Do-it-yourself stargazing for beginners – No. 2 May 2020

Go globular

In the last DIY stargazing article we learned how to recognise a few constellations such as Leo and Cancer and also found an open star cluster, the Beehive Cluster (M44, NGC 2632). In this edition we will learn to recognise some more constellations and find some of the most enigmatic of objects in the Galaxy – globular clusters. These globular clusters are quite bright and easy to find so you should be able to locate them from any garden or even a window facing the right way – so you can **stay home and stay safe** while travelling through the cosmos and even looking back in time, what could be better?
You will also be introduced to star-hopping. This is the way you can find objects in the sky that you cannot see with the unaided eye.

Before you go outside

- At this time of year it can be very cool outside at night so make sure you wrap up warm
- You may find it easier to use a phone app to help you locate the objects, I use SkySafari but there are many others, have a look in your app store.
- Read about how to find the objects in this article and perhaps look them up on the internet to get some more background information and detail. You will find that having an understanding of what you are looking at greatly enhances the observing experience.
- Using binoculars is a skill that you will need to practise. Ensure to have something to rest the binoculars on or you will quickly have aching arms. The trick to finding things is to look at the sky to where you think the object is then while still looking raise the binoculars to your eyes.
- All the objects described here can be seen through most binoculars and are even better through a telescope if you have access to one. Globular clusters in particular just get better and better with higher magnification.
- As in the previous article start by finding south, that is the way the figures have been drawn.
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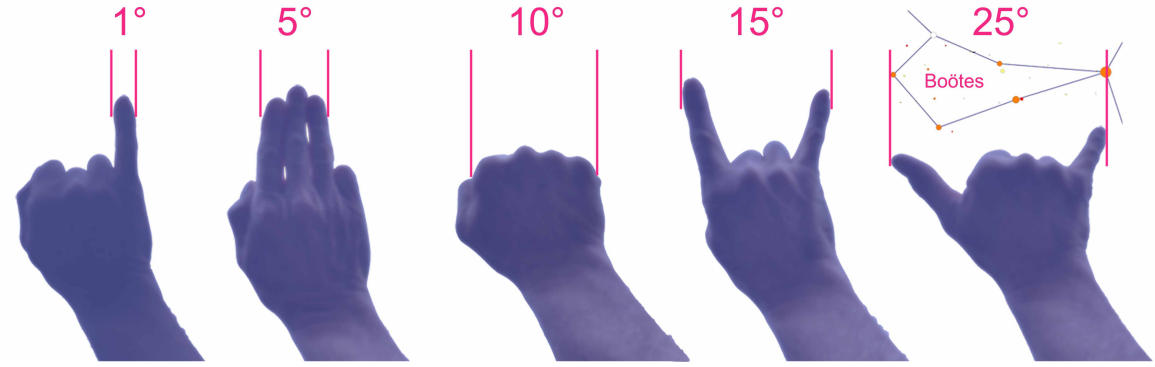
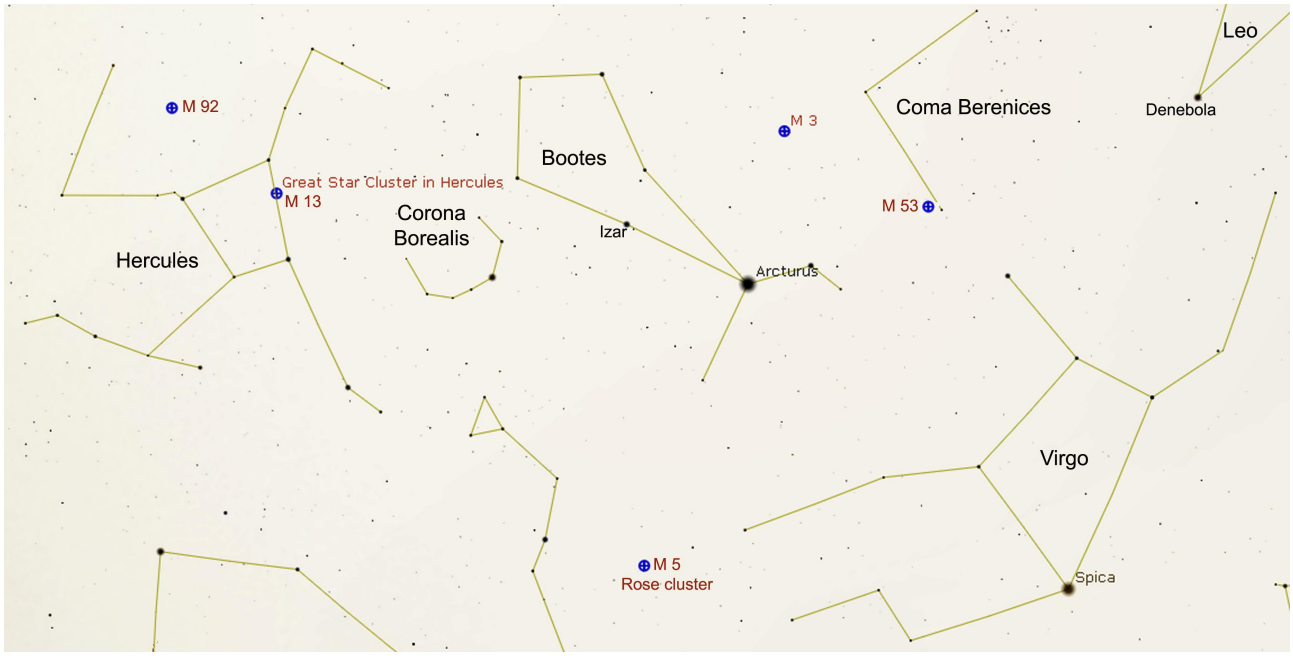
Measuring angles

It is possible to estimate the position of objects in the sky using degrees; a full circle along the horizon from south to east to north to west and back to south is 360 degrees. Sounds complicated but your hand can be a very convenient measure at arm's length. Now you may say “yes but I have very large hands and my child small hands” - but your arms will be longer than your child's so it sort of compensates – believe me it does work! The figure below shows how it can be used with your right hand at arm's length.



So if you place the tip of your little finger over the Moon it more than covers it, the moon is about ½° (a degree) wide (about the width of just the nail). If two stars are said to be about 15° apart hold up your hand and each star should be near the tip of your forefinger and little finger. We will use this later to help us navigate the sky.

Constellations



The chart above shows the sky (in negative) for late evening, Mid to late May looking south.

Boötis (Bo oh tees)
The part of the sky we will look at is just to the east of that in the last article; Leo is just to the west (your right). If you can remember how to recognise Leo that is a good place to start.
Bang in the centre of this chart is the bright and beautiful Arcturus (α Boötis). This is the brightest star in the constellation of Boötes, the fourth-brightest in the whole night sky, and the brightest in the northern celestial hemisphere. With a mass similar to our own Sun it has expanded to 25 times its size and shines 170 times brighter. Arcturus, Spica and Denebola are sometimes referred to as the Spring triangle. Boötes, the herdsman, is a sort of kite-shaped constellation and fairly easy to see even with modest light pollution. It is about 25° across. Apart from Arcturus, Izar is also notable being a rather lovely double star, although you will need a telescope with high magnification to split the two nicely coloured stars.

Corona Borealis
This constellation is just to the east of Boötes, its name means the northern crown and it does indeed resemble a crown. Being a relatively small and distinctive constellation, although not particularly bright, it is quite a useful signpost. It can be used to find Hercules which is a bit sprawling and can be hard to spot. Look about 10° (a fist width) to the left (east) of Corona Borealis and you have arrived in Hercules!

Hercules
Hercules is a reasonably large although dim constellation. The main feature to recognise

is the “keystone” the trapezium shaped block in the centre. Hercules contains two of the globular clusters we will try to find later in this guide.

Coma Berenices
This is really quite a difficult constellation to see as it only consists of three stars all of which are pretty dim. In even modest light pollution it can be really tricky to find. However it has a few claims to fame. It contains the northern galactic pole. This in concept is similar to the Earth's North Pole – the point furthest from the equator. The galactic pole is the point furthest from the plane of the Milky Way. Indeed when this constellation is high in the sky the Milky Way is down near to or below the horizon. As there is little interstellar gas or dust obscuring the view this is a good place to go looking for distant galaxies and Coma Berenices, like Virgo, contains many. Most, although not all, require a telescope to see them. It also contains a nice and large open cluster that can be seen by eye as a hazy patch (and looks great in small binoculars). In fact like the constellation Cancer, the cluster is often easier to spot than the constellation itself. It is this cluster, the Coma Star Cluster, that gives the constellation its name – which means Berenice's Hair. If you are struggling to find the cluster, find Denebola at the eastern end of Leo and the cluster is about 10° to the east and a little bit north – or the width of a clenched fist at arm's length.

Virgo
While in this part of the sky you can also look for Virgo. The sort of “V” shape to the west of the constellation is relatively easy to find with some reasonably bright stars. The brightest star in Virgo is Spica. This star is bright because it is relatively close at 262 light years. It is actually a binary star – two stars are orbiting each other and both are much hotter than our Sun at around 20,000°C (Sun is about 5,500°C) so are bluish in colour. The star at the top left of the “V” is called Vindemiatrix which is yellow in colour (4,800°C), the next star down that arm of the “V” is Minelauva – it is very orange in colour owing to it being much cooler, around 2700°C. Have a look at these stars with binoculars to really bring out the colours. These different colours along with other information from the spectra and distance can tell astrophysicists a lot about the mass of the star and where it is in its lifecycle.

Globular clusters
Objects outside the solar system are called “deep sky objects” by astronomers. It includes stars and clusters as well as galaxies and nebulae amongst others. Globular clusters are fascinating objects that are part of galaxies. Our Milky Way galaxy has at least 150 known globular clusters but some galaxies can have thousands. These clusters are roughly spherical collections of stars that orbit the galactic core. They are very different from open clusters (that just have a few hundred stars) in that they contain hundreds of thousands of stars and are not confined to the plane of a galaxy, they orbit above and below the core in the halo of the galaxy. That is why they can be observed a long way away from the Milky Way, which is over low on the western horizon at this time of year. The stars in globular clusters are incredibly closely packed, up to 1000x more closely than stars in our part of the Galaxy. The stars in globular clusters are also unusual in that they contain essentially only hydrogen and helium and very little of any other elements, they have remained isolated from the rest of the galaxy since their formation. Globular clusters are also very old – in our galaxy around 12 billion years, much older than our Sun (4.7 billion years), they are among the oldest objects in the Galaxy, almost 90% as old as the Universe itself. The formation of these clusters is not well understood and some may even be parts of failed galaxies. All the globular clusters described below can be found with binoculars and

are amazing in telescopes.

Finding globular clusters

We will find 5 globular clusters. You will not only be seeing these intriguing objects but you will also learn how to find objects that cannot be seen by the naked eye.
A quick word on naming. All deep sky objects are listed in various catalogues and are given reference numbers. One of the most popular is the New General Catalogue (NGC). It is no longer new as it was compiled by John Louis Emil Dreyer in 1888. So one of the best globular clusters is NGC6205 also known as the Hercules Globular Cluster. But it is often simply referred to as “M13”. This comes from another much smaller catalogue compiled by a French observer Charles Messier in the late 18th century. Messier was looking for comets but kept seeing various other fuzzy blobs of light that did not move in the sky as comets do. To avoid wasting time checking if a given fuzzy blob might be a comet he made a catalogue of objects to avoid. Eventually it had 110 objects in it. Today it provides the amateur astronomer with a list of probably the 110 best deep sky objects to look for in the northern hemisphere. Messier used a modest telescope with a 4 inch aperture, so all 110 objects are within easy reach of a small telescope and most can be seen with binoculars. So the Hercules Globular Cluster can also be called NGC6205 or M13 as it is the 13th object in Messier's list.

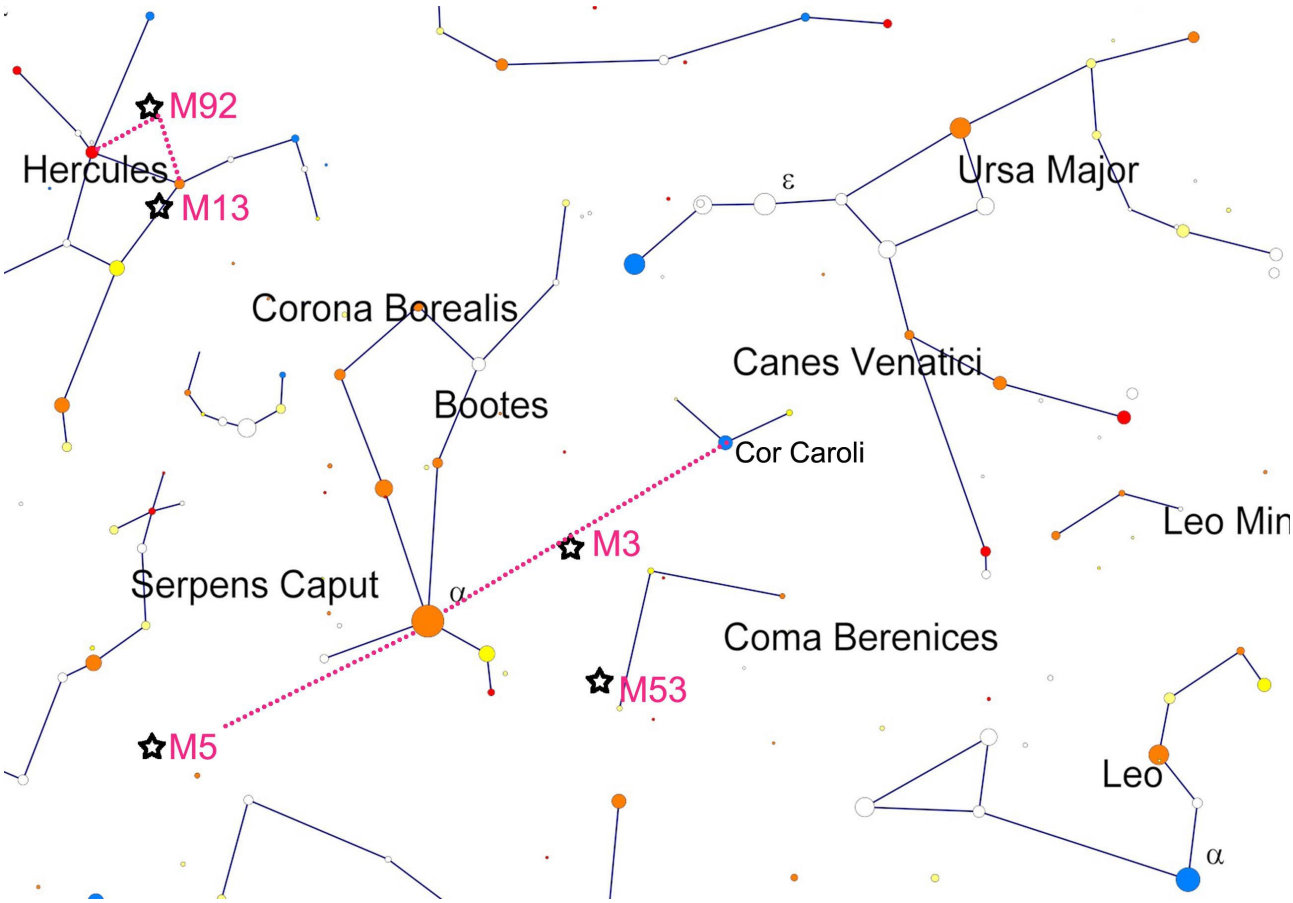
M13 (NGC6205)

This has to be one of the all-time favourite deep sky objects in the northern hemisphere. It is easily found with binoculars, in theory it can be seen by eye but would need truly exceptional conditions. In a telescope it is awesome.

Credit: ESA/Hubble and NASA

We will start with M13 principally because it is bright and in a very convenient place to find it. Look at the star chart above and find the constellation of Hercules tucked just east of Corona Borealis. A lot of the rather untidy constellation can be hard to make out but look for the trapezium shaped keystone. Then look for the star in the top right corner and follow down an imaginary line towards the star in the lower right corner, but only go about a third of the way, about the width of your thumb. Look there with your binoculars or telescope and the round blob of light is easy to find, even with significant light pollution. There you have found your first globular cluster! You will not see the individual stars with binoculars but you will with even a small telescope. In larger telescopes it is the kind of thing you never forget, magnificent. It is about 22 thousand light years away, it has a mass of

600,000 Suns and a light beam would take 168 years to get from one side to the other.



Location chart of globular clusters – you may need to rotate the chart so that it matches the time and date that you are observing on. Note that the colours shown on this chart represent the colours of the stars and the size of the circle the relative brightnesses. Colours show up better in binoculars – defocussing them a bit can also help.

M92 (NGC 6341)

Hercules is blessed with two excellent globulars. M92 is not quite as good as M13 but is still lovely and easy to spot. Again find the keystone of Hercules. Now you will need to use a trick that is familiar to just about every experienced observer – making imaginary triangles in the sky. Look at the two stars on the top-right and top-left of the keystone in Hercules, now make an imaginary equal-sided triangle, M92 will be close to the apex. M92 is almost 27 thousand light years away with a mass some 200,000 times more than the Sun. It is believed to be just over 14 billion years old and well over 200 light years in diameter. Poor old M92 sometimes gets a bit overlooked being so close to the magnificent M13, which is a shame because it is also a great example.

M3 (NGC 5272)

M3 is another bright globular cluster and also quite easy to find. First locate the star Cor Caroli. This is not a very bright star but it rather stands out on its own. It is sort of surrounded by the tail of the Great Bear – Ursa Major. While we are on this star it is worth looking at with a telescope as it is quite an easy double star. It was named after King Charles I, who was executed in 1649. It means “Charles' heart” - which is much easier to remember than its scientific name - Alpha Canum Venaticorum. Now make an imaginary

line from Cor Caroli to the bright star Arcturus (α Boötis) . M3 lies on that line about halfway between the two stars. It is easy to find in small binoculars and easy to resolve into separate stars with a small telescope. M3 is 34 thousand light years away and has a mass of 450 thousand Suns. It is estimated to be over 11 billion years old and 180 light years across.

M5 (NGC 5904)
M5 can also be easily seen in any binoculars and resolved into stars with a telescope. It is quite bright and fairly easy to find. Perhaps the simplest way is to use the imaginary line that you found M3 with. Continue that line down past Arcturus and M5 is about 2 times as far down the line from Arcturus as M3 is up from the star. In binoculars it will be a small fuzzy ball but in a telescope it shows its full glory of hundreds of thousands of stars, it has a mass 850 thousand times more than our Sun. It is about 24.5 thousand light years away, 160 light years across and almost 11 billion years old.

M53 (NGC 5024)
This is the trickiest globular cluster to find of the 5. It can be found in binoculars of most sizes but can be difficult to spot with binoculars with an aperture less than 50 mm if there is light pollution or it is a bit hazy. It is right next to a star which should make it easy to locate except for the fact that the star itself is a bit dim. The first thing to do is to locate the constellation Coma Berenices. As mentioned above this lies just to the east of Leo and finding the Coma Cluster as a hazy patch if often the easiest way. The constellation forms a sort of right angle, the Coma Cluster is near the top right – about where the word “Coma” is in the chart above. You will need to find the star on the lower left (Diadem or α Comae Berenices) , it is about 10° away which you can estimate with the width of your fist. The globular cluster is just to the east and a bit to the north, in the same field with binoculars. M53 is a similar distance from the core of the Galaxy as our own solar system – about 60 thousand light years – although like other globular clusters not in the same plane. It has a mass of around 826 thousand Suns so along with M5 one of the more massive globular clusters of the 5, but being some 58 thousand light years away it is almost twice as far as the others so relatively dim. It has an age estimated at 12.7 billion years. It is around 220 light years across so the biggest of the 5.

Over to you
So next time we have clear skies get out and have a go at finding these wondrous objects. If you follow the article and manage to see the globular clusters you will have discovered how to recognise at least three constellations, possible more, found out how deep sky objects are numbered, and by no means least, learnt how to star hop and even how to find objects that you cannot see by eye – key skills for an observer. If you are having problems finding the globular clusters don't despair, persevere they are there and relatively easy to see with just about any binoculars. There is no need to travel to a dark site, most of these can even been seen from cities! As with anything practice makes perfect.

And lastly
STAY HOME AND STAY SAFE

If you have found this article useful or if you are having problems understanding it please feedback at Observing@abergavennyas.org.uk

The charts were made with the assistance of Stellarium and Carte du Ciel