The sky

by Ray Forma

Go to the end of this article to find more detailed information about the Star Chart, how to use it and a table of Moon phases. Use this table of phases to help you with the timing of successful astronomy evenings for students. The best time for an astronomy evening is usually six days after New Moon.

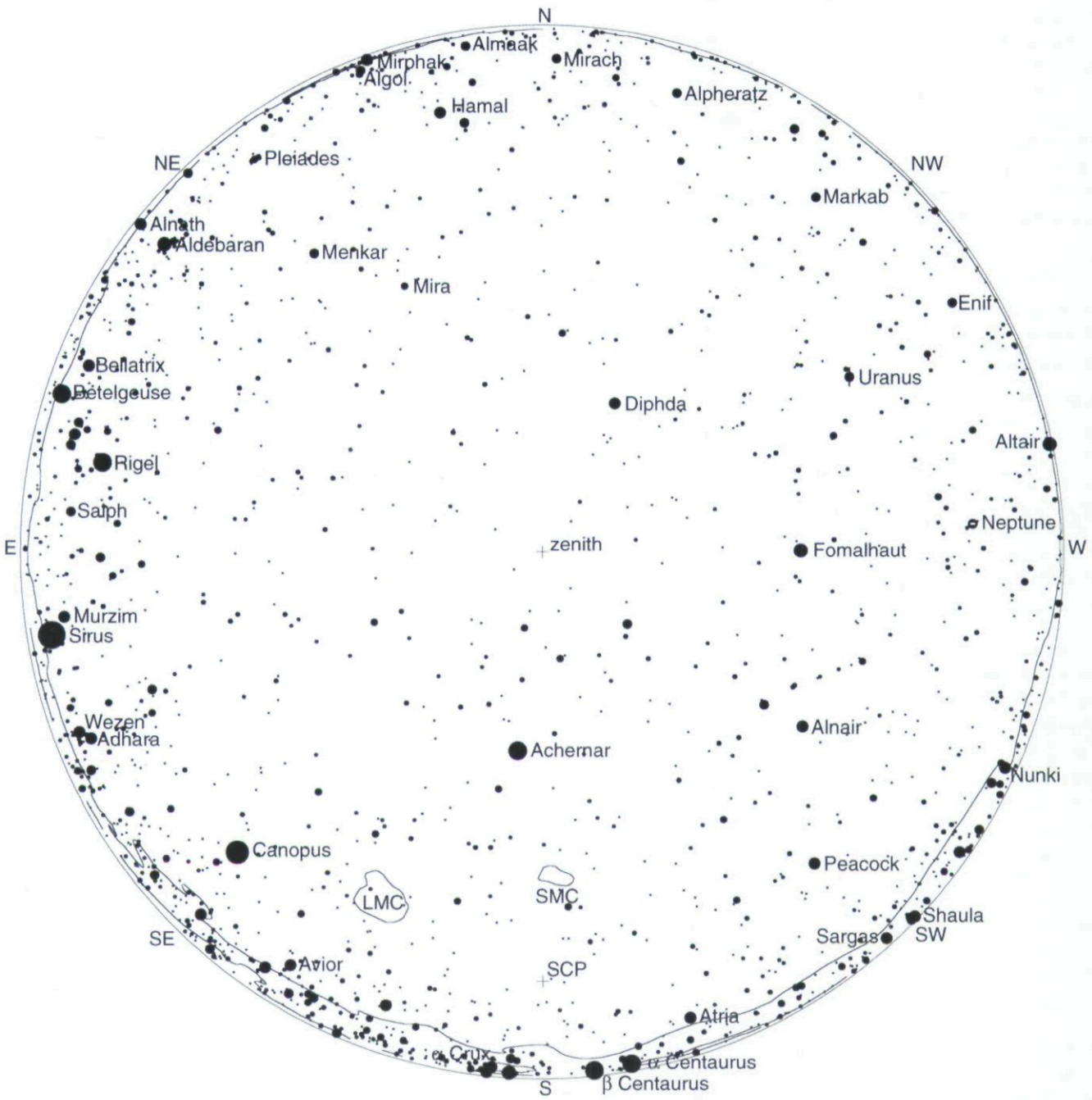

Chart centre: 01h 17.4m –35° 00' Universal time: Nov 20, 2006 10:00 LMT: 08:00 pm Location: 140° 00' E 35° 00' S

Fig 1. *The Star chart*

At this time of the year the weather may be great for being outside, and you may be thinking about finishing the school year with an astronomy evening, but it is at this time of the year that there is not much of immediate interest to view with the naked eye, or with binoculars or a telescope.

The plane of our galaxy, the Milky Way, is fairly well parallel with the horizon. As a result, the Milky Way is effectively not visible. Because we are close to mid-summer, the constellations of the zodiac lie where our winter Sun would be at noon; fairly low in the north. To make matters worse, the visible zodiacal constellations are the most unremarkable ones. They are the miscellaneous collections of stars that make up Capricornus, Aquarius, Pisces, and Aries. In most years, there are one or two interesting planets visible to the naked eye at this time of the year, but not this year. If you have a telescope, and a good idea of where to look, then you should still be able to see Uranus and Neptune in the western sky. Uranus, with a magnitude of 5.8, is in Aquarius, while Neptune, with a magnitude of 7.9 is further west, in Capricornus. Both planets produce very bland images.

In the East, there are some items of interest that will be rising ever earlier over the next few months. There are the constellations of Orion and Taurus, the brightest night-time star, Sirius, α *Canis Majoris*, and the second brightest Canopus, α *Carinae*, and the open Pleiades cluster in Taurus.

Readers who live in the north of Australia may want to try to view the Andromeda Galaxy, the only full-size galaxy that is close enough to be seen with the naked eye if you are in a dark place with a clear sky. It appears quite small to the eye because only the central part is bright enough to be visible, but the full angular diameter of the galaxy is seven times that of the full moon. From Adelaide and Melbourne the Andromeda Galaxy gets to about 12° above the northern horizon at best. From Darwin the galaxy lies up to 34° above the northern horizon. At 8 pm around November 11, the Andromeda Galaxy is due north, and at its greatest elevation.

This galaxy plays an important role in galactic studies, since it is the nearest giant spiral. It is approaching our Sun at about 300 kilometres per second, so it is one of the few blue shifted galaxies. Given the motion of our Solar System inside the Milky Way, the result is that

Figure 2. ***The Andromeda Galaxy, Messier object M31. At the bottom is its dwarf satellite galaxy, M32. In the top right corner is its dwarf elliptical satellite galaxy, M110***

the Andromeda Galaxy and the Milky Way are approaching one another at a speed of 100 to 140 kilometres per second.

The Andromeda Galaxy is about 2.5 million light years distant. Current mass estimates for the Andromeda halo, including dark matter, give a value of approximately 12.3×10^{11} solar masses, compared with 19×10^{11} solar masses for our Milky Way. M31 may be less massive than our own galaxy, but it does contain many more stars than our own galaxy and has a much bigger size. Astronomers estimate that M31 contains 10×10^{12} stars, greatly exceeding the number of stars in our own galaxy.

Like our Milky Way, Andromeda has satellite dwarf galaxies. The best known and most readily observed satellite galaxies are M32 and M110.

Our Milky Way Galaxy also has dwarf satellite galaxies, and the two that are naked eye objects are well visible from dark places at this time of year. These are the two Magellanic Clouds; irregular dwarf galaxies orbiting our Milky Way galaxy.

During summer, the Large Magellanic Cloud, and its neighbour and relative, the Small Magellanic Cloud, are conspicuous objects in the southern sky, looking like small clouds to the naked eye. Roughly 21° apart in the night sky, the true distance between them is roughly 75,000 light-years. Until the discovery of the Sagittarius Dwarf Elliptical Galaxy in 1994, they were the closest known galaxies to our own.

The Large Magellanic Cloud, or LMC, was host galaxy to a supernova in 1987, the brightest observed in over three centuries. The LMC lies at a distance of about 160,000 light years. It has about 1/20 the diameter of our galaxy and 1/10 the number of stars

From a hypothetical planet in the LMC, the Milky Way would be a spectacular sight. Our galaxy's total apparent magnitude would be –2.0, which is 14 times brighter than the LMC appears to us on Earth, and it would span about 36° across the sky, which is the width of over 70 full moons. Furthermore, because of the LMC's high galactic latitude, an observer there would get an oblique view of the entire galaxy, free from the interference of interstellar dust that makes studying in the Milky Way's plane difficult from Earth. The neighbouring SMC would be about magnitude 0.6, substantially brighter than the LMC appears to us.

Figure 3. ***The Small Magellanic Cloud. In the top right corner is NGC104, a magnitude 4 globular cluster that belongs to our galaxy, and is thus much closer***

When I look at these galaxies I am always humbled by the realisation that the light photons that are entering my eye have finally stopped after travelling at the speed of light for 150 000 years or more. When I mention that to others I occasionally get a reply that I am talking rubbish because God made the universe only 6000 years ago. I have found a useful website to which to refer these people: http://www.talkorigins.org/indexcc/list.html#CE. This site tries to make it easy to find rebuttals, and references from the scientific community, to the claims of creationist and creation science adherents.

Periapsis on January 3

In astronomy, an apsis (plural apsides) is the point of greatest or least distance of the elliptical orbit of a celestial body from its center of attraction, which is generally the center of mass of the system.

Astronomers call the point of closest approach the periapsis and the point of farthest excursion is the apoapsis. In the past astronomers combined the name of the more massive of the two bodies to produce several terms with basically the same meaning, such as Perihelion for orbits around the Sun, Perigee for orbits around the Earth, and Periselene for orbits around the Moon. Use of the single term, periapsis, simplifies things considerably.

On January 3, our Earth is at periapsis in its orbit around the Sun. Currently the difference between our closest approach to the Sun, periapsis, and our furthest distance, apoapsis, is only 5.1 million km or 3.4% of the radius of our orbit. This difference in distance results in a 6.8% increase in incoming solar radiation between January 3 and July 4. Perihelion currently occurs around January 3, while aphelion is around July 4. Note that this has some effect on our seasons, but that the tilt of the Earth's axis currently plays a much bigger role in affecting our seasons.

The Earth's orbit is an ellipse. The eccentricity is a measure of the departure of this ellipse from circularity. If the Earth were the only planet orbiting our Sun, the eccentricity of its orbit would not vary over time. However, Earth's eccentricity changes over time, mainly because of interactions with the gravitational fields of Jupiter and Saturn. The Earth's eccentricity changes mainly over a cycle of about 413 000 years. When the orbit is at its most highly elliptical, the amount of solar radiation at periapsis is about 23% greater than at apoapsis. Thus, when the Earth's orbit has greatest eccentricity the effect on our seasons will be significant.

Significant events

December 4 – The earliest sunrise of the year

December 22 – 01:23 UTC. Summer Solstice, the end of a Spring that lasted 89.85 days.

January – Saturn rises ever higher in the eastern sky

January 3 – The Earth is at periapsis.

January 25 – Orion lies due north

How to use the Star Chart

To use the sky chart go outside at the appropriate date and time, and hold the chart, upside-down above your head. Then turn around till the direction marks around the chart's edge are pointing in the correct compass directions. Now the chart should give you a condensed view of the sky that you see beside the chart.

Because no single sky chart will do for all localities in Australia, I have generated one for a position about 100 km east of Adelaide. It shows what the sky should look like at 35° south latitude anywhere in Australia at around 8:00 pm local time on November 20th. If you are situated further north then you may not be able to see those objects in the far south of the chart. Similarly, observers further south may not be able to view the northernmost objects on the chart. Use the chart 4 minutes earlier than 8:00 pm for every day before November 20th, and 4 minutes later for every day after November 20th. TS

About the author:

Ray Forma teaches science at Methodist Ladies College in Claremont, WA.

Table 1. ***Phases of the Moon over the coming year. The times are UTC (Universal Time)***

New Moon	First Quarter	Full Moon	Last Quarter
Oct 22, 2006 05:30	Oct 29, 2006 21:25	Nov 5, 2006 13:00	Nov 12, 2006 17:55
Nov 20, 2006 22:20	Nov 28, 2006 06:30	Dec 5, 2006 00:25	Dec 12, 2006 14:40
Dec 20, 2006 13:50	Dec 27, 2006 14:45	Jan 3, 2007 13:55	Jan 11, 2007 12:50
Jan 19, 2007 03:50	Jan 25, 2007 22:55	Feb 2, 2007 05:45	Feb 10, 2007 09:55
Feb 17, 2007 16:10	Feb 24, 2007 07:50	Mar 3, 2007 23:15	Mar 12, 2007 04:00
Mar 19, 2007 02:50	Mar 25, 2007 18:10	Apr 2, 2007 17:15	Apr 10, 2007 18:15
Apr 17, 2007 11:50	Apr 24, 2007 06:35	May 2, 2007 10:15	May 10, 2007 04:35
May 16, 2007 19:35	May 23, 2007 21:05	Jun 1, 2007 01:10	Jun 8, 2007 11:50
Jun 15, 2007 03:05	Jun 22, 2007 13:15	Jun 30, 2007 13:50	Jul 7, 2007 17:00
Jul 14, 2007 11:50	Jul 22, 2007 06:25	Jul 30, 2007 00:45	Aug 5, 2007 21:25
Aug 12, 2007 22:55	Aug 20, 2007 23:50	Aug 28, 2007 10:30	Sep 4, 2007 02:35
Sep 11, 2007 12:50	Sep 19, 2007 16:45	Sep 26, 2007 19:45	Oct 3, 2007 10:10
Oct 11, 2007 05:20	Oct 19, 2007 08:30	Oct 26, 2007 04:55	Nov 1, 2007 21:30

Enjoy looking up!