

FROM EARTH TO THE UNIVERSE



12 September 2009 – 18 July 2010

From Earth to the Universe is part of the International Year of Astronomy 2009, celebrating 400 years since the Italian scientist Galileo Galilei first used a tiny telescope to observe the night sky. The exhibition showcases a collection of astronomical images that reveal some of the most dramatic views of our Universe and show how the telescope has expanded our understanding of the cosmos. Featuring more than 100 large-scale print and projected images, this exhibition is an immersive experience that will take you and your students on a journey from Earth to the edge of our Universe.

At the start of the exhibition astrophotographer David Malin and Sydney Observatory guide Silvy Choi greet visitors and explain some of the things you will see as you take this journey into deep space. The exhibition is organised into three distinct sections.

1. The Solar System
2. The Milky Way
3. Beyond the Milky Way

Above: Earth by day seen from space. Image based on satellite data, created by Reto Stöckli for the NASA GSFC Earth Observatory.

Curriculum links

The exhibition can be easily integrated into units of work or areas of teaching and learning in the following syllabus areas:

Science and Technology (Years K–6)

Content strand: Earth and its surroundings

- Stage 2 outcome: Identifies some of the features of the Solar System and describes interactions that affect conditions on Earth.
- Stage 3 unit of work: Out in Space – looking at environments beyond Earth

Science (Years 7–10)

Stage 4

- Outcome 4.9: Describes the dynamic structure of Earth and its relationship to other parts of our Solar System and the Universe.
 - 4.9.1 The Newtonian model of the Solar System
 - 4.9.2 Components of the Universe

Stage 5

- Outcome 5.9: Relates the development of the Universe and the dynamic structure of Earth to models, theories and laws and the influence of time.
 - 5.9.1 The Big Bang theory
 - 5.9.3 Components of the Universe

Physics

Stage 6

- Preliminary Course
 - 8.5 The Cosmic Engine
- HSC course
 - 9.2 Space
 - 9.7 Option – Astrophysics

Relevant resources

Your students' learning experience can be further enhanced by combining the visit with other Museum exhibitions, programs, resources or one of our 'space' partners.

'Space' exhibition, level 1

Take your students on a journey of space flight – from the first rocket launch to the daily routine of life in zero gravity. Relevant sections in the exhibition include 'Exploring the Solar System', which looks at some of the amazing images and information collected by different robotic space probes. The *Space* exhibition includes comprehensive teachers notes to support your visit.

Sydney Observatory/IMAX Theatre joint visits

Combine your visit to the Powerhouse Museum with one of our joint visit partners to make it a full day of space exploration. Our space partners include Sydney Observatory located in the Rocks and the IMAX Theatre in Darling Harbour.

'Design a space station' discovery challenge

This educational resource asks students to contribute to the construction of the International Space Station. After your visit to the Museum, students build their own space station back in the classroom. Click on the hyperlink and download your copy. [\[www.powerhousemuseum.com/pdf/education/space_station_discovery_challenge.pdf\]](http://www.powerhousemuseum.com/pdf/education/space_station_discovery_challenge.pdf)

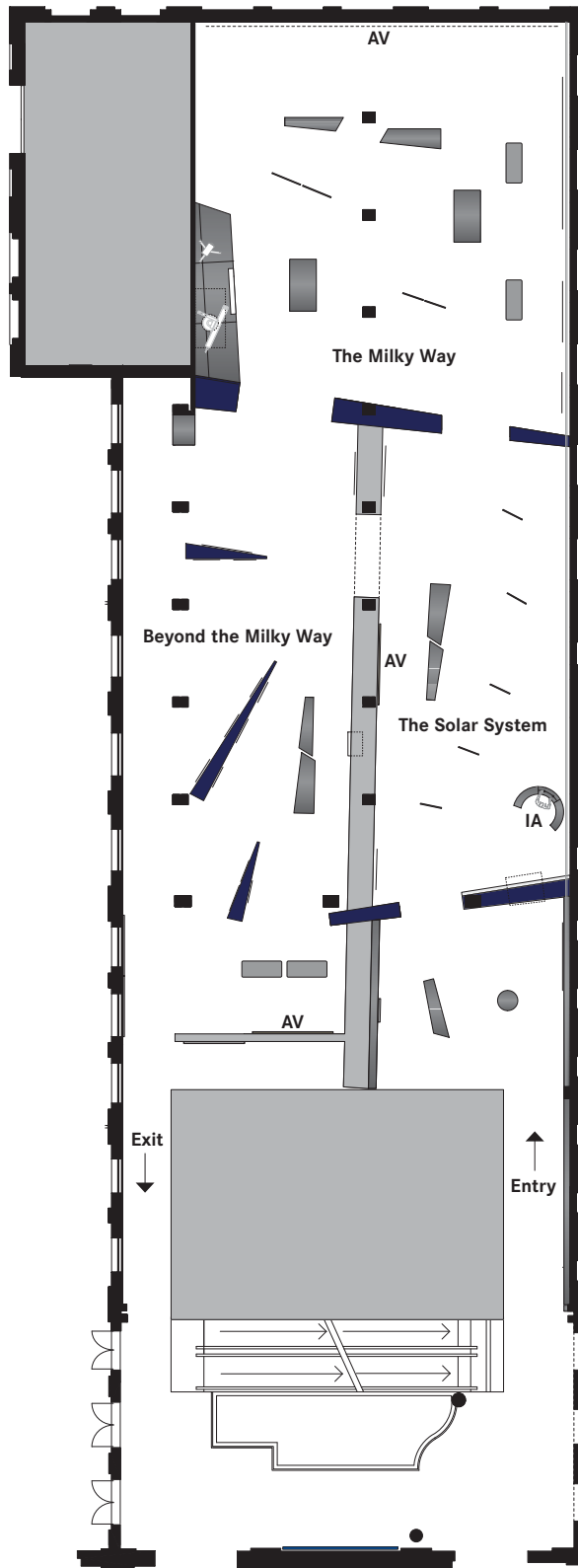
Powerhouse Museum collection database

An interactive database that contains thousands of images and information on the Museum's collection, much of it made public for the first time. [\[www.powerhousemuseum.com/collection/database/\]](http://www.powerhousemuseum.com/collection/database/)

2010 Australian sky guide

Published by Powerhouse Publishing. See page 14 for details.

Floor plan of the exhibition



AV Audiovisual
IA Interactive

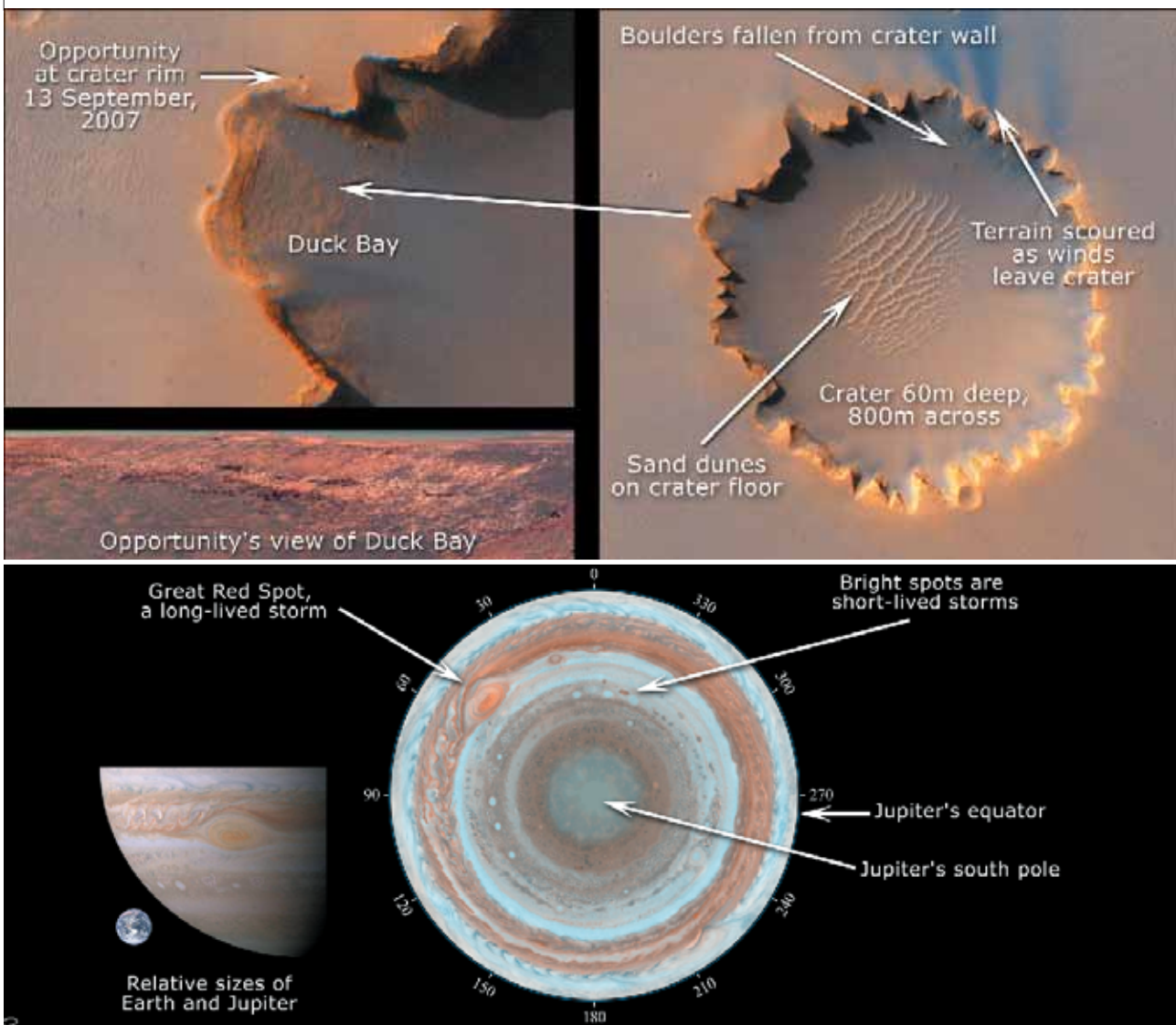
The Solar System

touring the Sun and the planets

As we start our journey through the Universe we take a quick glance at Earth's nearest neighbour, the Moon. The Moon is so close that its light only takes 1.3 seconds to reach Earth. The Sun, our local star, is eight light-minutes away. It creates immense amounts of energy in a nuclear furnace at its core and provides light and heat for Earth and other planets.

There are interesting sights to see on each of the planets. For example, Venus is permanently covered by cloud, but radar has allowed us to map its surface. And in close-up, Saturn's magnificent rings are revealed as countless individual ringlets.

Audiovisual: solar system highlights (about 7 mins).



(Top) Details of Victoria Crater on the surface of Mars. NASA/JPL-Caltech/University of Arizona/Cornell/Ohio State University

(Bottom) Jupiter. NASA/JPL/Space Science Institute

The Milky Way sightseeing in the galaxy

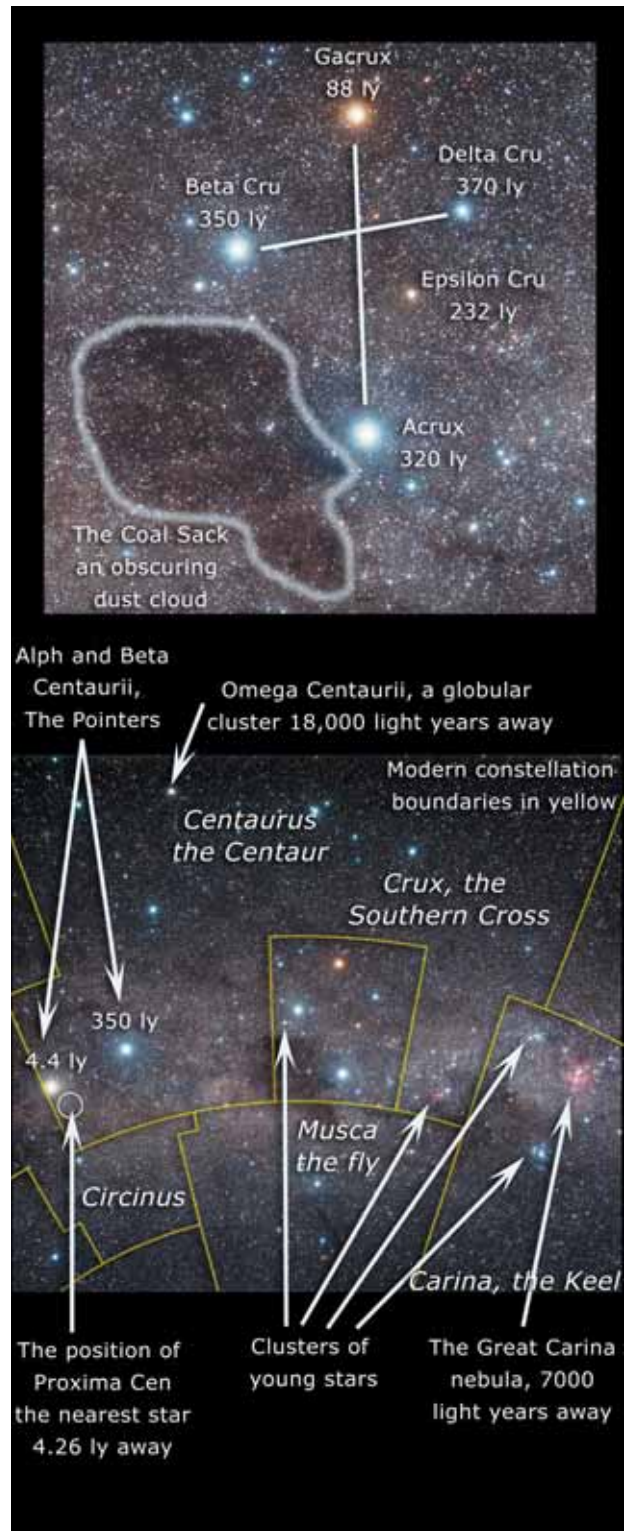
Our galaxy is shaped like a fried egg with a flat disc about 100 000 light years across and a central bulge consisting of old stars. In the very centre is a black hole that has the mass of four million stars like our Sun. Though we cannot see the black hole itself, infrared images reveal stars whirling around it.

As we travel about the galaxy we visit regions where new stars are born as well as the remnants of stars that had died. Low mass stars quietly throw off their outer layers forming planetary nebulae while massive stars explode in bright supernovae.

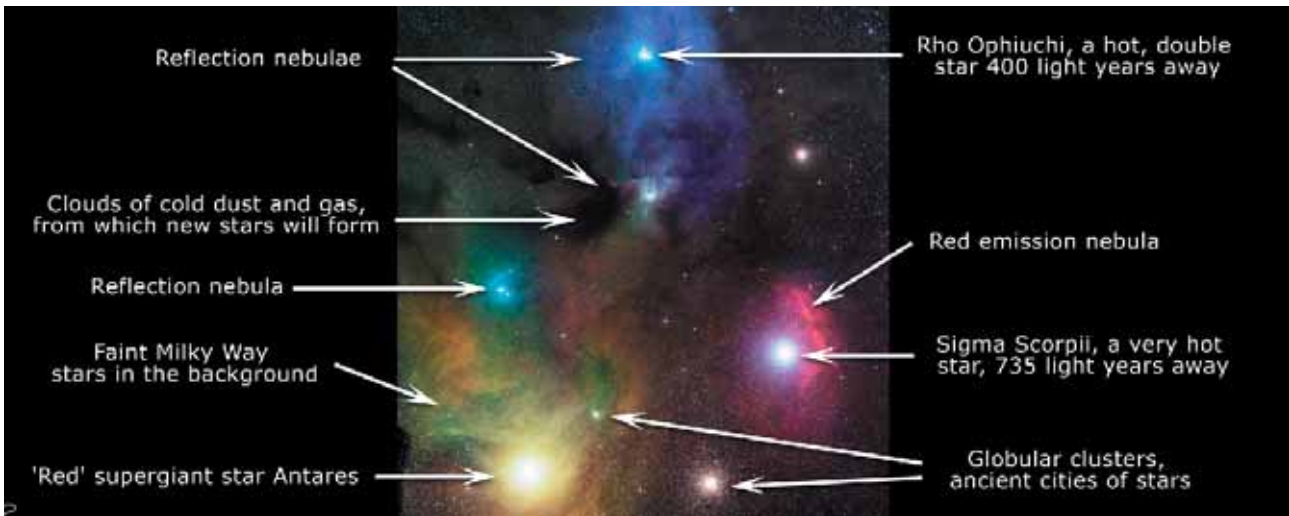
Audiovisual: Milky Way panoramas and celestial highlights (about 9 mins).



The Milky Way. NASA/JPL-Caltech/R Hurt (SSC-Caltech)



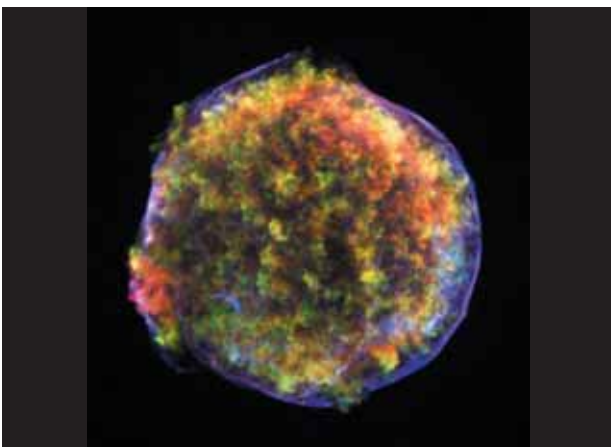
Southern Cross. Akira Fujii/David Malin Images



Stars in the southern part of the Milky Way. Anglo-Australian Observatory/David Malin Images



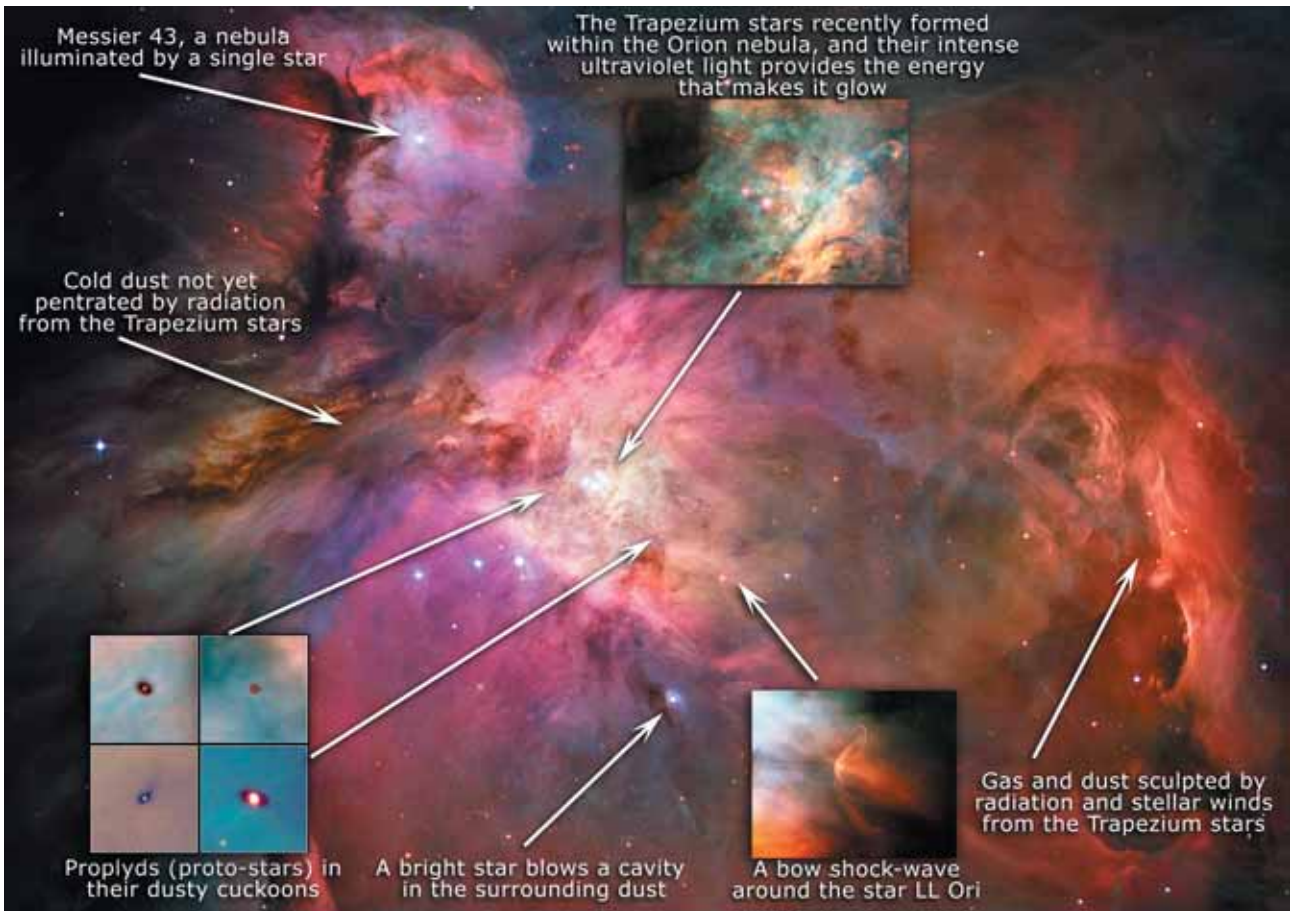
The Horsehead Nebula. European Southern Observatory



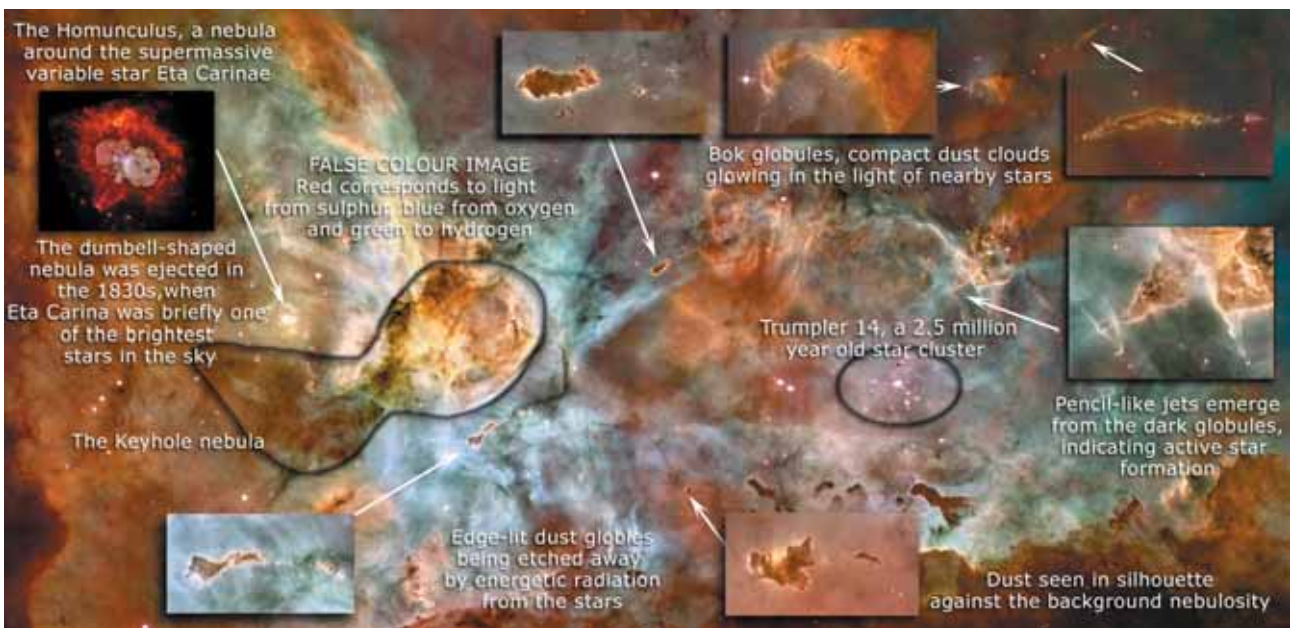
Tycho's Supernova. NASA/Chandra X-ray Observatory/Rutgers/
J Warren & J Hughes et al



The centre of the Milky Way. NASA/JPL-Caltech/S Stolovy
(SSC/Caltech)



The Orion Nebula. NASA, ESA, M Robberto (STScI/ESA), and the Hubble Space Telescope Orion Treasury Project Team



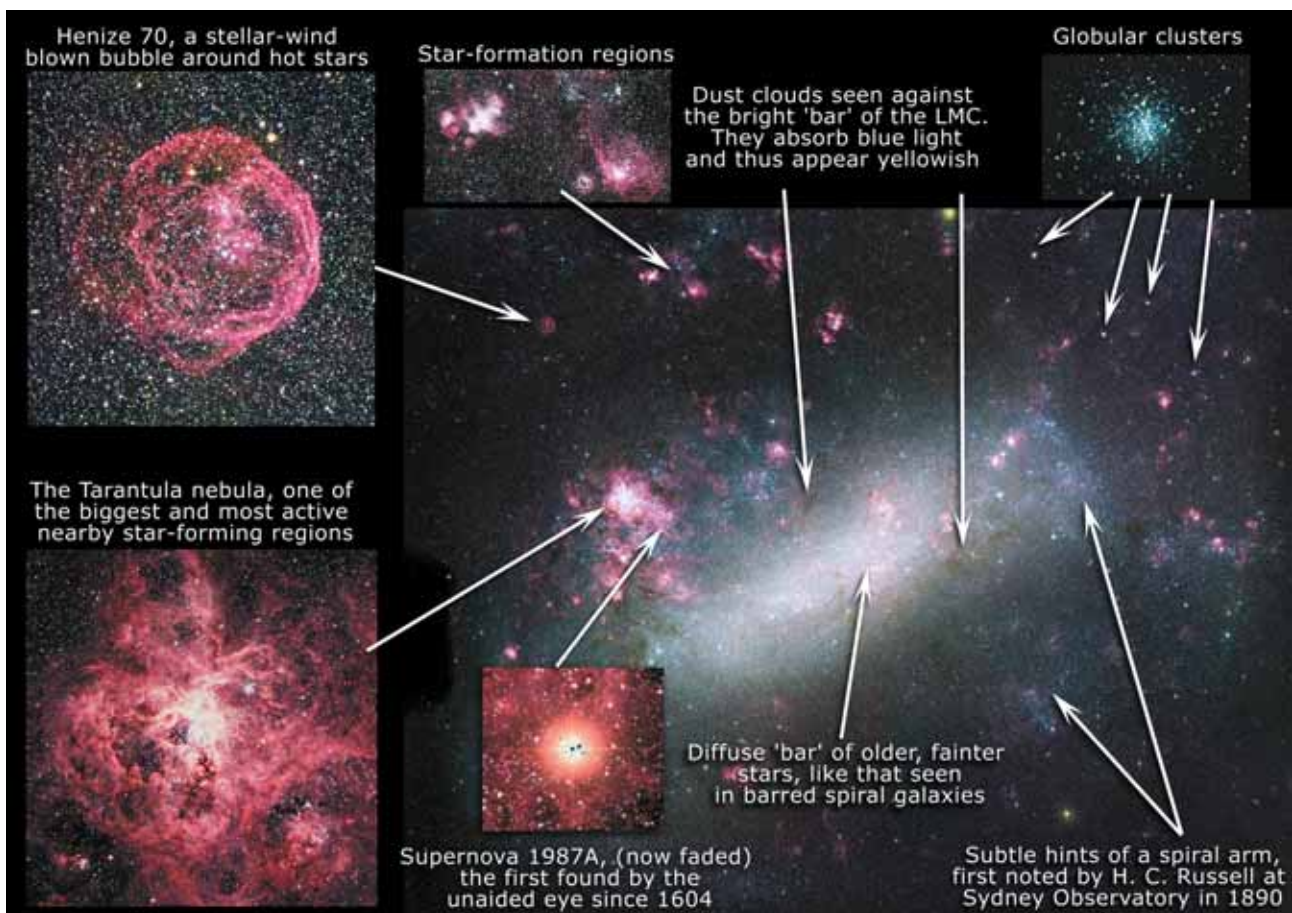
The Eta Carinae Nebula. NASA, ESA, N Smith (University of California, Berkeley) and the Hubble Heritage Team (STScI/AURA)

Beyond the Milky Way the end of the journey

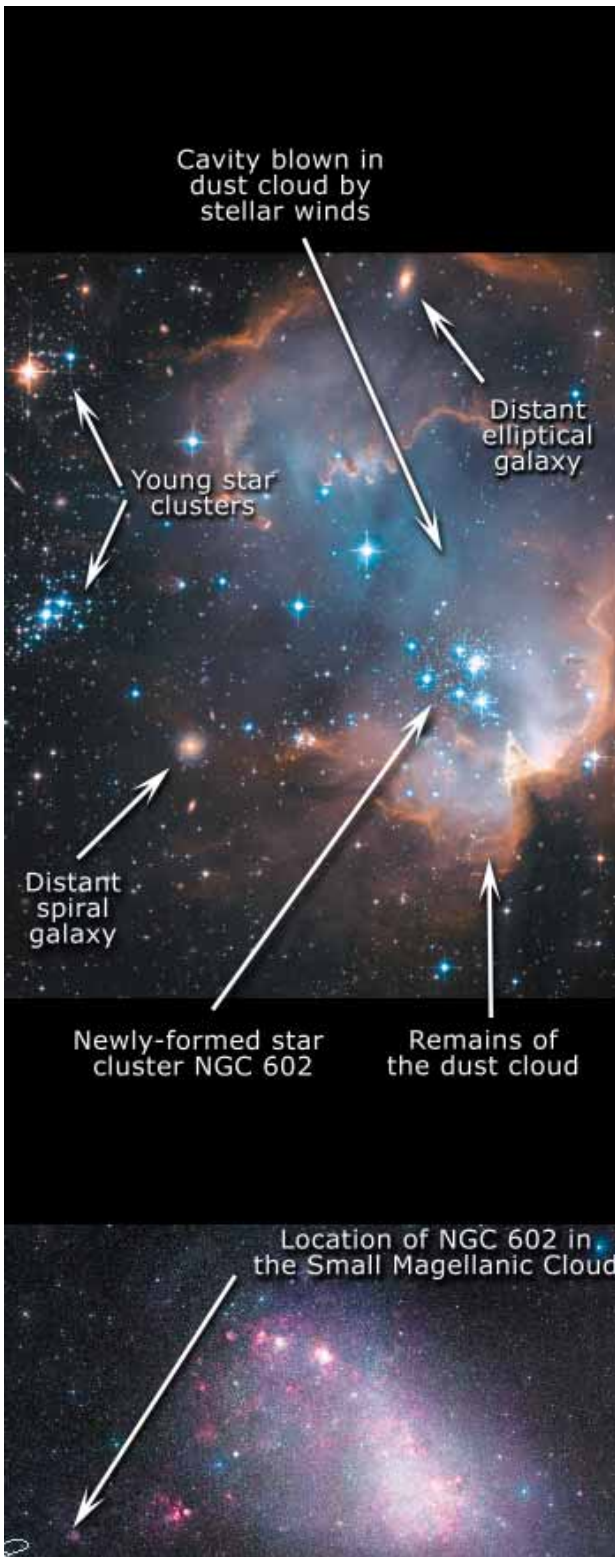
As we leave behind the realm of our galaxy, the Milky Way, we pass by one of our nearest galactic neighbours, the Large Magellanic Cloud at a distance of 160 000 light years from Earth. At a distance of 2.5 million light years, we approach the nearest large galaxy, Andromeda.

Journeying further and travelling faster we see a variety of galaxies flash by. Distances are now truly vast and we are also travelling further and further back in time. Finally, at a distance of 13.7 billion light years, we reach the limits of our view, a time when hot gamma and X-rays filled the Universe.

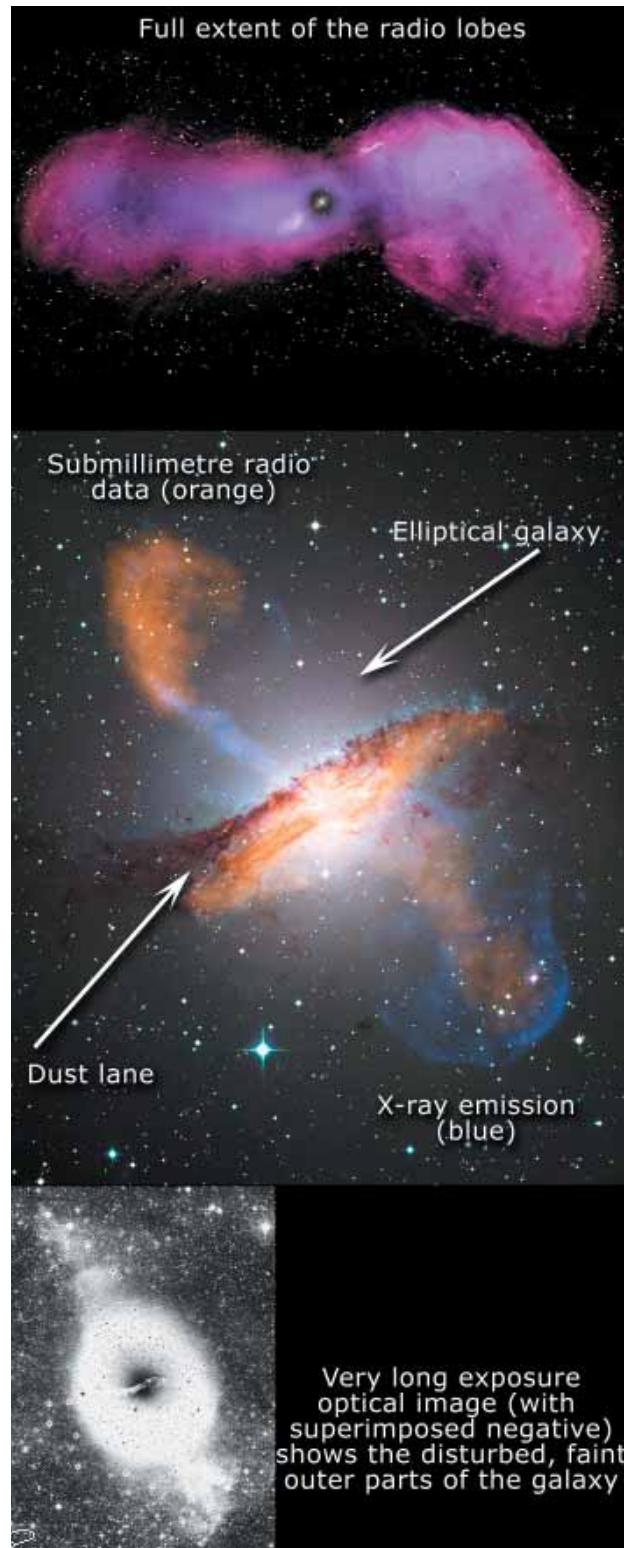
Audiovisual: galaxy highlights (about 7 mins).



Large Magellanic Cloud. Anglo-Australian Observatory/David Malin Images



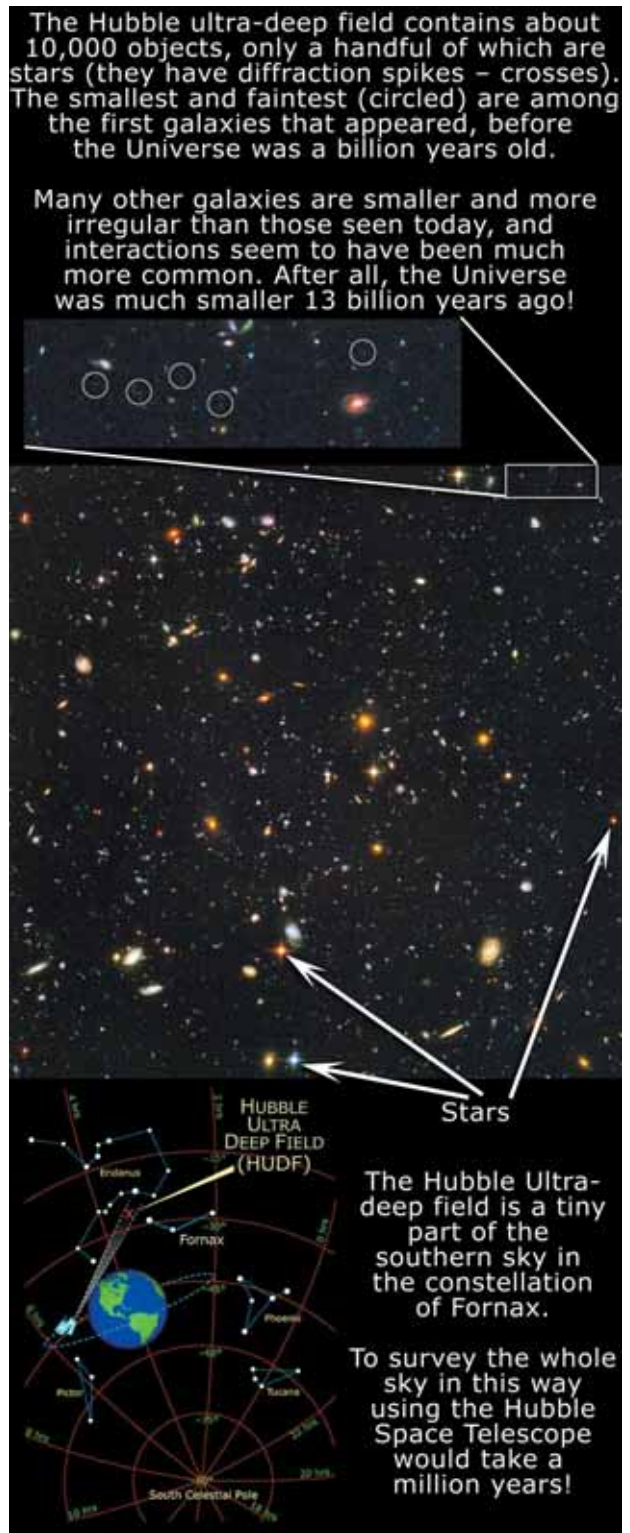
NGC 602. NASA, ESA, and the Hubble Heritage Team (STScI/AURA)



Centaurus A. ESO/WFI (optical); MPIfR/ESO/APEX/A Weiss et al (submillimetre); NASA/CXC/CfA/R Kraft et al (X-ray)



Messier 74. NASA, ESO and the Hubble Heritage (STScI/AURA)



Hubble Ultra Deep Field. NASA, ESA, S Beckwith (STScI) and the HUDF Team

Appendix 1

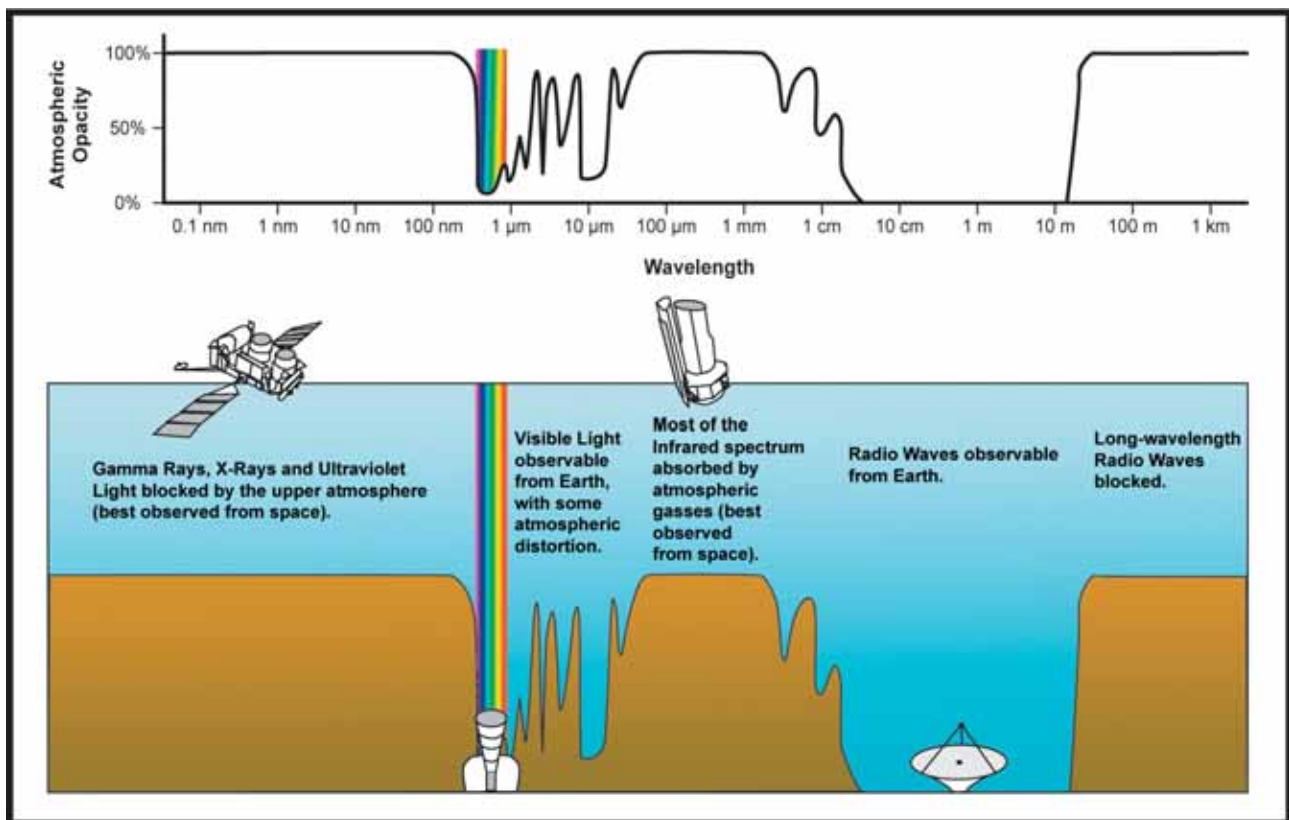
Electromagnetic radiation and the different types of telescopes

The visible light that Galileo observed through his telescope 400 years ago represents only a fraction of the actual spectrum of electromagnetic radiation that we now know radiates across the Universe. Modern telescopes on Earth and in space allow us to detect electromagnetic radiation beyond the kind that we can identify with the human eye.

Electromagnetic radiation is a form of energy which travels through space as waves of electric and magnetic fields. The electromagnetic spectrum (see the illustration below) is the range of all possible wavelengths or frequencies of electromagnetic radiation.

Objects such as planets, asteroids, comets and stars reflect or emit light in a variety of different

wavelengths or frequencies. Visible or optical light (red, orange, yellow, green, blue and violet), which human eyes can see, only represents a small part of the whole electromagnetic spectrum. It is only relatively recently in human history that scientists have been able to explore and study wavelengths beyond the visible light spectrum. The illustration below shows the types of telescopes used in astronomy today, both in space and on the ground. All of these allow views of the sky that Galileo, back in 1609, could never have imagined. Utilising different types of light to examine the cosmos provides us with a more complete understanding of the Universe. Many images in the exhibition were obtained in wavelengths other than the visible.



Some wavelengths can only be observed by telescopes in space. Image courtesy NASA/IPAC

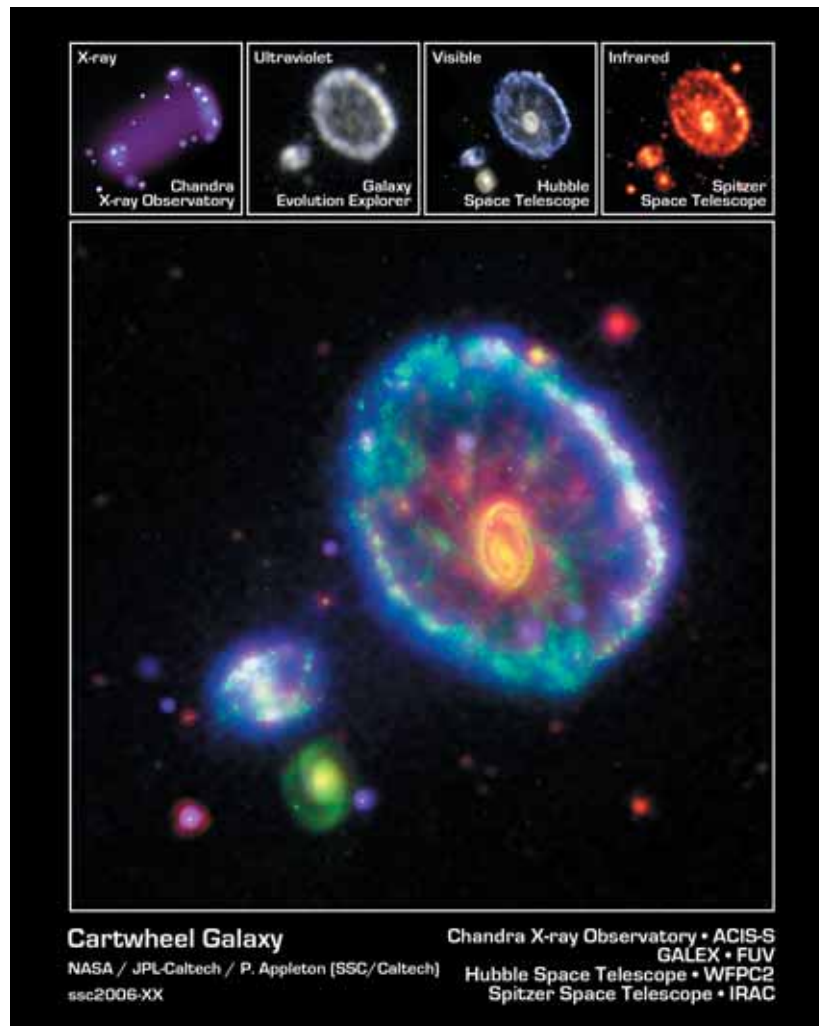
Appendix 2

Interpretation of the images on display in the exhibition

The images in the exhibition have been selected to represent the wide range of telescopes and observations available to modern astronomers. All the images seen here are in colour. In the visible light or optical images, the colours are approximately how you would see them if you were close enough and had eyes sensitive enough to do so.

Different colours are used to represent the radiation that is outside the visible spectrum – radio waves, infrared, ultraviolet, X-rays and

Gamma rays. The colours are assigned for scientific and aesthetic reasons: the ‘reddest’ or longest wavelength light is often represented as red and the ‘bluest’ or shorter wavelength light is often represented as blue. This way it is possible to map the invisible light to produce images that we can see. Some images are taken through special filters that target individual physical processes, such as certain compositions or temperatures, and these are often colour-coded in a way that shows the most information.



The Cartwheel Galaxy shown in X-ray, ultraviolet, visible and infrared wavelengths.

Online resources

1. International Year of Astronomy 2009 – a global effort initiated by the International Astronomical Union and UNESCO [<http://www.iya2009.org/general/>]
2. *From Earth to the Universe* – take a virtual journey across the Universe [<http://www.fromearthtotheUniverse.org/index.php>]
3. Solar System guide, Sydney Observatory – a quick online overview of our Solar System [http://www.sydneyobservatory.com.au/astromy/solar_system_guide.asp]
4. Sydney Observatory news and blog, Sydney Observatory – find out about the latest news and astronomy views from the Sydney Observatory team [<http://www.sydneyobservatory.com.au/blog/>]
5. Monthly sky guides, Sydney Observatory – learn about the stars, constellations and planets visible in the evening night sky from Sydney, with monthly star charts [<http://www.sydneyobservatory.com.au/blog/?cat=10>]
6. The Anglo-Australian Observatory – astronomical and astrophysical links and images [<http://www.aao.gov.au/about/abouttheaao.html>]
7. *Astronomy: Science without limits* – A K–12 resource book of ideas for teachers by the Australian Science Teachers Association [http://www.asta.edu.au/nscwk/2009_asta_national_science_wee_2] and [<http://www.asta.edu.au/>]
8. Window to the Universe: The Square Kilometre Array – developed as part of the Questacon-Scitech SKA Education project for years 9–10 [http://www.asta.edu.au/resources/windows_to_the_Universe]
9. Space-Based Astronomy Educator Guide, NASA – with units of study that include science demonstrations, lesson plans and student sheets on Earth’s atmosphere, the electromagnetic spectrum and telescopes [<http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Space.Based.Astronomy.html>]
10. Explore Space and Astronomy, ABC – with news, quizzes, games and images on space and astronomy [<http://www.abc.net.au/science/topics/?topic=space>]
11. Science & Nature: Space, BBC – with general information and news on space and astronomy [<http://www.bbc.co.uk/science/space/>]
12. Google Sky – view the sky and explore the Universe online [<http://www.google.com/sky/about.html>]

Please note: the websites referred to in these notes were available and suitable at the time of publication. We advise teachers to check sites before recommending them to students.



2010 Australian sky guide

by Dr Nick Lomb

The celestial equivalent of a street directory!

Compact, easy to use and reliable, this popular guide contains everything you need to know about the southern night sky with monthly star maps, diagrams and details of all the year's exciting celestial events.

Wherever you are in Australia, easy calculations allow you to determine when the Sun, Moon and planets will rise and set throughout the year. Also included is information on the latest astronomical findings from space probes and telescopes around the world.

Published annually by the Powerhouse Museum, the *Australian sky guide* is recommended for photographers, event planners, sports organisers, teachers, students – and anyone who looks up at the stars and wants to know more.

RRP \$16.95, ISBN 978-1-86317-127-4. Available November 2009 from the Powerhouse Museum, Sydney Observatory and good bookstores. Or Powerhouse Publishing online ordering www.powerhousemuseum.com/publications.

MAJOR EXHIBITION PARTNER



EXHIBITION SUPPORTER



For more information on the exhibition
***From Earth to the Universe*, visit the Powerhouse**
Museum's website [www.powerhousemuseum.com/](http://www.powerhousemuseum.com/exhibitions/earth_to_universe.asp)
[exhibitions/earth_to_universe.asp](http://www.powerhousemuseum.com/exhibitions/earth_to_universe.asp)

For more information about education support or your booking, contact Bookings at the Powerhouse Museum:
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