi. What follows is some major points in the history of how telescopes came to be today.

In 470 BC, Mozi, a Chinese philosopher, focused the sun's rays by using concave mirrors.

In 4 BC, Seneca the Younger used water to magnify letters and words.

In 23, Pliny the Elder discovered doctors using a crystal ball with the sun's rays beaming through it to cauterize wounds.

In the ninth century, telescopes were possibly made from Visby lenses, a Middle Eastern glass.

In 1520, Leonard Digges, an English mathematician, invented two telescopes – Reflecting and Refracting.

In 1608, A Dutch lens maker, Hans Lippershey, applied for a patent on a design for a telescope.

In 1609, Galileo improved on Lippershey's design and renamed it “perspicillum” - An Italian word for telescope.

In 1616, Niccolo Zucchi invented a reflecting telescope.

In 1663, James Gregory, a Scottish mathematician, produces a telescope with a parabolic primary mirror and an elliptical secondary mirror.

In 1668, Isaac Newton designed a telescope using a parabolic primary mirror and a flat diagonal secondary mirror.

In 1733, Chester Moore Hall created the achromatic lens.

In 1880, Ernst Abbe invented the first orthoscopic eyepiece.

In 1910, The Ritchey-Chretien telescope that is used in many of the large astronomical telescopes is invented by George Ritchey and Henri Chretien.

In 1930, The Schmidt camera is created by Bernhard Schmidt.

In 1937, Grote Reber developed a telescope for wavelengths ranging from radio to Xrays.

In 1944, The Maksutov telescope is designed by Dmitri Maksutov.

In 1962, The UK launched an orbiting solar telescope.

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In 1990, the Hubble Telescope was launched into space.

In 2013, the James Webb Space Telescope will be launched and take the place of the Hubble.

And this all started with the polishing of a few stones.

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How Telescopes Work

A telescope is a device that allows us to bring distant objects closer to us so that we can study them. A good example is the many planets, galaxies, and stars in outer space. Some range from $1 at the toy store to the $1.2 billion Hubble Telescope. There are two types of telescopes. Refractors use a glass lens. Reflectors use mirrors instead of a lens.

Let's take the different pieces of a microscope and see how they work. The objective lens in a Refractor or primary mirror in Reflectors gather incoming light and brings it to a focus. The eyepiece takes that same light and magnifies it to take up a large part of the retina of the eye. Thus, it takes a small image and spreads it out to make it look bigger.

There are two general principles to any telescope. One is how well it can collect light. The other is the magnification of the image you are viewing. Collecting light is related directly to the diameter of the lens. The more light collected, the brighter the image.

Magnification is the ability to take an object as a far distance and enlarge it so you can see it clearly. Any magnification can be obtained by using different eyepieces depending on the object you are trying to view.

Here is a simplified explanation. Obtain two magnifying glasses and a piece of paper. Hold one of the glasses between you and the paper. At this point, the image will be blurry and unreadable. Take the second glass and place between your eyes and the first glass. Moving the second glass up or down should bring the piece of paper into view. It will be larger and upside down though. Give it a try and see what happens.

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Buying A Telescope

There are actually some technicalities that go into buying your first telescope. Many times what people think they want and what they really want are two very different things. Just like with any other large purchase, you have to ask yourself two simple questions:

1. **What do you really want to do with your telescope?**
2. **How much money do you want to spend?**

It's often a good idea to start out small and work your way up to "bigger and better". If you don't have much money to invest, you may want to start out with a pair of binoculars. Even the cheap ones will amaze you with how much you can see of the night sky.

Binoculars are classified according to their optics (7 x 10 for example). The first number is the magnification factor and the second number is the size in millimeters of the objective lens. Obviously, the larger the first figure is, the larger the magnification is, but you will have a smaller field of view. The larger the second figure, the more light is gathered by the binoculars and therefore fainter objects become visible.

Seven to ten times magnification is the optimum you should look for in a pair of binoculars for general use. The objective lenses should be between 40mm and 50mm. If there is anything less then the light grasp may be insufficient, anything greater and (apart from the additional expense) the binoculars will start to become too heavy to easily hold by hand.

Many binoculars suitable for astronomical use start in the 7 x 40 to 10 x 50 bracket. If you do decide to buy something larger, say 10 x 70, you will almost certainly have to consider mounting them on a tripod - they will be difficult to hold by hand. Up to 20 times magnification may be considered in a set of binoculars but again, a tripod will become a necessity. In any event do find out if the binoculars have the facility to be tripod mounted - not all of them can!

Binoculars will bring into view the brighter star clusters, galaxies and nebulae. They can be used to help locate an object with a telescope, identifying the chosen target before bringing the telescope to bear on it. Bright variable stars, comets, satellites and large scale night sky features are all well suited to observation with binoculars. The bright planets can also be spotted

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in twilight with binoculars so overall they are a useful instrument for both the beginner and the experienced astronomer.

A good pair of binoculars will run you anywhere from $50 to $250. Of course, this will depend on where you buy them and your area, but this is a good general number to expect to pay.

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Finding The Telescope That Meets Your Needs

There are so many choices of telescopes out there. What do you buy and what do you really need? Here are a few things to keep in mind so you don't buy a telescope that won't meet what you need or want it to do.

High power magnification is not always the primary consideration. You should have 40-60x magnification per 1 inch of aperture. The scope's ability to enlarge an image is dependent upon the lenses used and the focal length within the scope itself. Most objects can be seen at the lowest magnification because there is more light being focused.

The most important feature to think about when buying a telescope is aperture. Buy as much as you can afford. Remember, though, the biggest telescope is not always the best one. The aperture sizes that follow are usually sufficient: Refractors – 3 inches or 80 mm, Reflectors – 4 to 8 inches or 10 to 20mm, and Compound Telescopes – 6 to 8 inches or 16 to 20 cm.

A focuser can move the eyepiece up and down helping to adjust the focus for each observer. There are two types of focusers – Friction Focusers and Rack and Pinion Focusers. Your telescope should never shake once while you are using these. In some telescopes, you may not get a choice.

Check out the eyepieces that come with your telescope. Some don't come with any. Make sure you have a couple so you can vary the magnification of the object you are viewing. You also need to be sure that the eyepiece will fit the eyepiece holder in your telescope as not all fit all telescopes.

The type of mount you use is extremely important. Ensure it has a low center of gravity so it doesn't tip over. It should not vibrate and it should be held in place at a comfortable height for you.

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Factors To Consider When Purchasing A Telescope

When you go to purchase your first telescope, there are many things you should consider before buying it. Among them are portability, Maintenance, Storage Space, and Price. The goal is to get the most viewing ability for what you can afford.

If you live in the city and long for some clear skies at night to view, you may have to move the telescope to a better seeing area. Usually in the country or rural area, you can get a beautiful expanse of sky in which to use to view your objects. Make sure your telescope is easy to carry and will fit in your car. Another good rule is to make sure you know how to assemble it in the dark.

Maintenance is upkeep of the telescope and its pieces. Probably the most common maintenance will be keeping the mirrors or lenses aligned properly. Also, the open ended telescopes are famous for collecting dust and debris. You may have to clean the mirrors and then realign them.

When you are not using your telescope, find a safe place for it to stay. You need a space that is dust and moisture free as possible. Cover your telescope, when not in use, to prevent dirt and dust from getting into it.

The prices for telescopes vary these days from inexpensive to expensive and everything in between. They can range from the $2 toy store model to a few thousand dollars. So know what you are looking for before you buy. You may even try a used one to see if the type is really what you want. Depending on the type, here are some average costs for a few common telescopes: Small Reflectors - $250 to $1000, Achromatic Reflectors - $250 to $1000, Large Reflectors - $300 to $2000, Compound Telescopes - $1000 to $3000, and Apochromatic Refractors - $2000 to $10,000.

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Terminology

Beginners often have trouble describing distances on the sky. The problem is that distances on the sky can't be expressed in linear measures like feet or inches. The way to do it is by angular measure. Astronomers might say the two stars are 10 degrees (10°) apart. That means if lines were drawn from your eye to each star, the two lines would form a 10° angle at your eye.

Hold your fist at arm's length and sight past it with one eye. Your fist from side to side covers about 10° of sky. A fingertip at arm's length covers about 1°. The Sun and Moon are each ½° wide. The Big Dipper is 25° long. From the horizon to the point straight overhead (the zenith) is 90°.
There are finer divisions of angular measure. A degree is made up of 60 arc minutes, and each arc minute is made up of 60 arc seconds.

If two objects appear a quarter degree apart, astronomers might note that as 15 arc minutes (abbreviated 15'). The brightest planets usually appear just a few dozen arc seconds across as seen from Earth. A 5-inch telescope can resolve details as fine as 1 arc second (1") across. This is the width of a penny seen at a distance of 4 kilometers (2½ miles).

Seen from Earth, the night sky looks like a huge dome with stars stuck on its inside surface. If the Earth beneath us vanished, we'd see stars all around us — and we'd have the breathtaking sensation of hanging at the center of an immense, star-speckled sphere. Astronomers designate the positions of stars by where they are on this celestial sphere.

Picture the Earth hanging at the center of the celestial sphere. Imagine the Earth's latitude and longitude lines ballooning outward and printing themselves on the celestial sphere's inside. They now provide a coordinate grid on the sky that tells the position of any star, just as latitude and longitude tell the position of any point on Earth. In the sky, "latitude" is called declination and "longitude" is called right ascension. These are the standard celestial coordinates.

Declination is expressed in degrees, arc minutes, and arc seconds north (+) or south (–) of the celestial equator.

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Right ascension is expressed not in degrees, but in hours (h), minutes (m), and seconds (s) of time, from 0 to 24 hours. Astronomers set up this arrangement long ago because the Earth completes one turn in about 24 hours. So the celestial sphere, with its coordinate grid permanently printed on it, appears to take about 24 hours to complete one turn around Earth.

There's a slight complication. A star's celestial coordinates gradually change over the years, due to a slow shift of the Earth's orientation in space called precession.

When right ascension and declination are given in books and atlases, you'll often see them accompanied with a year date such as 2000.0. (The ".0" means the beginning of the year: midnight January 1st.) This is the moment for which the coordinates are strictly correct. For most amateur purposes this refinement is too small to matter.

The brightness of a star (or anything else in the sky) is called its magnitude. You'll encounter this term often.

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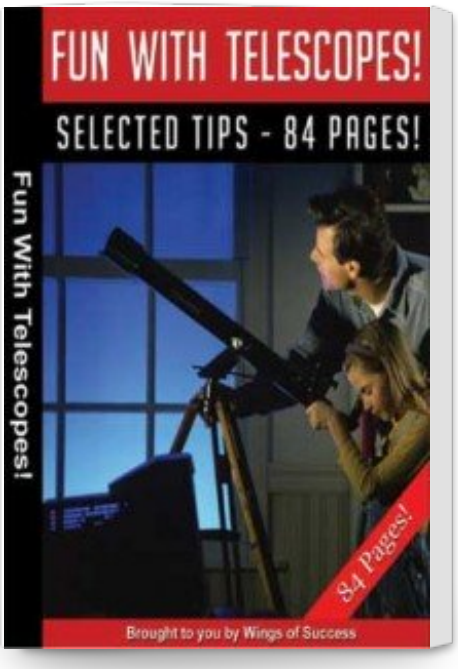
Fun With Telescopes!



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