ASTRONOMY FOR NOOBS

An introduction to all things spacey for those wanting to learn without falling asleep. Welcome to Astronomy by The Mobile Observatory

It all started with a big bang!

Just to be clear; we are not talking about the antics of four physicists and their neighbour. We are talking about the origin and evolution of our Universe. Don't worry though, I'll keep it light enough for the noobiest of astronomers to follow along. All ready then? Let's get started!

The universe began 13.8 billion years ago from, so far as we can tell, a single unimaginably dense point called a Singularity. From this one single point the whole of the universe including all the planets, stars, galaxies, dust, rocks, comets and everything in between has expanded out to 92 billion light years in diameter. And just so you know that is only what we call the observable universe. Let me explain.

Because the universe is expanding everywhere and not just on the edge, this means that everything is moving away from everything else. Now galaxies and solar systems will hold together by gravitational attraction but the space between everything is constantly growing. Now this is not too visible at close range but the further you get away from us the faster things are moving away from us because there is so much more space being created between them and pushing them away.

This becomes very obvious at the farthest reaches of the universe because what happens is the galaxies and other things there appear to be moving away at the speed of light. This means we will never be able to see past this point because the light travelling to us is not fast enough to cross the ever expanding distance from there to here.

So what does this mean? It means that we know there is more to the universe than we can see but we will never know just how big or what other mysteries it contains. I kind of like that myself. One of the things I love about Astronomy is the constant discovery of new and amazing things and the mysteries waiting to be uncovered.

Now that we know where the universe came from, where is it going?

I have told you the universe is expanding all the time but what I have not told you is that the expansion of the universe is *accelerating*. This is due to the effect of Dark Matter and Dark Energy which account for 95% of the total mass-energy of the universe. It's pretty amazing to think that everything we can see and interact with in the universe is just 5% of what's really there.

We can't directly detect Dark Matter and Dark Energy which is why we call it 'Dark' but can only infer its existence from observing galaxies that should not have formed or should fly apart unless there was more mass than could be seen.

What does this mean to the universe as a whole? It means that the universe will keep expanding until one day in the distant future all the galaxies will be so far apart that they will not be visible to each other and eventually the universe will turn dark and be dominated by dark matter and energy as the last star fades.

And on that cheery note, lets move on to some Definitions of Astronomy Objects, or what I like to call: What's that thingy up there?

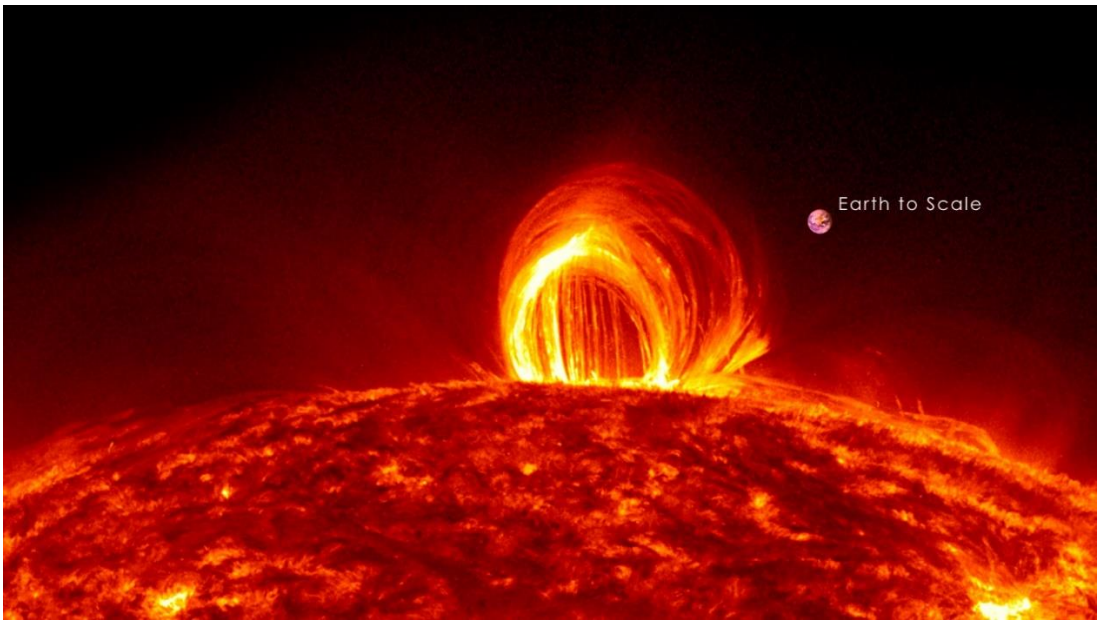
What's that thingy up there?

You would be surprised to hear how many times I'm asked, 'What is this thingy I'm looking at?' Well to be honest, none. But it sounded better in my head when I thought of it than Astronomical Objects Terms and definitions, so I'm keeping the title. Right, anyway, moving on.

Light Year – a light year (ly) is simply the distance that light travels in a year. We use this as a measurement because light is the fastest moving thing in the universe. So how far does light travel in a year? 9.46 *trillion* kilometres. Light takes about 1 second to reach the Moon and about 8 minutes to reach the Earth from the Sun. Now that's fast!

Nebulas (Gas thingy) – Nebulas come in all shapes and sizes but all of them are giant clouds of gas and dust in space. Some are remnants of stars that have exploded while others are many light years across and are nurseries for stars with many forming inside them. Have a look at the 'Pillars of Creation' in the Eagle Nebula for an example of a stellar nursery where stars are being born.

Stars (Bright thingy) – Stars, like our own Sun, are giant balls of hydrogen gas that are so hot and under so much pressure at their cores that they fuse hydrogen into helium and this is what powers their light and energy output. Some stars called Red Dwarfs barely burn and are just a little bigger than Jupiter, and may burn for up to *10 trillion years*, while blue hypergiants are stars hundreds of times larger and hotter than our Sun and burn so fierce they will burn out in just a few million years. Our own Sun is likely to continue burning for about another 4 or 5 billion years so we're good. Here is a picture of a Solar Prominence, a loop of solar matter following our Suns magnetic fields with earth to scale to give you some size perspective.



Galaxy (Swirly thingy) – a Galaxy is a group of stars bound by gravity. Galaxies range in size from dwarf galaxies with just a few hundred million stars up to giant Elliptical Galaxies 6 million light years wide containing an estimated 100 trillion stars. Our own galaxy, The Milky Way is a large galaxy about 100 000 light years across containing about 400 billion stars. So far we have found about *2 trillion* galaxies in the visible universe with more being discovered as the instruments we search with get more powerful and sensitive.

Star Cluster (lots of thingy's – aaand I think we've reached the end of this particular gag.) Star Clusters are exactly what they sound like, a group of stars. Star clusters come in two flavours, vanilla and chocolate. Well maybe not, but some are more exciting than others so… Open clusters are a loose grouping of stars generally containing less than 100 members while Globular clusters are very tightly bound by gravity and can contain hundreds of thousands of stars in a spherical shape, hence globular. The largest globular cluster is Omega Centauri and contains 10 million stars and can be seen as a fuzzy blob with the naked eye on dark nights, have a look at it below.

Planets (what happened to Pluto?) – Planets come in two types; small rocky planets like Earth and the larger gas planets like Jupiter and Saturn. So, what is the definition of a planet and what happened to Pluto?
Planets have to meet 3 requirements:

1. Be a celestial body orbiting the Sun.
2. Have sufficient mass that its own gravity causes it to become a nearly round shape.
3. Has cleared the neighbourhood around its orbit.

Pluto runs into trouble with the third point. Clearing the neighbourhood means it should have vacuumed up or ejected other large bodies in its orbit leaving it the only object in that region. Pluto however has not been able to do this due to its small size mass, being about 70% of that of the Earth's Moon. Because Pluto shares its orbital path with other large objects similar in size to it, Pluto it has been stripped of its designation as a full planet and is now just one of thousands of minor planets in our solar system, though now it is definitely the most well-known. Ever wondered what Pluto looks like? See below.

Why the Universe is awesome:

There is so much variety in this weird and wonderful universe that I am just going to give you a few examples of just how wonderfully different things out there in the dark are, compared to what we are used to here on Earth.

1. **The sky is full of diamonds.**
   Hidden in the sky about 900 light years away is an ancient White Dwarf star that has cooled into a crystallized chunk of carbon, a diamond, the size of Earth, and it's 11 billion years old. This is just one of many diamonds found floating in space and may one day be the fate of our own sun.

2. **Saturn Floats.**
   If you we to place Saturn on a body of water, it would float. Saturn's average density is less than that of water so if you could build a pool over 120000km wide you could have the solar systems most awesome pool toy.

3. **The long way around.**
   It takes light 8 minutes to cross the distance from the sun to the Earth, but did you know that because the core of the Sun is so dense, the light can bounce around inside the sun for up to 200 000 years before it finally breaks free of the surface to begin its journey through space.

4. **Space beer.**
   About 10 000 light years away there is a cloud of Ethyl Alcohol, the alcohol found in beer, wine and liquor, 1000 times larger than our solar system. That's enough alcohol for over 400 septillion drinks (that's 400 with another 24 zeros after it). Now that's a party!

5. **It's life Jim, but not as we know it!**
   Latest estimates by NASA's Kepler Telescope, their planet hunting instrument, suggest that there are upwards of 50 billion planets in our galaxy, of which 500 000 may be in their stars 'habitable zone'. That small region from the star where water can exist as gas, liquid and solid, giving life the best chance to evolve. Are we alone? I don't think so!

6. **The taste of the galaxy.**
   Raspberries and Rum? You may be asking what does this have to do with astronomy? Well, this is what the centre of the galaxy smells like! Ethyl Formate, a key chemical component for both raspberries and rum has been found in abundance in the centre of the galaxy. Heston could make the universes biggest Raspberry Mojito with our galaxy.

7. **Extreme defoliation.**
   On a giant blue planet 63 light years away, the daytime temperature is almost 1000 degrees centigrade and the wind speed is over 7000km per hour. On top of this the atmosphere is high in silica which is heated into molten glass from friction and rains down sideways because of the extreme winds. Definite not your average spa treatment.

8. **Heavyweight champion.**
   Neutron Stars are the collapsed cores of stars and are so dense that their atoms have been so compressed they break down until just the subatomic neutrons remain and are pressed against each other. A Neutron Star is about 10km in diameter but has a mass of around twice of our sun. A tablespoon of matter from the core of a Neutron Star would weigh about a billion tons.

9. **Watching the biggest show in town.**
   Cosmic background radiation is the afterglow and heat of the Big Bang which heralded the creation of our universe 13.8 billions years ago. When a television is not tuned in, about 1% of the interference is made up of cosmic background radiation which means you are actually watching the remains of the big bang. Well, more like the credits after the movie has finished.

10. **And then there was two, three, four…**
    Different branches of science from Mathematics, Quantum Mechanics and Astrophysics have all come to a similar conclusion: our universe is not the only one. We are all part of a Multiverse made from many universes. This may seem like science fiction, but it is actually the most simple and elegant solution to many of the problems our discoveries have uncovered as to how the universe works.

Finding objects in the night sky and first viewing guide:

People often tell me that the biggest obstacle they have in astronomy is needing to memorise all the objects in the night sky or they think they need to spend a lot of money buying a computerized telescope to locate objects for them.

This is truly not the case.

For under $30 you can buy a Southern Hemisphere Planisphere, which will show you the constellations visible for any day and time of night and a simple set of star charts. I have several sets of star charts, some extremely detailed but the one I use the most is a Pocket Guide by Collins Gem. It's a little book 5cm by 7cm and has all the major objects in each constellation. I use it a lot for planning my shows as I know if it is in there, it is an easily visible bright object and so will be perfect for beginners with smaller telescopes.

I have found the best way to learn where things are in the night sky is to just start with one bright easily identifiable constellation. This time of year (January) I'd recommend Orion, but if you read this later just check your planisphere and pick something else.

For those of you who would like an online option for the planisphere, I use this site. Don't forget to change the location and time, you can project as far into the future as you like with this site.

https://theskylive.com/planetarium

Alternately you could use one of the phone apps like Sky View or Star Walk 2. Be warned though, sometimes they don't show things in their correct positions, but they can give you a good idea of what the constellation looks like and what it contains. You may just have to accept that the objects may not quite be where you are pointing.

Once you have learned the first constellation and had a good look at everything it contains then learn a constellation next to it. This will build up your knowledge of a portion of the sky until you know all the major features. Once you have this base then learning new constellations and objects as the seasons turn is very simple, you can just 'star hop' until you are in the right vicinity. Take your time with this and don't try to learn too much at once. Make it enjoyable, you are not cramming for a test.

So, once we have an idea of how to find things, what do we look at?

I'm going to list a few things that will be easily visible for beginners with smaller telescopes now and in the next few months, I'll post more guides later in the year for those dark winter nights. All the objects I have listed here will be in any star chart, you can also put the catalogue code into google for more information and pretty pictures.

Once you get through this list, start experimenting, see what you like and go from there.

Constellation	Catalogue code	Object
Orion	M42	Orion Nebula
Tucana	NGC104	Globular Cluster (47 Tucanae)
Dorado	NGC2070	Tarantula Nebula
Sculptor	NGC253	Spiral galaxy (edge on)
Crux	Alpha Crucis	Double Star (Acrux)
Crux	NGC4755	Jewel Box (open cluster)
Centaurus	NGC5139	Globular cluster (Omega Centauri)
Centaurus	NGC5128	Centaurus A (Elliptical galaxy)
Andromeda	M31	Andromeda Galaxy (closest galaxy to us)
	Mars	Bright red star in the west sky (men are from here)
	Moon	Big bright thing in sky (if you can't find it, I can't help you)

Buying my first telescope and maintaining it:

One of the biggest questions for people starting astronomy is, 'What should be my first telescope?'

I'm going to talk about Dobsonian Reflecting Telescopes as I believe they are the best starter telescopes for a number of reasons.

1. Easy to set up and break down.
2. Biggest aperture for dollar spent.
3. Simply to move from object to object, just grab and move.
4. Easy to maintain and look after.

So what is a dobsonian? Below you can see pictures of my 12" Skywatcher and my 22" Obsession; both of which are dobsonians.

The scale might be a little different, but you can see that they pivot at the base and in the vertical position. I've had a number of telescopes over the years and I can say that my Skywatcher is the easiest telescope to use I've ever had. Simply grab the top rim and point it in the direction of something interesting, then use the finder scope (the little scope attached to the top) to centre it on what you are looking at.

Dobsonians give you the biggest aperture for dollar spent and in astronomy bigger is definitely better. The more light a telescope gathers, which is determined by the size of the mirror, the brighter and more detailed the object will be, giving you a better view.

I'd advise against getting a computer-controlled mount unless you are seriously committed to long term astronomy and you have the budget for it. For a fraction of the cost you can get a larger telescope that will give you nice views that will keep you interested in astronomy rather than just 'looking at the moon' once and mothballing it because you can't see anything else or get it to work right.

In Western Australia you can talk to Kevin of BinoCentral in Joondalup or get something secondhand from Gumtree or eBay. If you go the secondhand route, make sure you inspect the telescope carefully or have someone with you who knows what to look for. I'd recommend trying to have a viewing session one night to make sure everything is working as it should be. It may have been sitting in a shed for the past ten years and be rusted or covered in dirt.

If you are unsure about anything you can always talk to the local Astronomy Club or Association or send us a message. The clubs and associations are always friendly and willing to give advice. When you get your scope, they are a great place to meet some very knowledgeable and likeminded people.

Basic Telescope Maintenance:

So now you have a telescope, how do you look after it? To be honest, it is usually just dust buildup on the mirror and fingerprints and grease from eyelashes on the eyepieces that cause the most problems.

A showercap over the end of the telescope is the easiest solution to keeping dust off the mirrors. It's not glamourous I know, but in this case, it's results that matter. Eyepieces will come in some sort of case; when they are not being used keep them packed away. Don't just leave them sitting in the telescope or they will soon have a layer of dust that will interfere with viewing.

If your eyepiece is dirty you can get some lens cleaner from your local Camera Shop or telescope supplier. A drop of that on a cotton bud will clean it up in seconds. There are lots of videos of this on the internet but basically, use one cotton bud or ball to clean and another dry one to wipe away excess moisture.
Do not touch the mirrors of your telescope, and yes, I just did this myself the other day. If you do the grease from your fingers will leave fingerprints on the reflective coating of the mirror. If you do it's not the end of the world, it wont affect viewing in most cases.

If you do have a telescope mirror that is dirty to the degree that it is affecting viewing you will need to clean it. Once again there are many videos on this. I would say though that the coatings have changed over the years and some of the older videos show people rubbing the mirror with their fingertips. **Do not do this!**

If you have bought it from a shop, contact them and ask them for a method or see if they have a video showing how to clean it. If you bought it secondhand, check the manufacturers site, most of them have cleaning and maintenance procedures. Just don't touch the mirror until you are certain you know what to do, ok?

If you want to learn more about the night skies or enjoy the views through our awesome 22" (2.3m tall) Obsession Telescope. Be careful though, because 'aperture fever' is contagious, (because bigger in astronomy is definitely better!) sometimes it only takes one viewing. Fair warning!

Don't forget to like and follow our facebook page to find out about our upcoming events.

Good luck and clear skies my friends, I hope to see you out there soon.

Peter O'Connor
The Mobile Observatory

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Written by Peter O'Connor – January 2019 / Images: Credit NASA
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