ASE-24

Observing list for beginners

The Astronomical Society of Edinburgh

Often people get a new telescope, perhaps for a birthday present or for Christmas, and then don't know where to begin. ASE-24 is a simple list, numbered for our founding year of 1924, which gives you a starting point in astronomy, identifying some of the most interesting and easy to observe objects in the night sky. It will help you to decide on what aspects of astronomy interest you most, allowing you to specialise more in the future should you wish to. Some of them are very easy, some quite a bit harder, but all will help you to get useful observational skills, most importantly how to find objects in the night sky. All should be be visible with a small beginner's telescope but the amount of detail you see will depend on the telescope. You will need to be able to identify a few of the brighter constellations to use the finder charts.

We have deliberately not included the Sun in this list because it is potentially dangerous to observe and you should always take advice on what equipment to use first. Never look at the Sun directly as you will damage your eyesight permanently! When done safely, the Sun is a fascinating object to study.

Here is a checklist where you can mark off the ones you have done.

MOON			**NEBULAE AND GALAXIES**		
ASE-1	Lunar seas and ray craters		ASE-13	M42 – Orion nebula	
ASE-2	Copernicus and Plato		ASE-14	M31 – Andromeda galaxy	
ASE-3	Other craters and features		ASE-15	M27 – Dumbbell nebula	
ASE-4	Apennines and Alpine valley		ASE-16	M57 – Ring nebula	
DOUBLE STARS			**GLOBULAR CLUSTERS**		
ASE-5	Albireo – Cygnus		ASE-17	M13 - Hercules	
ASE-6	Epsilon Lyrae		ASE-18	M15 - Pegasus	
ASE-7	Mizar, Alcor – Ursa Major		ASE-19	M2 - Aquarius	
PLANETS			**OPEN CLUSTERS**		
ASE-8	Jupiter moons and cloud belts		ASE-20	M45 Pleiades - Taurus	
ASE-9	Saturn rings		ASE-21	M35 - Gemini	
ASE-10	Venus phases		ASE-22	M34 - Perseus	
ASE-11	Mars		ASE-23	M44 Beehive - Cancer	
ASE-12	Uranus and Neptune		ASE-24	Double cluster - Perseus	

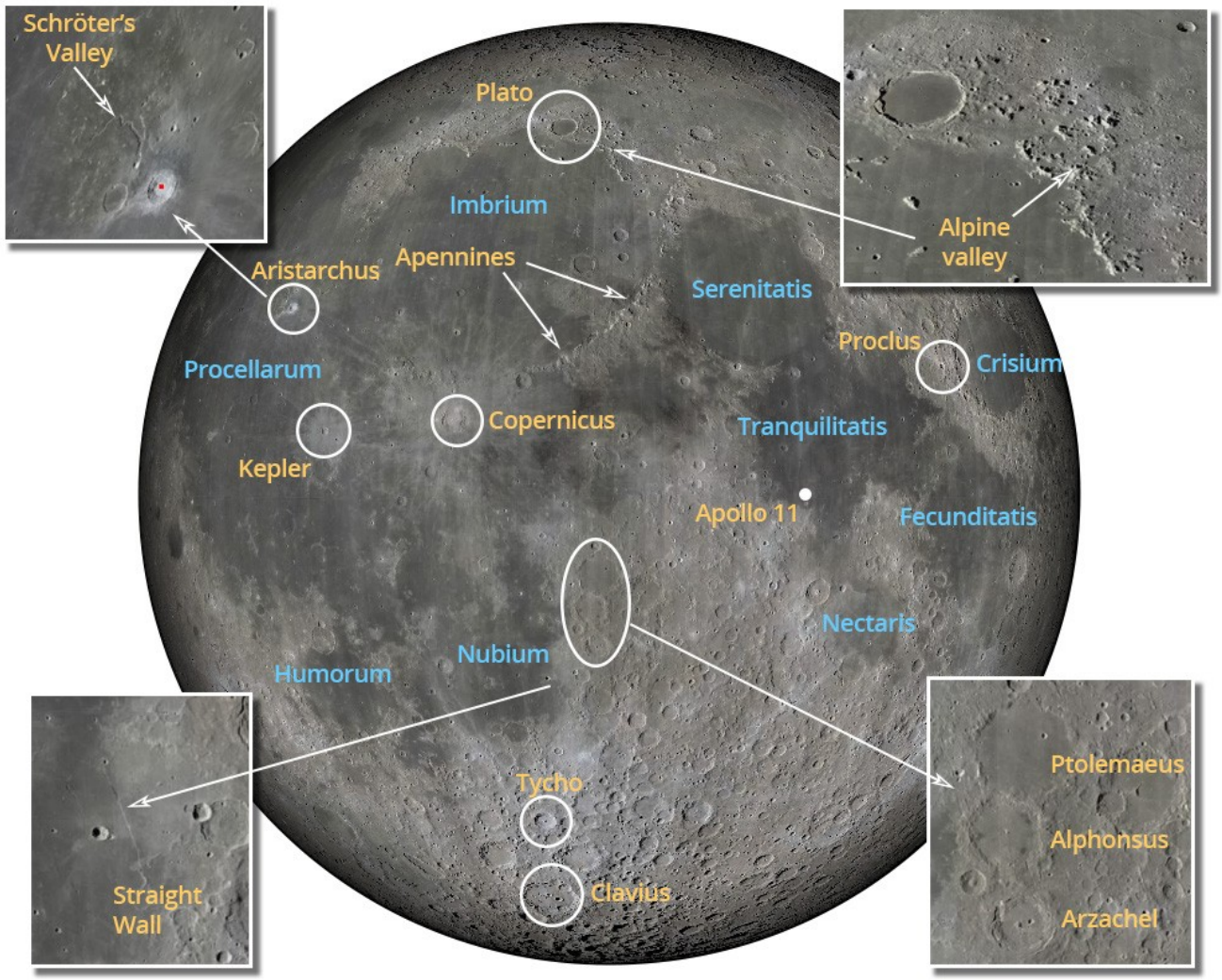
More details and finder chart are on the following pages or on our website at:
www.astronomyedinburgh.org/ase-24

ASE 1-4: THE MOON

The first time you look at the Moon through a telescope is an unforgettable moment! The clarity with which you can see the amazing range of features, in more detail than just about any other astronomical object, is staggering.

At times it can frustrate when you want to observe fainter objects and its light blots them out, but it has a beauty all of its own. The best time to observe the Moon is not normally at full Moon, when there are few shadows, but at any other phases when the Sun strikes the surface at an angle casting shadows that provide more contrast. However, there are some features that are best observed at full Moon.

To get the most out of the Moon, use software such as Virtual Moon Atlas, to help you identify interesting features. You can download it for free at https://ap-i.net/avl/en/download.



ASE-1 Lunar seas and ray craters

The Lunar Maria – or seas – are the large, dark, smooth areas formed by lava from ancient volcanic eruptions.

The major ray craters are also visible around full Moon time. Craters Tycho and Copernicus have the most complex and far-reaching systems of rays but there are other less-prominent ones such as Kepler.

Spot as many seas as you can and identify them using the chart. Identify the main ray craters and see if you can find any others.

OBSERVE: They are visible at most phases of the Moon but all are more clearly visible for a few days either side of full Moon.

Mare Tranquilitatis, the Sea of Tranquility, is where Neil Armstrong and Buzz Aldrin landed in the Apollo 11 mission in 1969.

ASE-2 Copernicus and Plato

These are two of the most interesting craters on the Moon. **Copernicus** is a large ray crater, 97 km wide, with several central peaks. It stands by itself just south of Mare Imbrium. The walls of the crater can appear bright white, casting long, dark shadows onto the crater floor at various lunar phases.

Plato is an impact crater, filled with lava, 109 km across at its widest point. It has a collapsed wall on the west side leading to interesting light and shadows at different illuminations.

Try and observe them at different phases and watch how the appearance changes with varying illumination. Although the floor of Plato looks smooth, there are actually several small craterlets in it. These are a real challenge to see.

OBSERVE: Copernicus is visible from about 2 days after first quarter phase (half Moon). At full Moon (lunar midday) the rays become more obvious. When the crater is on the terminator between light and dark (lunar dawn) the shadows become well-defined.

Plato is visible from 1 day after first quarter.

ASE-3 Other craters and features

Aristarchus and Schröter's Valley – Probably the brightest impact crater on the Lunar surface. The sinuous Schröter's Valley winds away to the north-west of the crater and is the largest rille on the Moon.
Proclus – Second only to Aristarchus in brightness, it is a young ray crater, interesting because the rays only seem to be on one side of the crater rather than all around.
Clavius – One of the largest craters on the Moon, 231 km across, in the southern highlands and is one of the older features. It has several impact craters within it.
Ptolemaeus, Alphonsus, Arzachel – A prominent chain of 3 craters.
Lunar Straight Wall – Also know as Rupes Recta, it is a linear fault that casts a dark shadow under the right illumination.

OBSERVE: Aristarchus and Schröter's Valley – 4 days after first quarter
Proclus – 4 days after new Moon

Clavius– 1 day after first quarter
Ptolemaeus, Alphonsus, Arzachel – first quarter
Lunar Straight Wall – 1 day after first quarter

ASE-4 Apennine mountains and Alpine valley

The **Apennines** (Montes Apenninus) are a range of mountains forming the south-eastern wall of Mare Imbrium. At 3.9 billion years old, they are relatively young! At the southern tip is the crater Eratosthenes. Further west they are joined by the **Carpathians** (Montes Carpatus). Behind them to the south-east lies a small sea, **Mare Vaporum**.

To the north of them lie the Lunar **Alps** (Montes Alpes) which are bisected by the 166 km long **Alpine Valley** (Vallis Alpes). This is a tricky one to observe but with good seeing and patience you should be able to spot it.

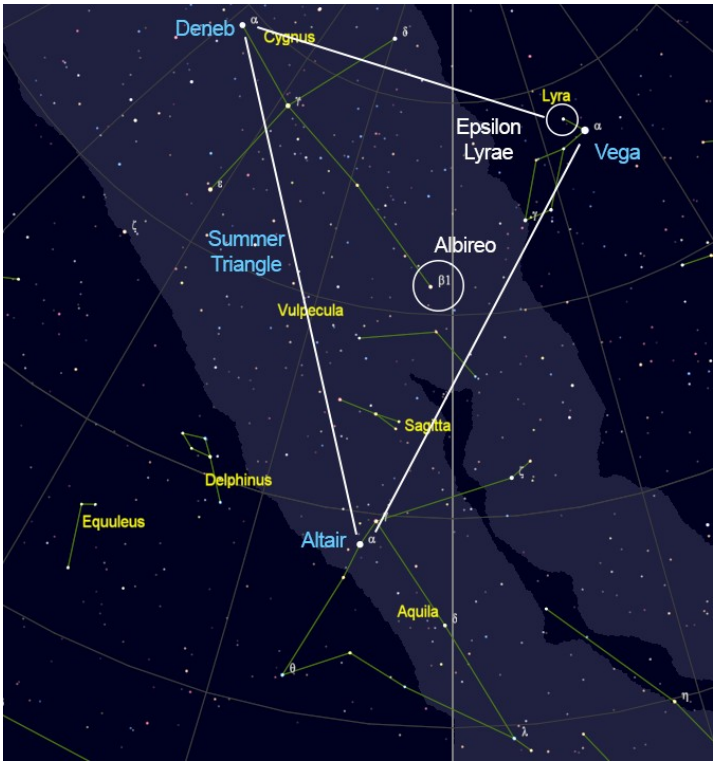
OBSERVE: From first quarter

ASE 5-7: DOUBLE STARS

Double stars are interesting objects where two stars appear close together in the sky. The may just be a chance optical alignment in the sky or they may actually be gravitationally associated, a binary system where the two stars orbit around each other. Some double stars are so close together that it is very hard to split them, but the ones we have selected are all viewable with small telescopes and are some of the more interesting ones in the sky. Use the finder charts to locate them.

ASE-5: Albireo, Beta Cygni

Albireo is probably most people's favourite double star because of the colour combination. It consists of a brighter yellow star with a fainter blue companion, making a very beautiful pair. Together they appear as a single naked eye star with a combined magnitude of 3, but through a telescope they are easily split into two stars of magnitude 3.1 and 5.1.



Albireo is just an optical double as the stars are separated by about 60 light years. They are about 400 light years away from us.

Find Albireo in Cygnus using the Summer Triangle as a guide. It is made up of the three bright stars Deneb in Cygnus the swan, Vega in Lyra the lyre and Altair in Aquila the eagle.

OBSERVE: The Summer Triangle is high in the sky during Summer months and early Autumn.

ASE-6: Epsilon Lyrae

Epsilon Lyrae is interesting because it is actually a double-double. The two brighter stars that make up Epsilon Lyrae, Epsilon 1 and 2, are themselves double stars.

The two brighter stars are easy to separate but the companions of each are much closer together and will be tricky to split unless you have really good seeing and sharp optics.

- Epsilon 1 stars have magnitudes of 4.7 and 6.2 separated by 2.6″
- Epsilon 2 stars have magnitudes of 5.1 and 5.5 separated by 2.3″

The brighter two stars are an optical alignment, but both stars are actually binary systems themselves.

Locate using the Summer Triangle as a guide.

OBSERVE: The Summer Triangle is high in the sky during Summer months and early Autumn.

ASE-7: Mizar and Alcor

Mizar, also know as Zeta Ursa Majoris, makes up a naked eye optical double with Alcor, 80 Ursa Majoris. Through a telescope Mizar itself is a double star. The components have a combined magnitude of 2 with a separation of 14″, so should be easy to split in a small telescope.

In reality Mizar is a quadruple system and Alcor is a binary. But most of these other stars are too close and faint to make out easily.

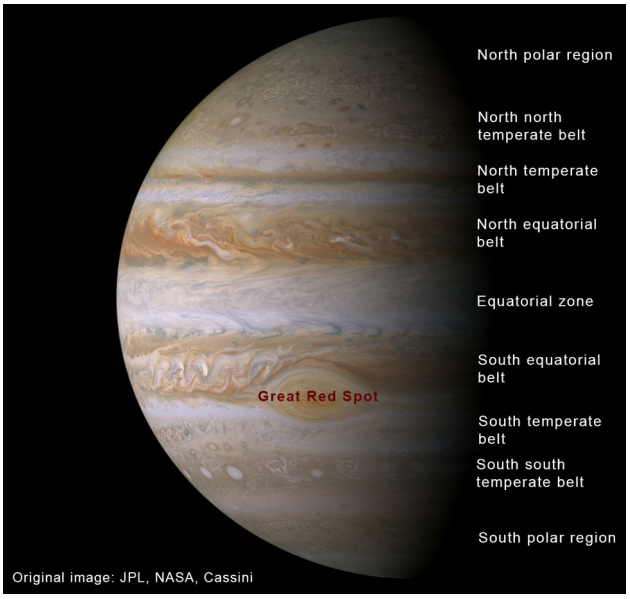
OBSERVE: Ursa Major is a circumpolar constellation from Edinburgh, meaning that it never sets, so you can view Mizar all year round.

ASE 8-12: PLANETS

Of course the planets are an obvious target for amateurs and can be very rewarding – but also disappointing at times. One of the biggest challenges when observing the planets is the seeing. Seeing is all about the stability of the atmosphere. When the seeing is bad the image in your telescope seems to boil and you can't make out any fine details. On the rare occasions when seeing is good you can get exquisite views. The amount of detail you see on planets is dependent on telescope aperture and seeing.

ASE-8 Jupiter moons and cloud belts

Jupiter is a fascinating body to study because of its ever changing cloud belts and the dance of its 4 main satellites – the Galilean moons – Io, Europa, Ganymede and Callisto, so called because they were discovered by Galileo Galilei in 1610 (using a very small telescope). You should easily be able to make out the two main north and south equatorial belts. On nights of good seeing you may even be able to glimpse the Great Red Spot and shadows of the moons as they pass in front of the planet, but this may be harder in a small telescope. Try and identify the 4 main moons on different days, using a guide such as https://in-the-sky.org/jupiter.php. To see any details on Jupiter you may need a higher magnification but this won't achieve much if the seeing is bad.



OBSERVE: Follow our Journal for when to observe the planets.

ASE-9 Saturn Rings

No-one ever forgets their first view of Saturn through a telescope! It is a very surreal sight, seeing the pale yellow planet surrounded by its ring system just floating there in space. Definitely one to share with friends and family.

Not much detail is visible on the surface of Saturn using a small telescope but you can make out the main division in the ring system – the Cassini Division – on nights of good seeing.

ASE-10 Venus phases

With the naked eye Venus is a dazzling morning or evening star. Through a telescope it goes through various phases in a similar way to our Moon. Try and keep a track of the phases through an evening or morning apparition. Larger telescopes can show faint, dusky markings on the clouds of Venus but you are unlikely to see much apart from the phases with a small telescope.

For safety reasons you should only observe Venus once the Sun is below the horizon.

ASE-11 Mars

Despite being the second closest planet to Earth, Mars can be a real challenge to observe as it often shows a very small disc in a telescope. However, when Mars is close to Earth you can sometimes make out the bright north or south polar caps and some faint, dark markings on the surface. The red colour is very obvious through a telescope and with the naked eye. You may need a higher magnification to view Mars but only if the seeing allows.

ASE-12 Uranus and Neptune

Uranus and Neptune never show any details on their cloud surfaces but the greenish colour of Uranus and the pale blue of Neptune are definitely visible. By locating Uranus and Neptune through a telescope, you will be gaining some valuable observational skills. You will need to use a finder chart (e.g. https://in-the-sky.org/data/planets.php) to locate them as they are both usually below naked eye visibility.

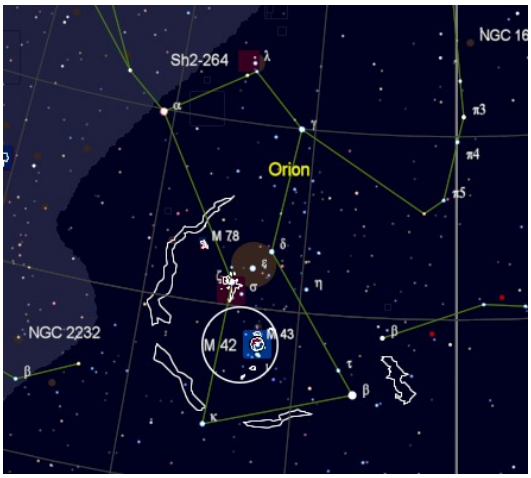
ASE 13-16: NEBULAE & GALAXIES

We've all seen the fabulous images of galaxies and nebulae taken by some of the biggest telescopes in the world and by the best astrophotographers. Obviously it's not going to be possible to see them like that through a small telescope but there's something amazing when you see an object thousands or millions of light years away with your eye and your own small telescope. The light from those objects started out the journey towards your eye many years in the past and you're seeing these objects as they looked then. Take your time and the longer you look the more details you will see.

Planetary nebulae have nothing to do with planets although they are often circular. The term comes from the fact that early astronomers though they looked a little like planets. In reality they are caused by stars that have thrown off large amounts of material, glowing because the gas is excited by a nearby star.

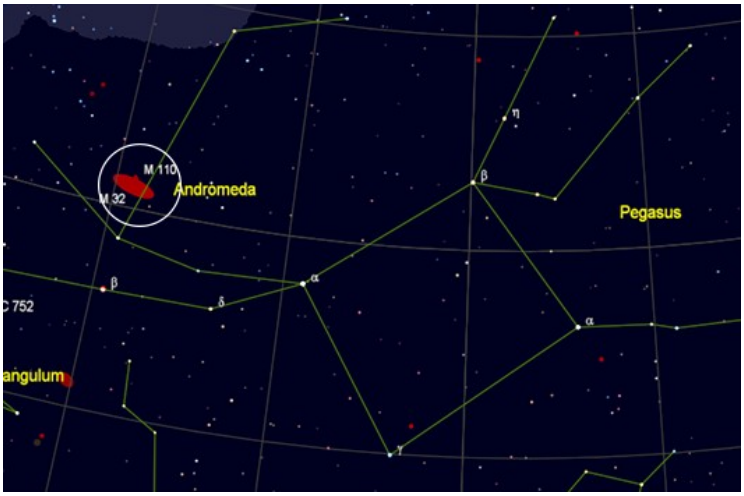
Nebulae are interstellar clouds of gas and dust. Some glow because they are excited by the radiation from nearby stars; others glow because they reflect the light of the stars around them.

ASE-13 M42 Orion Nebula



It is very hard to miss the constellation of Orion when it rises in the Winter skies. The equally famous Orion Nebula is also easy to find just below three stars in Orion's belt. View it on dark, moonless nights and you will see more of the fainter nebulosity. Take your time and let your eyes adapt to the darkness and you will keep seeing more detail. Try and make out the four central stars – the Trapezium. These are the stars that excite the gas cloud and cause it to glow.

OBSERVE: Orion is definitely a Winter object, visible in the south from November to February.



ASE-14 M31 Andromeda Galaxy

The Andromeda Galaxy is probably the most well known galaxy and the closest large galaxy to our own Milky Way. It is also the furthest you can see with the naked eye at 2.5 million light years!

Andromeda itself is not an obvious constellation but you can find it by locating the square of Pegasus then following the top left corner of the square to the left for two stars then go "up" to find the galaxy.

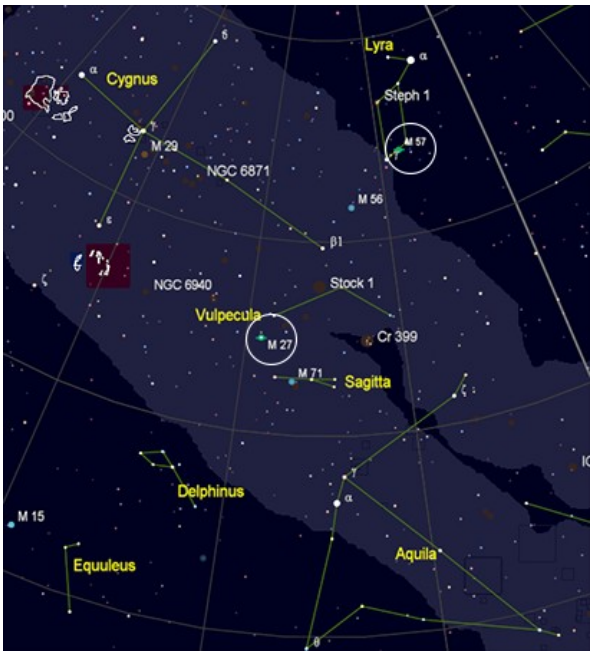
M31 is a very large object in the sky – about six time the size of the full Moon, so it should fill your field of view. The glow of the central bulge is obvious and you may also be able to make out some of the dark dust lanes and fainter spiral structure under dark skies. M31 has two satellite galaxies, M32 and M110, but these are much harder to see.

OBSERVE: Andromeda is best seen in late Summer and Autumn.

ASE-15 M27 Dumbbell Nebula

M27 is a planetary nebula in the undistinguished constellation of Vulpecula. See how much of the structure you can make out and if you see the dumbbell shape.

OBSERVE: Vulpecula is high in the southern skies in the evenings in early summer to autumn.



ASE-16 M57 Ring Nebula

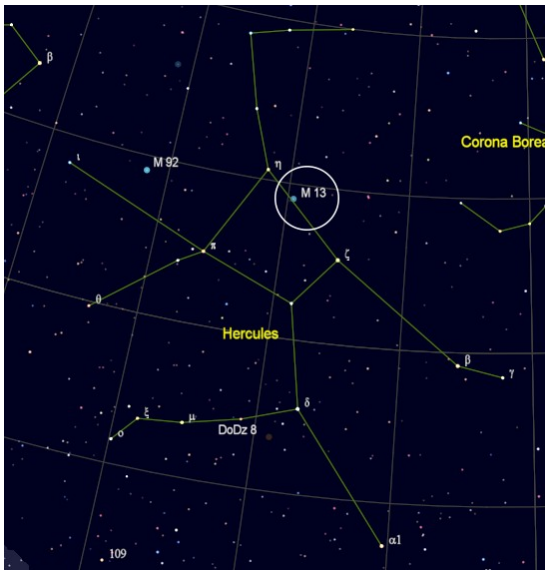
M57 is a planetary nebula in Cygnus that looks a little like a smoke ring. It is quite small and faint but worth trying to observe.

OBSERVE: Lyra is high in the southern skies in the evenings in early summer to autumn.

ASE 17-19: GLOBULAR CLUSTERS

Globular Clusters are spherical groups of stars that surround our galaxy in a halo. They are very distinctive in shape, almost looking like an explosion of stars. In a telescope they are seen as fuzzy patches with some of the individual stars being resolved with larger telescopes. All are very similar in appearance but different in size and setting against the background stars. These are the three brighter ones seen from the northern hemisphere. There are about 150 known to be surrounding our own galaxy.

ASE-17: M13 Hercules



M13 is often called the Great Globular Cluster in Hercules. It is the brightest and largest of the ones here. As you look you may start to see some of the individual stars resolved. Hercules is not the easiest constellation to find but look for the distinctive "keystone" shape of its four central stars and work your way out from there. There is another globular cluster nearby, M92.

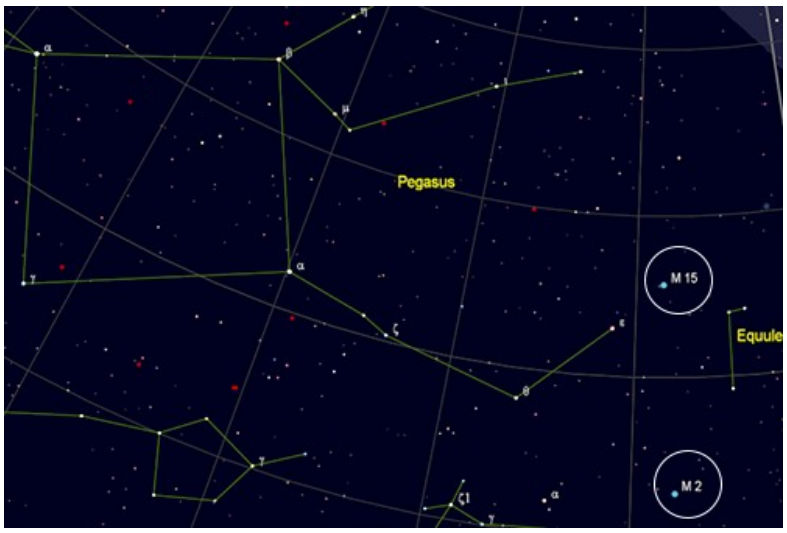
OBSERVE: Hercules is best seen in late Spring and early Summer.

ASE-18 M15 Pegasus

M15 is actually one of the oldest globular clusters known at 12 billion years. It is a little fainter than M13 so trickier to find. Find the square of Pegasus and work your way around from there.

OBSERVE: Pegasus is best seen in late Summer and Autumn.

ASE-19 M2 Aquarius



M2 is one of the largest globular clusters at 175 light years across. It is also a little fainter than M13 but has no easy way to find it other than by star hopping using the chart. It is almost due south of M15.

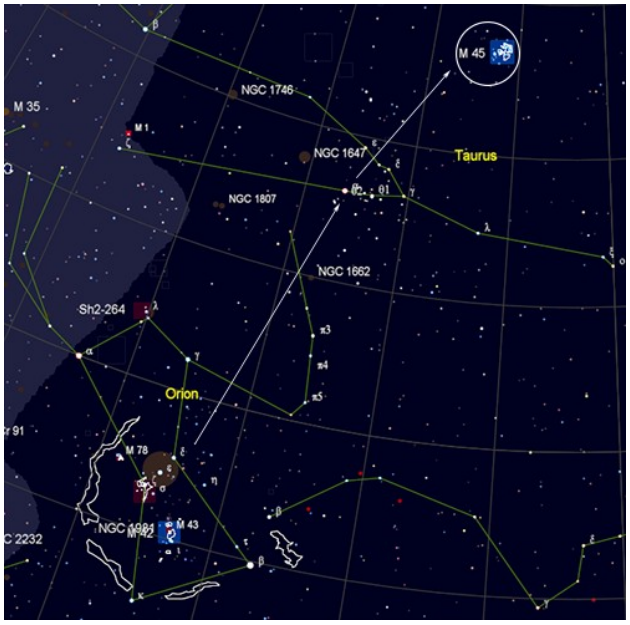
OBSERVE: Aquarius is best seen in late Summer and Autumn.

ASE 20-24: OPEN CLUSTERS

Open Clusters are also known as Galactic Clusters (not to be confused with Galaxy Clusters which are clusters of galaxies) because they exist within our own Milky Way galaxy. They are groups of stars loosely associated with each other and bound by gravitational attraction. They take many different shapes, sizes, brightness, colours and numbers of stars. Some are embedded in gas clouds which can be excited by the stars or simply reflect the light of the stars.

ASE-20 M45 Pleiades – Taurus

The Pleiades star cluster is probably the most well-known and easiest to see with the naked eye. It is quite a large cluster at over three times larger than the full Moon in the sky. It is surrounded by its distinctive blue nebulosity which reflects the light of the hot young blue stars that make up the cluster. Most people can make out 6 or 7 stars with the naked eye, but there are many more visible through any small telescope.



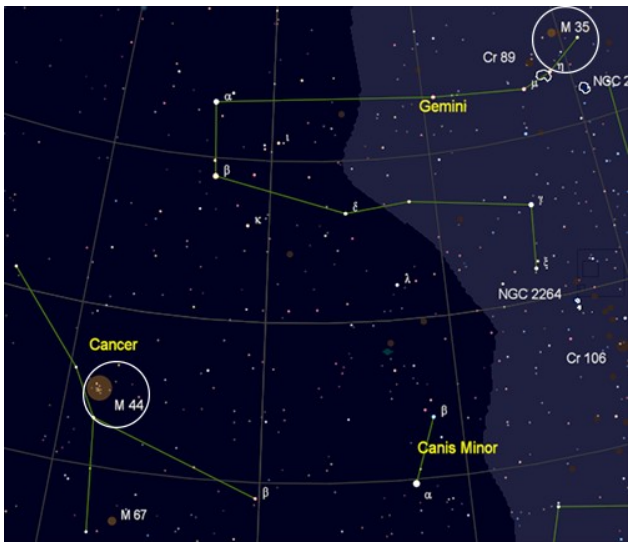
You can find M45 by following the line of Orion's belt upwards until you reach the bright reddish star Aldebaran in Taurus and the follow the line a little further until you reach the Pleiades. Hard to miss.

OBSERVE: Taurus is a Winter constellation and is high up in the South from November to January.

ASE-21 M35 Gemini

M35 is a beautiful cluster on the edge of Gemini, at just about naked eye visibility. It is relatively easy to find once you have found the twins of Gemini, Castor and Pollux. It is about the size of the full Moon in the sky.

There is actually a smaller, fainter cluster on the south-west edge of the cluster, NGC 2158. It is much fainter but you may be able to spot it. it is not associated with M35 as it is about 9,000 light years further away.



OBSERVE: Gemini is a Winter constellation and is best viewed in December and January.

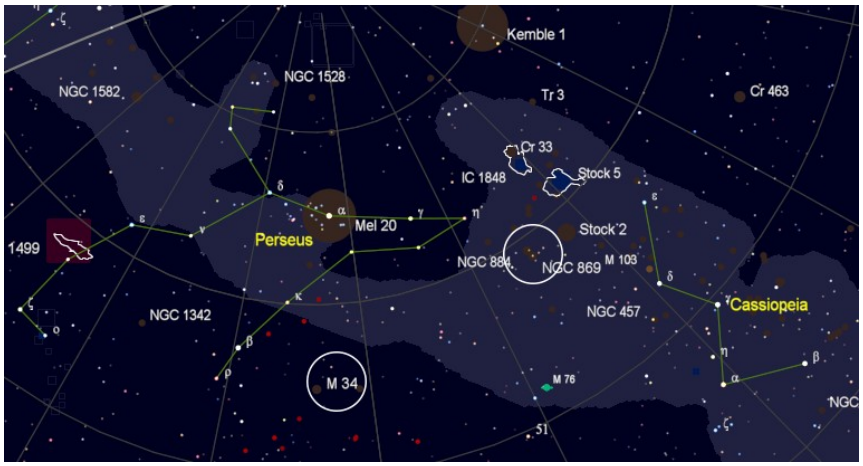
ASE-22 M34 Perseus

M34 is another easy to find cluster, on the edge of naked eye visibility. There are a handful of brighter stars and many fainter ones. It lies between Perseus and the ‘W’ of Cassiopeia, just to the right of Beta Persei, the bright star Algol.

OBSERVE: Perseus is usually high in the sky in northern latitudes so is visible all year round. It is best seen in the evenings in Autumn and Winter months.

ASE-23 M44 Beehive – Cancer

M44, also known as Praesepe (manger in Latin), is a large, naked eye open cluster in Cancer and is one of the closest to Earth. It is quite large at about three times the size of the full Moon in the sky. There are a handful of bright stars in the cluster with many more fainter ones. Some of the stars are red giants which means that they are in the later stages of stellar evolution.



Cancer itself is not a very easy constellation to find as it contains no really bright stars, but you should be able to find it just south of Castor and Pollux, the two bright stars in Gemini.

OBSERVE: Cancer is a Winter constellation and is best viewed in December and January.

ASE-24 Double cluster – Perseus

The Double Cluster is a lovely pairing made up of two open clusters, NGC 869 and NGC 884. They are visible with binoculars and you should be able to fit both clusters into the low power field of your telescope with a combined size in the sky twice that of the full Moon.

The cluster is relatively easy to find as it is about half way between the constellations of Perseus and the ‘W’ of Cassiopeia.

OBSERVE: Perseus is usually high in the sky in northern latitudes so is visible all year round. It is high up in the evenings in Autumn and Winter months.

Article: Mark Phillips
Star charts created with Cartes du Ciel