Celestial guided tour

Anglo-Australian Observatory/David Malin Images

When giving a guided tour of the night sky to family and friends I have found the following notes useful. Focussing on one or two brighter examples of the various types of objects seems to maintain interest better than showing many examples of one type of object. My experience has been that for many of my family and 'non-astronomy' friends a session lasting about 20 to 30 minutes is more than sufficient. The following guide may also be of interest to new members. The 'old hands' in the society will no doubt have their own, perhaps better, versions of this.

BY TERRY MOON

The Pleiades

Of the 225,000 stars brighter than about 10th magnitude (as listed in the Henry Draper Catalogue) 20,000 are like our Sun and, it is estimated that, 95% are within 3000 light-years (l.y.) Most of these are of spectral types B, A, F, G, K, M (all but 2000).

STARS

A magnitude difference of 5 is a brightness ratio of 100. An aperture (D) of 100 mm sees down to about magnitude 12. For good optics the resolution = 1.22 λ/D. All stars are that distant from us that they appear as pinpoints of light.

Ten of the 20 brightest stars readily visible in the southern hemisphere are:

Name	Spectral Type	Distance (l.y.)	Absolute Mag.
Sirius	A1 V	8.7	+1.4
Canopus	F0 I-II	98	–3.1
α Centauri, Rigil Kentaurus	G2 V	4.3	+4.4
Rigel	B8 Ia	900	–7.1
Betelguese	M2 Iab	520	–5.6
Achernar	B3 V	118	–2.3
β Centauri , Hadar	B1 III	490	–5.2
Aldebaran	K5 III	68	–0.7
Antares	M1 Ib	520	–5.1
Fomalhaut	A3 V	22.6	+2.0

Except for Alpha (α) Centauri (also known as Rigil Kentaurus) all are bigger and brighter than our Sun.

DOUBLE STARS

Optical doubles are stars not physically connected but just happen to lie on the same line of sight. Binaries are stars that are physically associated. Below is a table of a handful of bright double stars visible from the Southern Hemisphere.

GALACTIC (OPEN) CLUSTERS

These are loose collections of stars generally a few tens of light years in diameter. They may contain from a dozen to over 500 stars spaced about four to six light years apart. Open clusters usually contain younger (called Population I) stars and are found in the spiral arms (plane) of our Milky Way Galaxy. Gravitational perturbations from the rest of the Galaxy slowly disperse the stars in an open cluster.

The **Jewel Box** (NGC 4755) contains about 100 stars. At 7.1 million years old it is one of the youngest known galactic clusters. The fourth brightest star, a M2 red supergiant, appears near the centre of the cluster and stands out owing to its reddish hue.

The **Pleaides** (pictured above), also called the *Seven Sisters* or M45, have been known since antiquity with references to this cluster in the Bible and Homer's *Odyssee*. The Japanese call this cluster 'Subaru', the name and configuration for this cluster having been adopted by a Japanese car maker. It is a young galactic cluster comprising hot, blue stars and is estimated to be about 50 million years old. Unfortunately it is only visible from Adelaide for part of the year. We have, however, our Southern Hemisphere version.

▼ Some double stars visible from the Southern Hemisphere

Name	Double Type	Separation	Spectral Types	Star Magnitudes
α Centauri	Binary	14.1 arcsec.	G2V + K1V	–0.01; 1.33
α Crucis*	Binary	4.4 arcsec.	B0.5IV + B1V	1.58; 2.09
δ^1, δ^2 Gruis	Optical	~ 17 arcmin.	G6-8III & M4.5IIIa	3.97; 4.11
μ^1, μ^2 Gruis	Optical	~ 21 arcmin.	Both G8III	4.79; 5.10
μ^1, μ^2 Scorpii	Optical	~ 7 arcmin.	B1.5V + B6.5V & B2IV	3.08; 3.57
ζ^1, ζ^2 Scorpii	Optical	~ 9 arcmin.	B1Iape & K4III	4.73; 3.62
β Scorpii	Binary	13.6 arcsec.	B1V + B2V	2.62; 4.92
γ Velorum	Binary	41.2 arcsec.	B1IV + WC8 + O7.5e	4.27; 1.78

*Triple star. A third, fainter star is nearby.

The **Southern Pleiades** are also called the 'Theta Carinae cluster' as they include the 3rd magnitude star Theta (θ) Carinae. The cluster is nearly 1° across; that is, about twice the apparent diameter of the Moon.

GLOBULAR CLUSTERS

Globular clusters are spherical concentrations of hundreds of thousands of older (Population II) stars. In contrast to open clusters, globular clusters are found in the Galactic Halo—a spherical volume of space surrounding the galactic core. Most of the known ones lie in a region close to the galactic centre. The density of stars in a globular cluster is about one per cubic light year, sufficient to resist disruption by gravitational perturbations (tidal forces). They may be 10,000 million years, or more, old.

Omega (ω) Centauri (NGC 5139) is the brightest globular cluster in the night sky appearing as a fuzzy star of magnitude 3.7. It is the biggest and most luminous globular cluster in our galaxy containing a million or more stars, has the mass of a small galaxy and is located about 16,000 light years away from us.

47 Tucanae (NGC 104) is a 4th magnitude object. It is 120 light years across, located about 13,400 light years away and approaching us at about 70,000 kph! It has a noticeable central condensation.

NEBULAE

A nebula is a diffuse cloud of gas (mainly hydrogen) and dust (accounts for about 1% of the material). Such material may account for around 10% of the total mass of the galaxy. Emission nebulae are found in close proximity to one or more hot, bright stars, the radiation from these stars causing the nebula to glow with a predominantly red colour. In contrast, the dust in reflection nebula reflects light from nearby stars giving them their characteristic blue colour. Dark nebulae are similar dust clouds but they do not have nearby stars to illuminate them or embedded stars to cause them to shine—they then merely blot out the light from stars behind them! Planetary nebulae can resemble planetary disks, hence their name. They are an expanding shell of gas resulting from the ejection of material by old stars.

Eta (η) Carinae lies some 10,000 light years from us and is one of the most remarkable stars in the sky. Its mass is more than 100 times that of our Sun placing it among the most massive and luminous stars in our galaxy and perhaps the Universe. Its brightness has varied dramatically since it was first catalogued in 1677. In 1843 it outshone all stars except Sirius then faded until, in 1868, it was no longer visible to the naked eye. It has brightened recently and is now just visible to the naked eye. The nebulosity close to the star consists of material ejected from it.

The giant, star-forming diffuse nebula (NGC 3372) surrounding η Carinae is one of the largest H II regions (ionised Hydrogen gas) in our galaxy.

The **Coalsack** is the most prominent dark nebula in the sky being located in Crux between Alpha (α) and Beta (β) Crucis. It appears large to us because it is only 2,000 light years away, and dark because it is situated in a bright part of the Milky Way (and thus obscures the myriad of stars behind it). The Coalsack has a brightness only 10% that of the surrounding Milky Way.

The **Tarantula nebula** (NGC 2070) is situated in the LMC 179,000 light years from us and was first catalogued as a star—30 Doradus. It has also been called the *Great Looped nebula* and *True Lovers' Knot*.

The **Orion Nebula** (M42 and 43) is the brightest diffuse nebula in the sky as is readily visible to the naked eye. M42, the largest part of the nebula, is located some 1,600 light years from us and has a diameter of about 30 light years. The small north eastern part of the nebula is designated M43. The Orion nebula is part of a larger cloud of gas and dust extending over several hundred light years. M42 is a turbulent part of this cloud where new stars are forming. Near the centre of M42 is a group of very young stars known as the Trapezium.

▼ Omega Centauri is one of the finest globular clusters in the sky (left) and the Orion Nebula is easily visible with a binoculars and even the naked eye, even under light-polluted skies (right).

Tony Virgo

Omega Centauri

Tony Virgo

Orion Nebula

GALAXIES

We are located in the **Milky Way** galaxy about ⅔ of the way out from the centre in a spiral arm. We see our galaxy as a hazy band of stars across the night sky with the centre located in Sagittarius.

The **Magellanic Clouds** are diffuse objects that may look like separated pieces of the Milky Way, but they are in fact irregular-shaped galaxies orbiting our own. The Large and Small Magellanic Clouds (LMC and SMC) lie approximately 179,000 and 210,000 light years from us respectively. Next to the Sagittarius dwarf elliptical galaxy (discovered in 1994), they are the closest galaxies to us.

PLANETS

Mercury, Venus, Mars, Jupiter and Saturn are bright objects that can all be readily seen with the naked eye at various times of the year. They may be distinguished from stars as they do not 'twinkle' the common name for scintillation the effects of which are more noticeable for points of light (stars) than small disks (planets).

Mercury is the closest planet to the Sun and hence is only seen just before dawn or just after dusk. A very small, coloured, featureless 'blob' is about all there is to see with a small telescope.

Venus is the brightest object in the sky after the Sun and Moon. It is found in the evening sky after sunset or the morning sky before sunrise. A small telescope will reveal the phases of Venus but there is nothing else of interest to be seen—it appears as a bright, featureless disk owing to the dense cloud that envelopes it.

Mars appears as a small, reddish disk in small telescopes. At its closest approach to Earth some darker patches on its surface may be just visible. To reveal other surface details larger telescopes are needed.

Jupiter is the largest planet in the solar system with a volume more than 1000 times that of the Earth. In a small telescope the darker bands across its disk can be seen along with the four largest moons that were discovered by Galileo in 1610. Because of its fast rotation (about 10 hours to revolve once on its axis compared to 24 hours for the Earth), Jupiter appears flattened at the poles.

Saturn is the second largest planet but is much further from the Sun than Jupiter hence it appears much smaller in telescopes. Despite this, a small telescope will readily show the rings that surround it and its largest moon, Titan.

Uranus is just visible to the naked eye but you have to know where to look! **Neptune** can be found with a small telescope if you know where to look. **Pluto** is far more difficult to see. You need to know where to look and use a larger telescope.

THE MOON

The Moon is our closest celestial neighbour and the second brightest object in our sky. Broad features on its surface can be seen with the naked eye and a small telescope will reveal its rugged surface comprising craters, mountains and plains. The best time to observe the Moon through a small telescope is when it appears as a crescent or 'half moon' as the relative position of the Sun results in features on the Moon casting long shadows and thus highlighting the relief of its surface. At full moon it appears very bright and its features are not highlighted with shadows. ★

REFERENCE

http://www.absoluteastronomy.com/

▶ The Large Magellanic Cloud (LMC) is a satellite galaxy of the Milky Way. This beautiful image, taken by David Malin from the UK Schmidt Telescope in NSW, shows the rich field that would keep any observer busy for hours.

▼ The Tarantula Nebula, one of the Southern Hemisphere's showpieces.

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