NEWBURY ASTRONOMICAL SOCIETY

BEGINNERS SECTION MAGAZINE – OCTOBER 2010

CONSTELLATIONS

Star charts can be used like normal maps but using different features to navigate. On normal maps we use roads and towns to navigate but on star charts we use stars and constellations. In this article we will see how astronomers use the patterns of the stars to find objects they want to observe. A star chart or planisphere will be required. If you do not have a chart, then use the one on page 6.

A star chart has to be orientated according to the time of year so that it can be aligned to the sky on the night it is being used. This is because the stars appear to slightly change their position from night to night due to Earth moving around the Sun on its orbit. Earth takes 365¼ days (a year) to complete one orbit of the Sun. A circle (the approximate path of Earth's orbit) is normally divided into 360 degrees therefore we could say that the Earth moves approximately 1 degree around the Sun per day. This means that when viewed from Earth, the star patterns (the constellations) in the sky appear to move approximately 1 degree from east to west every day. Put another way in 30 days (a month) the sky appears to move 30° from east to west.

From one night to the next the change in position of the stars will not be noticeable but a month will make a significant difference. The chart on page 6 is drawn so that the stars at the bottom of the chart are in the south on 1st of the month. There is however an added complication caused by the rotation of Earth. Earth rotates once every 24 hours (1 day). Again we can say one rotation is 360 degrees so the sky also appears to move 15° per hour (360° ÷ 24) due to Earth's rotation. An object rising over the eastern horizon at 6 o'clock in the evening will disappear over the western horizon by 6 o'clock in the morning.

The chart on page 6 shows the sky at 9 o'clock BST on 1st of the month. At 8 o'clock the sky will appear 15° further to the east and at 10 o'clock 15° further to the west.

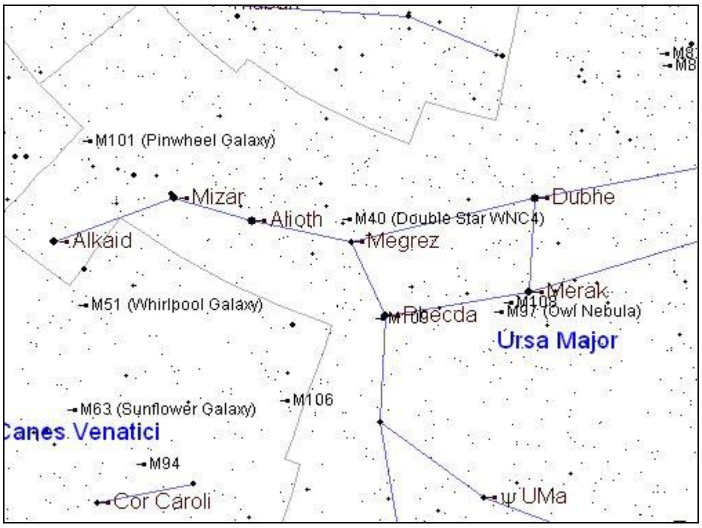
So what are constellations? Those bright appear to form patterns in the sky these what we call the constellations. The chart on page 6 shows some of the internationally accepted constellations of which there are 88 covering the whole sky. The chart shows the brightest stars joined by lines to denote the grouping for each constellation. Many of the constellations in the northern hemisphere are named after characters from Greek mythology and mostly originate from ancient times.

Very few constellations look like the character they are named after. Cygnus the Swan, Leo the Lion and Orion the Hunter are perhaps exceptions and do (with a little imagination) look remotely like those characters. The stars making up the constellations are not generally physically associated but are simply formed by a 'line of sight' effect.

Astronomers use the recognisable patterns of the constellations to find their way around the sky. Constellations do have borders as shown in the chart on page 6 but borders are not important because they can't be seen in the sky. The pattern of the brightest stars is the important thing.

It is important for an astronomer to be able to recognise at least the brightest and most familiar constellations to enable them to locate objects within the bright constellations and in any of the other constellations.

Once one of the brighter and easily recognized has been identified other constellations surrounding it can be found. Gradually, by working out from a known constellation and by using a star chart, other constellations can be identified.



The familiar saucepan shape in Ursa Major (The Plough) is formed by the seven brightest stars and is one of the most recognisable constellations. The 'saucepan' asterism (pattern) formed by the brightest stars is probably the best known constellation of all. Ursa Major is therefore the best to use to start your orientation. It is also 'circumpolar' that means it is visible all year and does not disappear below the horizon. The text below the chart on page 6 gives advice on how to use Ursa Major to find Polaris the Pole Star and how to orient the chart for use. Almost directly opposite Ursa Major and about the same distance away from Polaris is the constellation of Cassiopeia. With its distinctive 'W' shape it is a useful short cut for constellation identification.

Using constellations to find the way around the night sky is very much like using a map to find the way around the country. The bright stars are rather like the cities and large towns. And the constellations like the counties. We can imagine straight lines between stars so we can use the pattern of stars in constellations as a route map to find interesting objects.

Find the object to be observed on a star chart and work out a route to 'star hop' to the object. Star hopping is a technique used by astronomers to find objects to look at. Starting at a bright star look for that star in the sky. Then look for the next star identified on the chart that is in the direction of the object. Find the other stars that are closer and closer still to the object until the object can be found in the finder of a telescope.

THE NEXT BEGINNERS MEETING

20th October Planetary Nebulae

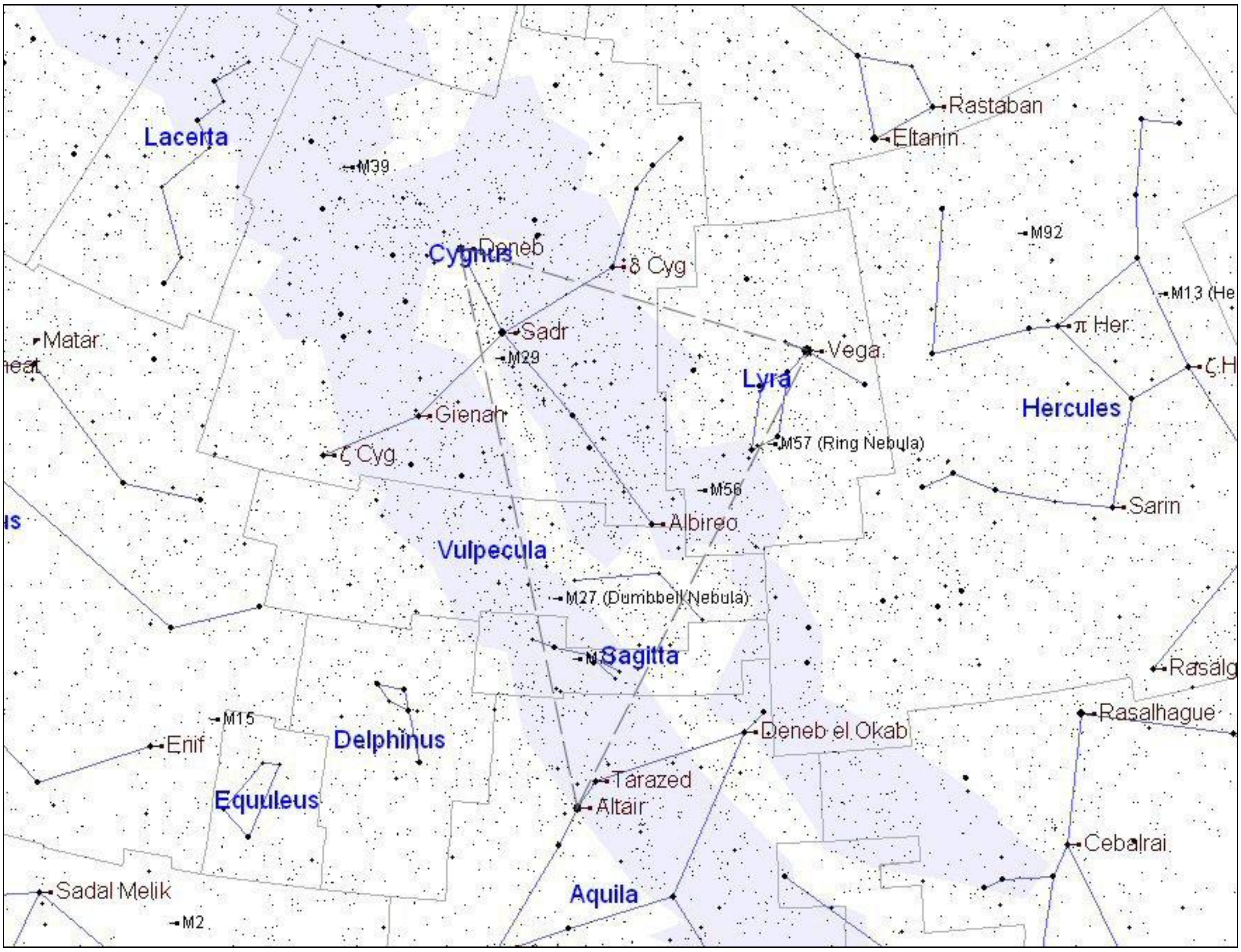
Website: **www.naasbeginners.co.uk**

NEWBURY ASTRONOMICAL SOCIETY MEETING

1st October The Isaac Newton Telescope

Website: **www.newburyas.org.uk**

THE SUMMER TRIANGLE



The autumn night sky is still graced with the Summer Triangle made up of three bright stars: Deneb in Cygnus, Vega in Lyra and Altair in Aquila. The Summer Triangle can be used to find other constellations around it.

CYGNUS is a beautiful constellation and has a number of interesting things to see. During late Summer and Autumn, it is almost directly overhead. It forms a distinctive cross shape that does actually look a bit like the Swan it is named after. When viewed through binoculars or a telescope, the observer will be amazed by the number of stars in the field of view. This is because Cygnus sits right on the Milky Way and has a background of rich star fields. Look for Cygnus on the chart above and on page 6.

The bright star Deneb is one of the brightest stars that we can see in our skies. Unfortunately Deneb is in the swan's tail, if it had been in the head it would have made a great eye. It is a bright hot white star, much brighter and hotter than our own sun at 10,000°C (the Sun is 6,400°C).

The star at the swan's head, furthest from Deneb on the centre line forming Cygnus, is called Albireo and it is beautiful to look at in a small telescope. It is actually a double star comprised of non identical twins. One star is a bright golden colour while the other is a beautiful ice blue.

Because they are so close together the colour difference is very noticeable. Also in Cygnus just north of Deneb, is M39 a small open cluster of about 20 stars all about 900 light years away. This is a group of stars that formed from the same nebula (cloud of Hydrogen gas).

LYRA can be found on the chart above, between the constellations of Hercules and Cygnus. The brightest star is Vega, the most westerly of the stars that form the summer triangle. Vega is one of the brightest stars in our night sky, the name Vega means 'Eagle' or 'Vulture'. Like Deneb, Vega is a bigger and brighter star than our Sun and much hotter at 10,000°C. It also appears bright because it is very close at only 27 light years away. Vega forms a triangle with two fainter stars Sulaphat and Sheliak.

Sheliak is a variable star of a type known as an eclipsing binary. This is a pair of stars that are orbiting each other in a very close orbit. When one passes in front of the other only one is seen so there is less light, when they are apart we see the light of the pair so it is brighter. The brightening period is about 12 days.

Between the two fainter stars is a beautiful Planetary Nebula called the Ring Nebula. The Ring Nebula is number M57 in Charles Messier's catalogue. A small telescope should show the Ring Nebula as a tiny 'smoke ring' like object, a larger telescope will show the ring clearly. See pages 3 and 4.

AQUILA is quite distinctive because its only bright star Altair has a pair of fainter stars equally spaced on either side. There is however not much else to see in Aquila other than the Milky Way that runs through it.

Other small constellations like Sagitta (The Arrow) and Delphinus (the Dolphin) are good to search out using binoculars. M27 in Vulpecula can also be seen.

PLANETARY NEBULAE

One of the most interesting objects to see in the night sky is a number of different types of object collectively known as 'Nebulae' the plural of 'Nebula'. Nebula actually means cloud and the objects that it describes are in effect clouds. Unlike the clouds we see in our atmosphere nebulae are tenuous (thin). What they lack in density is made up for in their vast size. Often the density of a nebula may only be a few atoms per cubic metre compared to billions of atoms per cubic centimetre on Earth. However nebulae can be thousands of light years across in fact so large that stars can form within them.

The main types of nebulae are the huge gas clouds like the one in the sword of Orion called M42 and also known as the Great Orion Nebula. This is the most spectacular and most famous and can be seen using just a pair of binoculars.

M42 the Great Orion Nebula

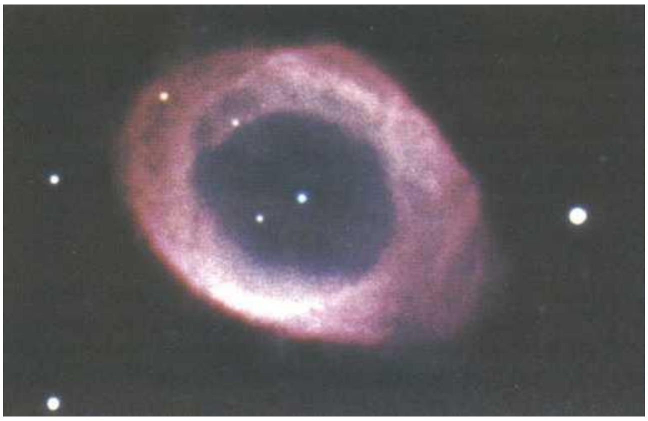
One of the most beautiful and sometimes colourful types of nebula is known as a 'Planetary Nebula' but it has little to do with planets but has a lot to do with stars of a similar type as our star, the Sun. As already mentioned some nebulae are the birth place of stars but Planetary Nebulae are the remains of the death of a star and is to be the fate of our Sun.

Stars form as the atoms of gas (mainly Hydrogen) in a nebula are drawn towards each other by their common gravity. As atoms move closer together their mutual gravity increases and they pull in more atoms. As the process continues the growing cloud of gas is drawn into a compressed sphere. The pressure in the centre raises the temperature to millions of degrees and begins the process of nuclear fusion. The pressure and temperature in the centre of the sphere forces pairs of Hydrogen atoms together to form a single atom of the gas Helium that has a larger atom. A tiny amount of mass is lost in each fusion process this mass is converted into energy in the form of a flash of X-Rays. These X-Rays further heat the sphere of gas and it begins to shine as a new star.

In a star like our Sun there is enough Hydrogen fuel to power the fusion process for about 10 billion years. The Sun has used up around half of its Hydrogen fuel in the 4¼ billion years since its birth. As the Hydrogen is converted to Helium the heavier atoms sink to the centre and begin to form a Helium core. The Helium cannot be processed in the nuclear fusion process at this time and build up the core. As the Helium core grows the Hydrogen fusion processing area forms into a shell around the outside of the growing Helium core. The core continues to grow and the fusion shell moves further and further out. Eventually there is not enough mass of gas on the outside of the fusion shell to compress the star inwards and the energy of the fusion pushes the outer layers outwards.

The fusion process continues to consume Hydrogen from the outer layer of the star and pass it into the core as Helium. Eventually as the Hydrogen begins to run out the star begins to start fusing the Helium into Nitrogen, Carbon and Oxygen. This extended process produces more energy than the Hydrogen fusion process on its own. The new source of energy pushes the outer layers even more and the dying star expands into a Red Giant.

A star that was originally the size of our Sun may grow so large that it will become as big as the orbit of Earth or even larger. Any planets in orbits close to the star will first be burnt to a cinder as the star expands and will eventually be consumed into the growing star. Towards the end of this process the star begins to lose its gravitational grip on the outer layers which drift off and form a vast bubble like halo around the star. This halo is different for each star and often forms a beautiful ring shape.



M57 the Ring Nebula in Lyra

Eventually the nuclear fusion process will exhaust its fuel supply of Hydrogen and Helium and the process will stop. With no energy being produced, gravity once again is able to take charge. With nothing to resist gravity the core of the dying star collapses in on itself. The atoms crash inwards towards the centre of the once powerful nuclear furnace. The remains of the star which was once over a million kilometres in diameter is crushed into super hot spherical cinder of compressed atoms about the size of Earth.

Larger stars end their lives in a much more dramatic way. The Helium gas that was produced as a bye product of the nuclear fusion process would have built up in the core of the star. A large star (more than five times the mass of the Sun) will produce high enough pressure and temperature in its core to enable the Helium to be used as fuel. The Helium will be fused into progressively heavier elements like Nitrogen, Oxygen, Carbon, Silicon until eventually it will start to produce Iron. The production of Iron causes the star to explode as a Super Nova and produces a nebula called a Super Nova Remnant.

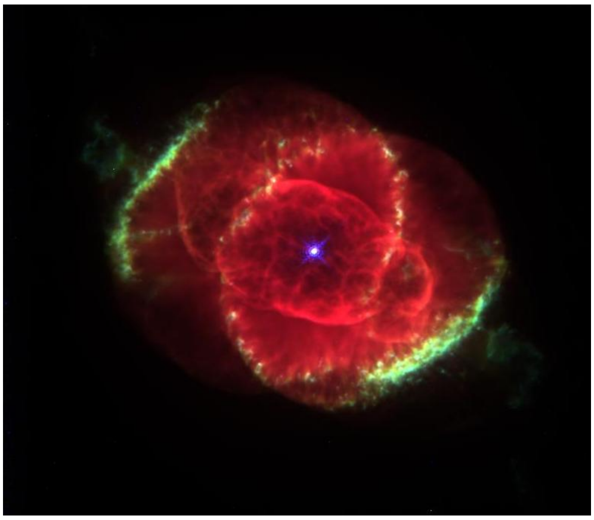
M1 the Crab Nebula 'Super Nova Remnant' in Taurus

Planetary Nebulae come in many shapes, sizes, colours and brightness. Some are quite easy to find and can even be seen quite clearly using a good pair of binoculars. Perhaps the biggest and easiest to find is Messier Catalogue Number 27 (M27) also called the Dumbbell Nebula in the constellation of Vulpecula. Vulpecular is one of the constellations located, at least in part, within the Summer Triangle. See Page 2.

M27 the Dumbbell Nebula in Vulpecula

M27 is an example of a 'lobed' Planetary Nebula. This type of nebula is quite common but the cause of the lobes is still a mystery. Two prime contenders in the list of possible causes are: Magnetic fields that were present in the star before it developed a planetary nebula. The magnetic field could have cause material in the nebula to follow the lines of magnetic force emanating from the poles to form jet like structures. The other theory is quite interesting because it involves the presence of planets. The gravity of planets in orbit around the star might have directed the material streaming away from the star into preferential directions causing denser areas in the nebula than formed into lobes.

Some nebulae have very complex structures that are so beautiful that they are often used as pictures to decorate buildings especially those connected with space. One of the most famous and most recognisable images is The Cats Eye Nebula imaged by the Hubble Space Telescope in 1995 is thought to have been caused by the original star being one of a double star system.



NGC 6543 The Cats Eye Nebula in Draco

Some of the images shown in the previous columns were produce using professional equipment or by advanced amateur astronomers. It goes without saying that the regular amateur astronomer looking through the eyepiece of a modest telescope will not see the detail or colours shown in the photographic images. However quite a number of the brighter planetary nebulae can be seen using a 100mm aperture telescope. M57 and M27 are both within the Summer Triangle and are shown in the chart on page 2.

To find M57 use the charts on pages 2 and 6 to locate the three bright stars of the Summer Triangle. These are Deneb in Cygnus, Vega in Lyra and Altair in Aquila. Identify Vega and find a pair of fainter stars to the south (below) Vaga. There is another even fainter pair closer to Vega but ignore the fainter pair. In a finder scope the two stars can be seen together. Aim the telescope between the two stars and look through the eyepiece. A longer focal length eyepiece such as a 25mm should be used initially. Gently move the telescope a little way in one direction and then another. Spend a little time looking and with a little patience it will be possible to pick out a star that looks a little fuzzy. Lock on to the fuzzy star and gently replace the 25mm with a 10mm eyepiece. M57 will look like a tiny smoke ring. When it is found centralise it in the field of view and replace the eyepiece with shorter one perhaps 6mm or fit a barlow lens and then fit the 10mm into the barlow. The barlow will effectively double the magnification of the 10mm to make it work like a 5mm.

In a small telescope M57 will be a bit of a challenge but in a 100mm or larger telescope it is well within reach. It will not be possible to see colour or detail but the ring shape should be visible. A larger telescope may even show the white dwarf star that created the nebula.

M27 the Dumbbell nebula is much bigger than M57 and is well within the capability of a 100mm telescope. However it is quite tenuous and therefore is seen much better if the sky is dark. That means one of those clear crisp nights when there is no mist to be illuminated by street light and pollution from built-up areas. If the sky looks grey or orange then it may be difficult to find M27 but if the sky looks reasonably black then it will be able to be found using a small telescope or even binoculars.

To find M27 first locate the bright star Altar at the south end (bottom) of the Summer Triangle. On a fairly good night the arrow shape of Sagitta can be found with the naked eye to the north (above) of Altar. See the chart on page 2. Using a pair of binoculars (8 x 50) or the telescope finder scan the sky just to the north of Sagitta. M27 will appear as a fuzzy patch. It is quite elusive to locate for the first time but once seen it becomes much easier. When found in a telescope finder look through the focuser of the telescope fitted with a 25mm eyepiece. If necessary move the telescope gently to and fro until the faint butterfly shape of M27 can be seen.

Here are a couple of helpful hints for finding these objects in a telescope. First, before starting to find an object locate a bright object such as one of the Summer Triangle stars and position it in the centre of the telescope eyepiece. Lock the telescope and adjust the finder telescope to ensure the star is also in the centre of view. Second, while the bright star is in view adjust the focus to achieve the smallest possible image of the star. It is easy to set the focus on a star but much more difficult to achieve perfect focus on a faint nebula.

THESOLAR SYSTEM THIS MONTH

MERCURY rises at around 06:00 in the east just before the Sun at the beginning of the month. It then moves towards the Sun and is in conjunction with the Sun by the middle of the month. Mercury will then make a brief appearance in the west at the end of the month setting just after the Sun. However it will be too close to the Sun for any useful observing this month.

VENUS will not be observable this month.

MARS is disappearing over the south western horizon just after sunset. It is not only very low but it is also getting very small at just under 4 arc seconds as it moves further away.

JUPITER is just coming into prominence in the eastern sky. It rises at 17:30 at the beginning of the month, 17:00 in the middle of the month and 16:00 by the end of the month. It will be in good a position for observing by about 21:00 at the beginning and about 20:00 by the end of the month. Jupiter is interesting at the moment because the Southern Equatorial Belt is missing see the image below (South is at the top). This has happened before but it is well worth having a look because it does not happen very often. The last time this happened was over 15 years ago. The Great Red Spot is normally imbedded in the Southern Equatorial Belt but can now be seen against nothing but white clouds. The moons in the image are Io closest to Jupiter and Europa further out. Jupiter will be the subject of the featured article next month.

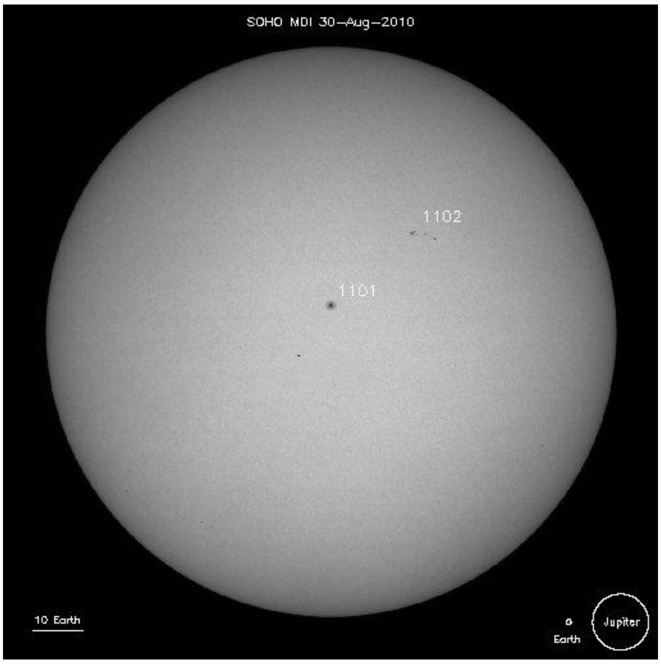
Jupiter imaged on 2^{nd} September by Steve Harris

SATURN is too close to the Sun and will not be observable this month. It is moving into conjunction with the Sun and will appear as an early morning object later in the year. The ring is opening out now after it had been closed up and almost disappeared last year. It will be looking much more like we expect when it reappears this time around.

URANUS is close to Jupiter throughout the month and is in a very good position to make it easy to find. Uranus is just 51 arc seconds to north (above) Jupiter this is only just short of two Moon diameters away. Uranus will appear as a rather smudged looking blue star. Once centred in a telescope use a higher magnitude eyepiece and possibly a Barlow to zoom in and a small blue disc will be seen.

NEPTUNE is at its best this month and can be found, perhaps with some difficulty, due south at about 21:30.

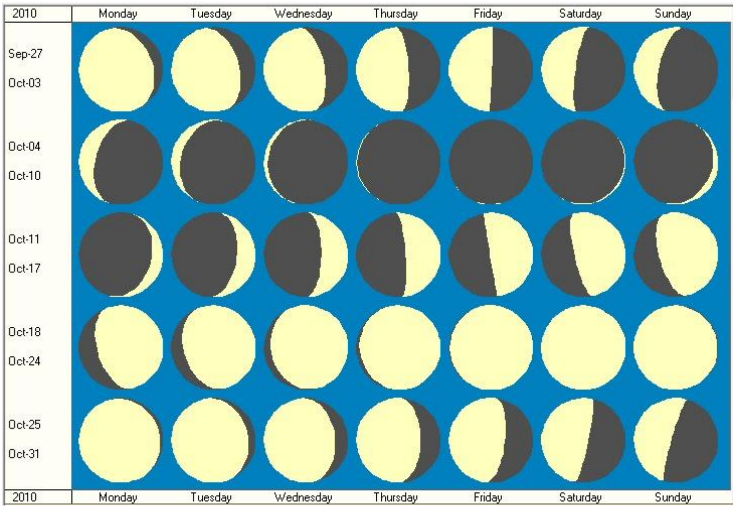
THE SUN There have been a few very nice Sunspots appearing over the last few months so it would appear the Solar maximum may have started. The Sun has an eleven year cycle of increasing sunspot activity. We should now be well into a period of maximum activity but the activity has been very sparse until the last few months with just a few medium sized spots starting to appear. Sun spots are caused by the lines of force in the magnetic field of the Sun as they break through the outer layers.



Sunspots imaged by SOHO on 30^{th} August 2010

A special solar filter must be fitted to a telescope to view sunspots or alternatively the image can be projected on to a screen. **DO NOT LOOK DIRECTLY AT THE SUN AS IT WILL CAUSE BLINDNESS**.

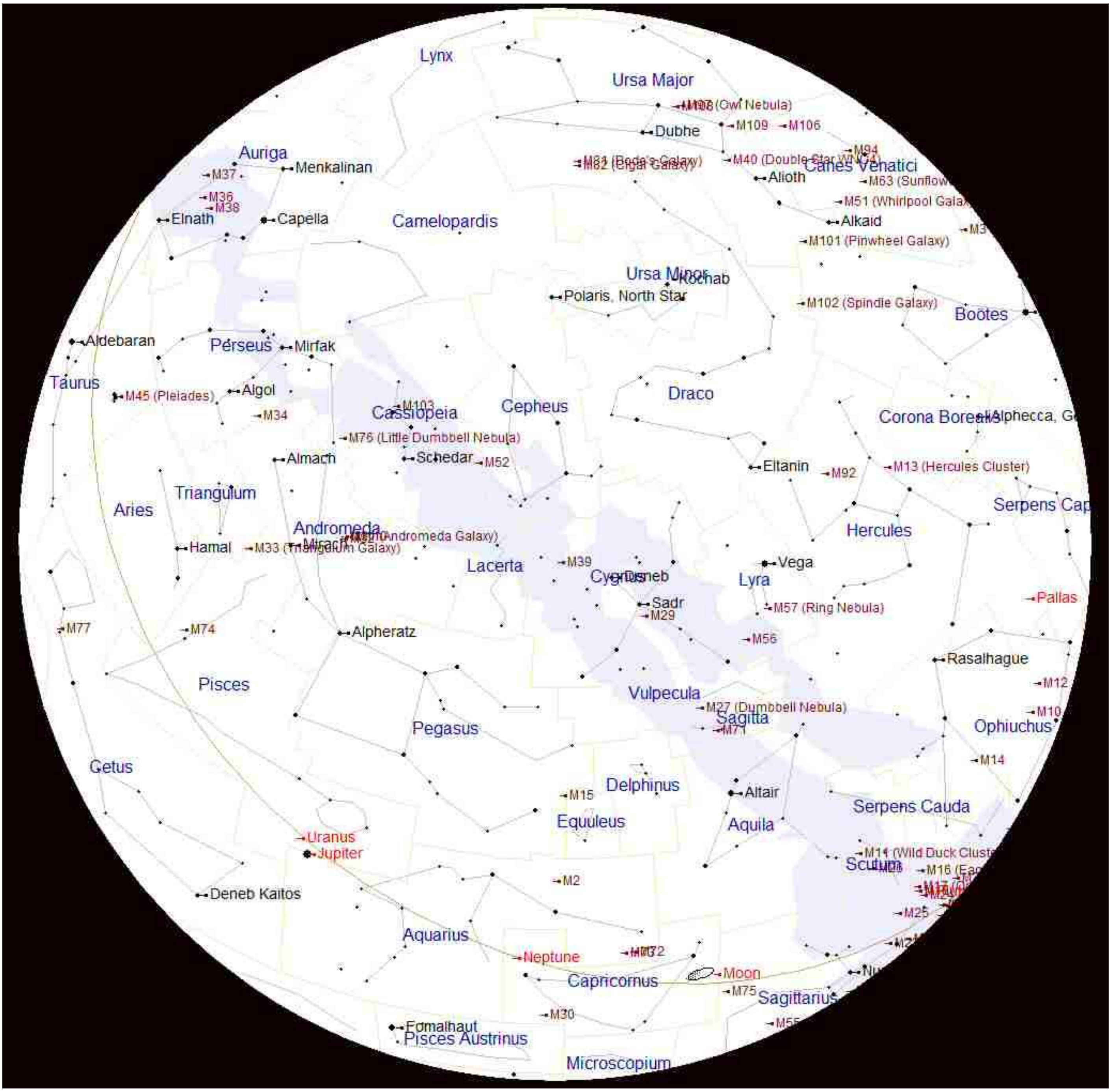
THE MOON The phases of the Moon this month:



Objects on the 'Terminator' (the line between light and dark) are in the best position to observe because they cast long shadows that give relief to the features.

METEORS There is one minor meteor shower this month. It is the Orionids seen between October 15^{th} and 25^{th} and peaking on 21^{st}.

THE SKY THIS MONTH



The chart above shows the night sky as it appears on 1st October at 9 o'clock British Summer Time (BST). As the Earth orbits the Sun and we look out into space each night the stars will appear to have moved across the sky by a small amount. Every month Earth moves one twelfth of its circuit around the Sun, this amounts to 30 degrees each month. There are about 30 days in each month so each night the stars appear to move about 1 degree. The sky will therefore appear the same as shown on the chart above at 8 o'clock BST at the middle of the month and at 7 o'clock BST at the end of the month. Due to the Earth rotating once every 24 hours, the stars also appear to move 15º (360º divided by 24) each hour from east to west.

The centre of the chart will be the position in the sky directly overhead. First we need to find some familiar objects so we can get our bearings. The Pole Star **Polaris** can be easily found by first finding the familiar shape of the Great Bear 'Ursa Major' that is also sometimes called the Plough or even the Big Dipper by the Americans. Ursa Major is visible throughout the year from Britain and is always quite easy to find. This month it is in the north west. Look for the distinctive saucepan shape, four stars forming the bowl and three stars forming the handle. Follow an imaginary line, up from the two stars in the bowl furthest from the handle. These will point the way to Polaris which will be to the north of overhead at about 50º above the northern horizon. Polaris is the only moderately bright star in a fairly empty patch of sky. When you have found Polaris turn completely around and you will be facing south. To use this chart, position yourself looking south and hold the chart above your eyes.

REMEMBER BRITISH SUMMER TIME ENDS ON 31st OCTOBER.