AMAZING MOBILES

SPACE

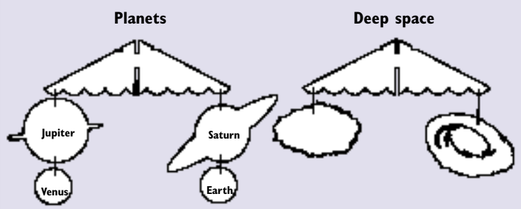
How to make your mobiles

You will need some thread to hang your mobiles.

1 You will find the mobiles inside this book attached to pages 6 and 7, and pages 10 and 11. Carefully detach the mobile pages along the perforated edges.

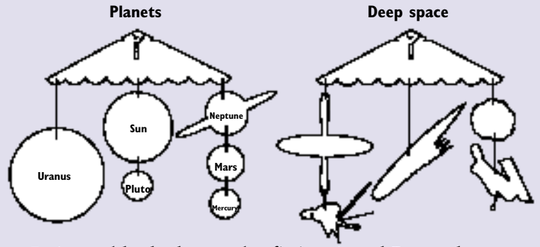
2 Press out all the mobile illustrations, except the pieces marked A, B, C and D. Cut small lengths of thread. Tie the thread to the mobile pieces by pushing the ends into the slits and winding them round at least three times.

3 Press out one part of the hanger, marked A. Following the positions shown in the diagrams, assemble the mobile pieces and tie them to A.



You can make the threads that link the mobile pieces as long as you like.

4 Now do the same with the second part of the hanger, marked B. Tie a thread to the top of B.



5 Assemble the hanger by fitting A and B together. Following this diagram, slide A into B through the diagonal slit in B.

6 Press out the ring marked C. Pass the thread from the top of B through the centre of it. Press C onto the top of the hanger until the four points of the X-shaped hole fit into notches cut in the hanger.

7 Press out the hook marked D and attach it to the thread from the top of the hanger. You can use the hook to hang up your mobile.

Empire of the Sun

THIS IS A DIAGRAM of our Solar SystemAt the centre lies the Sun, our local star. Circling round it are nine planets, including our own planet, Earth. Their paths, or orbits, are shown in different colours. The Solar System also includes moons, asteroids, comets and large amounts of gas and dust.

Pluto

Jupiter

Voyager 1 space probe

Galileo space probe

Pioneer 10 space probe

Earth

Venus

Sun

Mercury

Mars

Saturn

Asteroids

Uranus

Voyager 2 space probe

Neptune

Orbit of Halley's Comet

The planets

The planetsall orbit the Sun in the same direction, and in almost circular paths. Pluto has an orbit more oval in shape. Part of its journey takes it inside Neptune's orbit.

Space probes

We have found out a great deal about the Solar System from space probes.These unmanned spacecraft have flown close by planets and sent us back pictures of them.

The Sun

Like all stars, the Sun is a slowly spinning ball of hot gas. Life on Earth could not exist without it. The Sun is so huge, nearly 1,400,000 Earths could fit inside it!

Comets

Comets, balls of dust and ice, orbit the Sun along stretched-out oval paths. Halley's Comet passes by Earth every 76 years. Its tail always points away from the Sun.

The Moon

THE MOON is neither a star nor a planet. It is a ball of rock that travels round our planet Earth. It takes about 27 days to complete a circle. The Moon is the brightest object we can see in the night sky, although the light it 'shines' is reflected from the Sun.

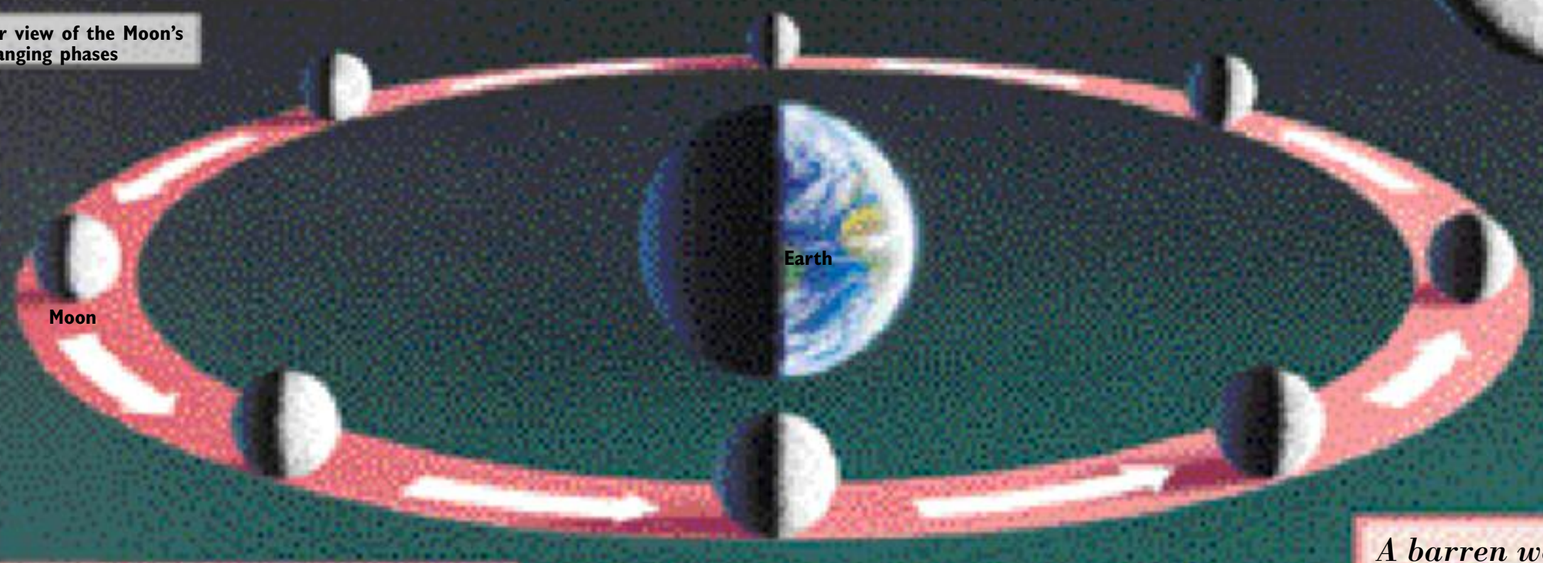
The Moon seems to change shape from one night to the next. This happens because as it travels round Earth, it spins only once, so the same face remains pointed towards us at all times. It is our view of the sunlit part that changes. When the face pointed towards us is turned away from the Sun, we cannot see the Moon at all: a New Moon (1) When it is turned towards the Sun, we can see a complete disc which we call a Full Moon (5) In between, it passes through crescent (2) quarter (3)and gibbous (4)

Our view of the Moon's changing phases

Next total lunar eclipses:
16 Sept 1997 Visible from Australia, Africa, Europe
21 Jan 2000 Visible from Asia, North America, Europe

Next total solar eclipses:
26 Feb 1998 Visible from Hawaii, America, West Africa
11 Aug 1999 Visible from Greenland, Europe, Middle East

MOON *Diameter*
3476 km • *Average distance from Earth*
384,600 km • *Surface temperature*
-155°C to -105°C



Disappearing tricks

Sometimes, the Moon blots out our view of the Sun completely, an event called a solar eclipse (seen in this sequence 1-3, right). On other occasions, when Earth lies directly between the Sun and the Moon, Earth casts its shadow on the Moon. This is called a lunar eclipse(left) The Moon turns a rosy colour.

A barren world

The Moon is much smaller than our planet and, unlike ours, a barren world. There is no air or water, so no plants or animals can live there. Its surface is pitted with craters. These have been blasted out by pieces of rock, called meteorites, crashing down from space. On a clear night, using a pair of binoculars, you can see the 'splash' marks surrounding several craters.

The Moon also has mountains and dark plains which early astronomers once thought were seas. They are still called by the Latin name for sea, mare.

Planets mobile

MERCURY ***Diameter*** **4880 km • *Day* 58.6 days • *Year* 88 days • *Average distance from Sun* 58 million km • Nearest to the Sun • No moons**

Fry or freeze

Mercury is the nearest planet to the Sun. You might think it would be the hottest planet, and where it faces the Sun temperatures do soar above 400°C. But at night, temperatures plunge to -180°C.

VENUS ***Diameter*** **12,109 km • *Day* 243 days • *Year* 225 days • *Average distance from Sun* 108 million km • 2nd from the Sun • No moons**

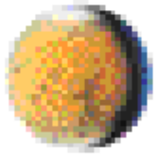
Planet from hell

Venus is the hottest planet in the Solar System and probably the nastiest. Its dense atmosphere keeps the heat in. If anyone were unlucky enough to land on Venus, he or she would be burnt to a cinder, crushed by the air pressure and suffocated by carbon dioxide—all at the same time!

EARTH ***Diameter*** **12,761 km • *Day* 24 hours • *Year* 365.26 days • *Average distance from Sun* 149.7 million km • 3rd from the Sun • 1 moon**

Our home in space

Earth, our home planet, has exactly the right temperature to support life. There is also liquid water and an atmosphere—a blanket of gas that surrounds the globe—to keep out the Sun's harmful rays but keep in some of the warmth. Earth has several layers inside: a thin, hard crust, a thick semi-solid mantle and a hot ball of solid iron at its core.



MARS ***Diameter*** **6797 km • *Day* 24.6 hours • *Year* 687 days • *Average distance from Sun* 228 million km • 4th from the Sun • 2 moons**

Alive or dead?

Mars, the red planet, is the only other planet in the Solar System where life could possibly be. Dry riverbeds on its surface show that water once flowed on Mars. Daytime temperature at the Martian equator may sometimes reach a warm 20°C (although average temperatures are a lot colder than on Earth). But if life ever existed on this planet, it probably doesn't now. Mars is a barren landscape of plains, canyons and immense extinct volcanoes. One, Olympus Mons, is the highest mountain in the Solar System. It is nearly three times as high as Mount Everest.

JUPITER ***Diameter*** **142,960 km • *Day* 9.8 hours • *Year* 11.8 years • *Average distance from the Sun* 779 million km • 5th from the Sun • 16 moons**

Swirling clouds

Jupiter is the largest of all the planets. In fact, it is big enough to contain all the other planets put together. With its colourful patterns of red, gold and white, Jupiter looks like a giant marble. But its 'surface' is not solid at all: those swirling patterns are clouds in its atmosphere. The Great Red Spot is a giant storm that has been raging for at least 300 years. Only Jupiter's core (probably twice the size of Earth itself) is solid rock.

SATURN ***Diameter*** **120,514 km • *Day* 10.2 hours • *Year* 29.5 years • *Average distance from Sun* 1427 million km • 6th from the Sun • 18 moons**

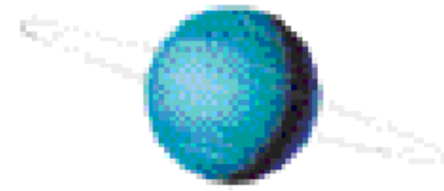
Magnificent rings

Saturn, the second largest planet, is famous for its rings. Jupiter, Neptune and Uranus all have faint rings, but Saturn's are broad and magnificent. There are thousands of rings. Each is made up of billions of blocks of ice and rock, the largest about the size of a house. Like the other giant planets, Saturn is made mostly of gas.

URANUS ***Diameter*** **51,166 km • *Day* 17.2 hours • *Year* 84 years • *Average distance from Sun* 2869 million km • 7th from the Sun • 15 moons**

Side spin

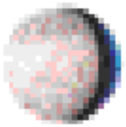
Uranus is a pure, pale blue-green ball. Unlike all the other planets, it spins on its side, so that each of its poles, in turn, faces the Sun. This means that, over the 84 years Uranus takes to travel around the Sun, each pole has 42 years of sunlight followed by 42 years of darkness. Uranus has 11 very faint rings, each only a few kilometres wide.



NEPTUNE ***Diameter*** **49,557 km • *Day* 16.1 hours • *Year* 164.8 years • *Average distance from Sun* 4496 million km • 8th from the Sun • 8 moons**

Fierce winds

Neptune is quite similar to Uranus in size. Sometimes, its blue globe is streaked by white, wispy clouds. Winds whip round at up to 2000 km/h.



PLUTO ***Diameter*** **2300 km • *Day* 6.4 days • *Year* 248 years • *Average distance from Sun* 5900 million km • 9th from the Sun • 1 moon**

Cold and lonely

Pluto is the outermost planet. It is also the coldest and smallest. Pluto does have a close companion, however: its moon, Charon.

SUN ***Diameter*** **1,400,000 km • *Rotation period at equator* 25 days • *Surface temperature* 5500°C**

Our local star

The Sun, our local star, is much bigger in relation to the planets than these illustrations show. Its diameter is nearly ten times that of Jupiter. The Sun is a hot, spinning ball of gas with temperatures at its centre of 14 million °C. Its surface bubbles and spits like water in a boiling kettle. Now and again, great flares and loops burst from it into space.

Worlds of ice and rock

ALL THE PLANETS of the Solar System, except for Mercury and Venus, have moons. Even tiny Pluto has a moon, Charon. Saturn has 18 of them, Jupiter 16, including four 'giants': Ganymede, Callisto, and Europa. The largest of Jupiter's moons, Ganymede, is larger than both Mercury and Pluto.

Some of the moons would be fascinating places to visit. Triton, a moon of Neptune, is the coldest place in all the Solar System. It has pink ice. Io looks like a pizza, but is covered with dozens of erupting volcanoes. Miranda, a moon of Uranus, looks as if it has been smashed to pieces, then put back together again in a different way. Saturn's moon, Mimas has a giant crater, while Europa is a smooth ball marked with mysterious lines. Just possibly, there may be liquid water beneath Europa's icy

Triton

Comet

Europa

Miranda

Mimas

Callisto

Ganymede

Io

Asteroids

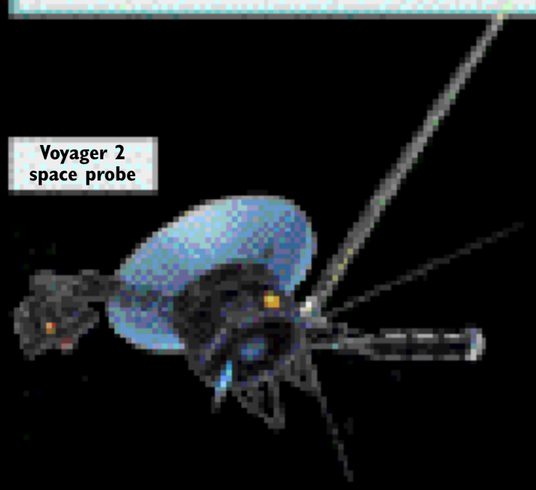
Dirty snowballs

Comets are really large 'dirty snowballs' made of ice and dust. Sometimes we may be lucky enough to see them in our night skies. They have long 'tails' made of gas and dust swept back by the Sun's rays. Some of the tiny fragments that escape from comets frequently come near Earth. Known as meteors, or shooting stars, they appear as split-second streaks of light in the night sky.

Rock fragments

Lying between Mars and Jupiter is a belt made up of tens of thousands of pieces of rock. Some are a few hundred kilometres in diameter, but most are tiny. They are called asteroids. Sometimes they collide with one another, sending fragments out in all directions. Some of these fragments may come near Earth, and can fall through the air onto the ground or into the sea. They are called meteorites.

Deep space mobile



Voyager 2 space probe

The greatest voyage

It would take years for a spacecraft to travel to the giant planets like Jupiter and Saturn. For people, such a mission would be a long and dangerous journey. So a number of unmanned space probes have been launched to explore more distant parts of the Solar System. The first was Pioneer 10, which left for Jupiter in 1972.

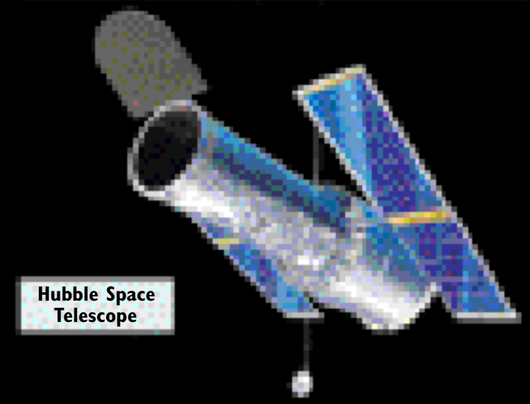
The greatest journey by a space probe was undertaken by Voyager 2. Between 1979 and 1989 it flew close by Jupiter, Saturn, Uranus and Neptune, sending back amazingly clear pictures of those planets and their moons.

Both Pioneer and Voyager probes are heading out of the Solar System, although scientists can still remain in contact with them. In case aliens should one day come across them, these probes carry messages from Earth. Pioneer 10 has an engraved plaque with pictures of humans on it, and a diagram showing Earth's position in the Solar System. Voyager 2 carries an audiovisual disc featuring 'Sounds of Earth', which includes sounds of whales, a baby crying and greetings

Milky Way Galaxy

Clustered in space

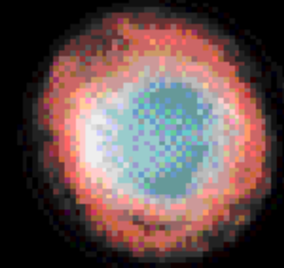
The Milky Way Galaxy (see page 14) is a vast, spiral-shaped collection of billions of stars, including our Sun and its family of planets. It is quite similar in shape and size to another galaxy just visible in the constellation of Andromeda. Both are accompanied by several smaller galaxies oval or irregular in



Hubble Space Telescope

Space telescope

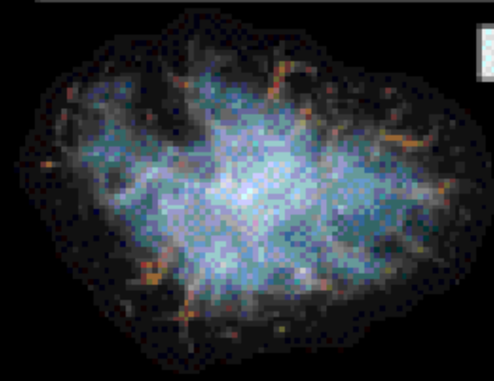
The Hubble Space Telescope is a kind of satellite, travelling round Earth. Scientists can point it towards any part of space and receive clear pictures of distant stars that are far better than any taken from Earth. This is because Earth-based telescopes have heat, cloud and other disturbances in the atmosphere to contend with. The Hubble is so powerful it could detect light from a tiny torch 400,000 kilometres away!



Helix nebula *(a planetary nebula)*

Glowing ring

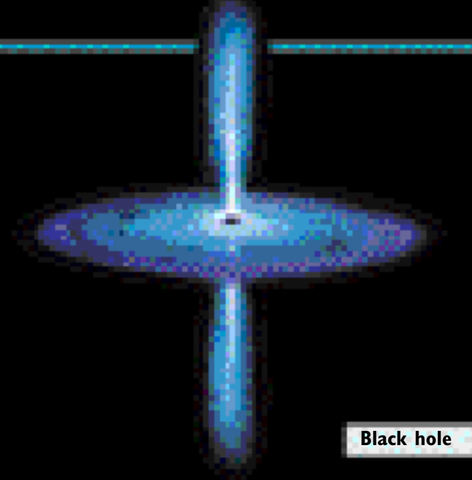
When the Sun runs out of fuel, it will swell up to become a red giant, perhaps a hundred times its present size. Eventually the outer layers will flake away into space. All that will be left of the Sun is a luminous ring of glowing gas, called a planetary nebula by astronomers, and a tiny core, known as a white dwarf. But don't worry—it won't happen for another five billion years!



Crab nebula

Massive explosion

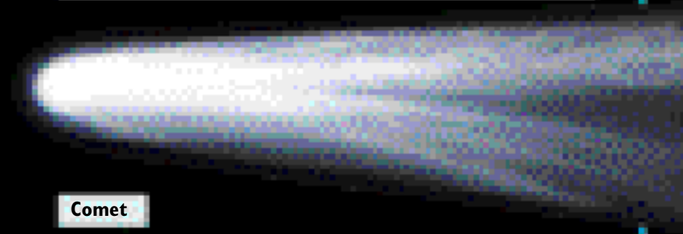
Stars much more massive than the Sun will end their days somewhat sooner, perhaps lasting 'only' 10 million years. But they will go out with a bigger bang! Having swollen to become a red supergiant (like Betelgeuse in the constellation of Orion), the massive star is blasted apart in a colossal explosion, called a supernova by astronomers. The Crab nebula in the constellation of Taurus is the remains of a supernova that was seen about 950 years ago by Chinese skywatchers. This gas and dust cloud is still expanding.



Black hole

Nothing can escape

After a supernova, the old star's core may be so dense that it collapses in on itself. The core may shrink to a tiny point, surrounded by a region of space where gravity is so strong that nothing, not even light, can escape from it. Scientists call these places black holes. A black hole may also form in the centre of a galaxy. In some galaxies, they are the scene of violent activity as stars and gas clouds are sucked into them. The incredible energy blasts huge jets of gas out into space.



Comet

Icy wanderers

Comets are lumps of ice and rock measuring only a few kilometres across, but with tails of gas and dust stretching for hundreds of millions of kilometres into space (see page 8). We know that comets travel round the Sun, sometimes with very long, oval-shaped orbits, but nobody knows where they came from originally. Some astronomers believe there is a gigantic cloud of such small icy bodies surrounding the Solar System deep

Legends in the skies

PEOPLE have always been fascinated by the stars of the night sky. Many years ago, astronomers grouped the stars together into patterns, imagining their shapes to look like people and animals from popular legends. Orion the hunter, for example, is an easy constellation to spot. Three stars almost in a row make up his belt, while others trace the pattern of his dagger and shield. Following at his heels is Canis Major (the Great Dog) which includes Sirius or the 'Dog Star', the brightest star in the night sky. These two constellations can be seen from both northern and southern hemispheres.

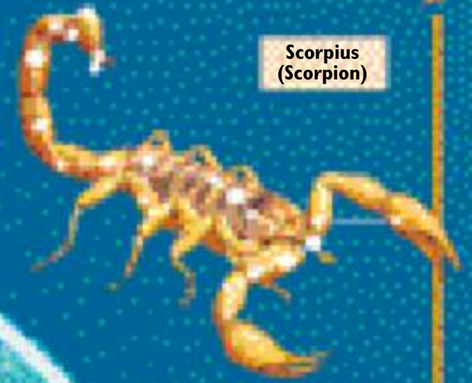
The pattern of constellations can help us to find and name stars. For example, the two end stars in Ursa Major(the Great Bear), Merak and Dubhe, point to Polaris, the Pole Star, almost exactly due north.

Andromeda

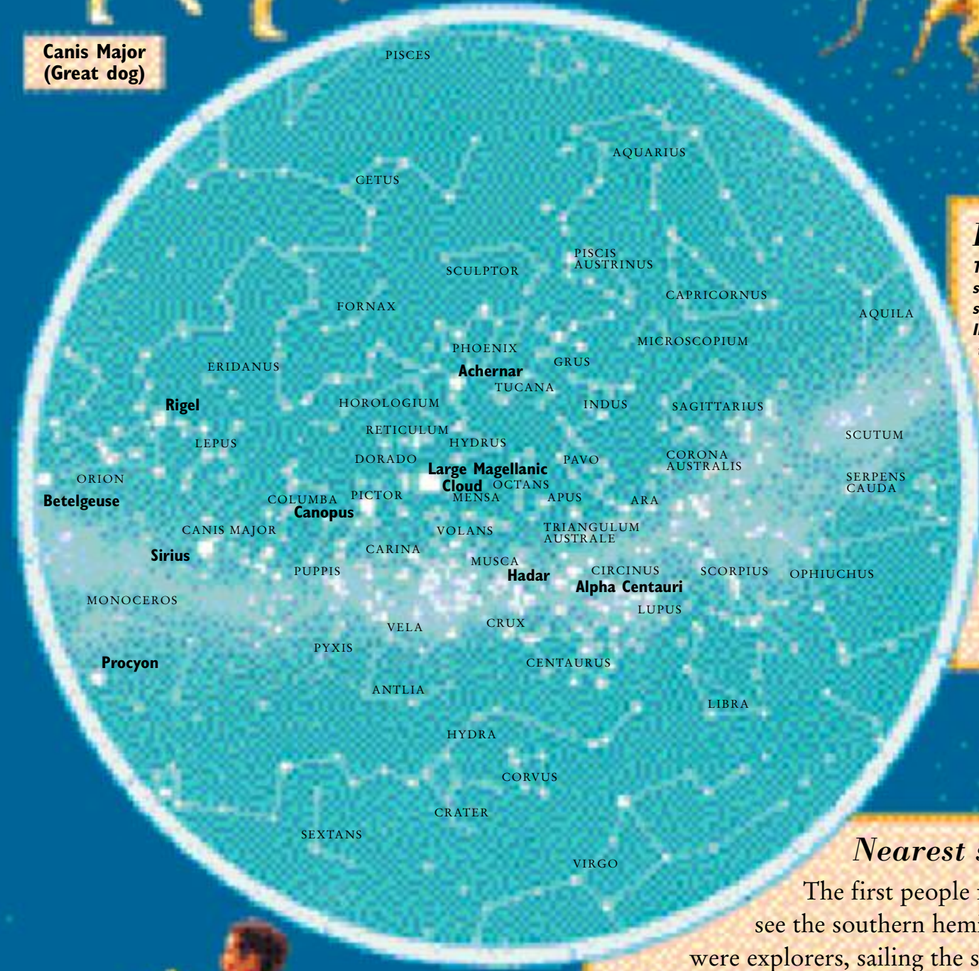
Ursa Major (Great Bear)

Canis Major (Great dog)

This chart shows the stars you can see if you live in the southern hemisphere. Turn the book around so the present month is at the bottom. Then face north at 10 pm. You should then be able to locate many of the stars on the chart.



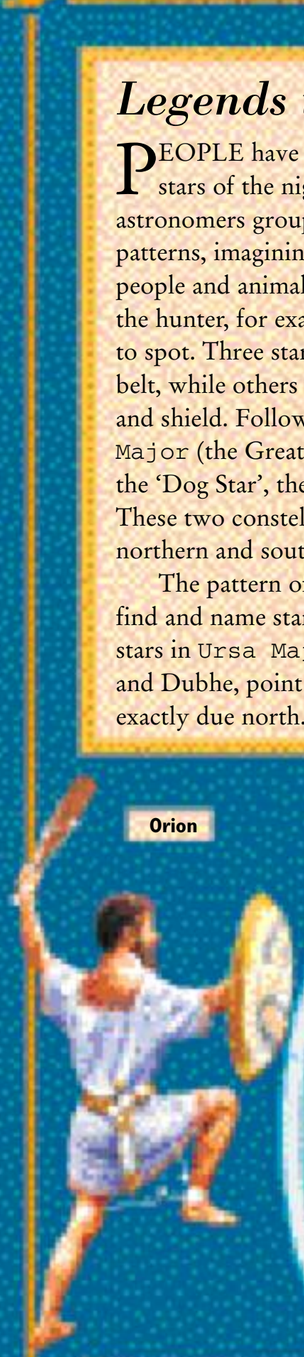
Scorpius (Scorpion)



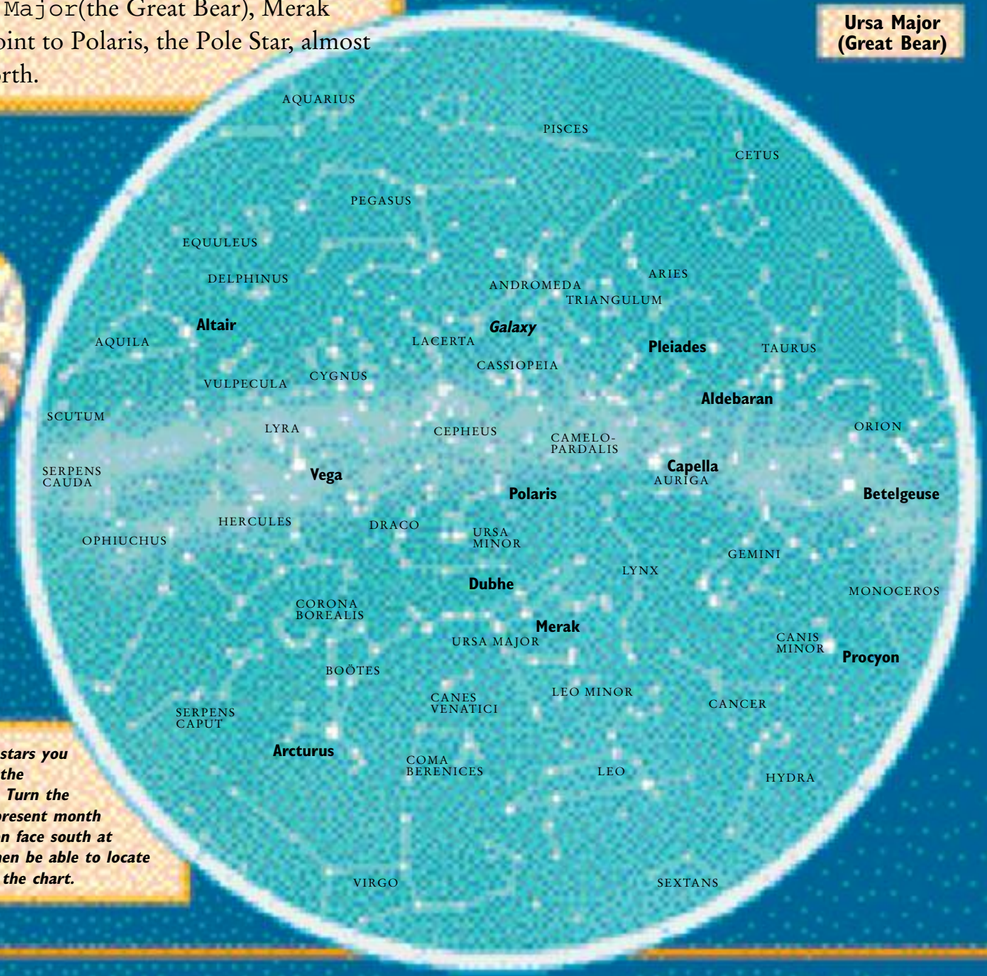
Brightest

The brightest stars are shown as the largest spots on these charts. In order of brightness, they are:

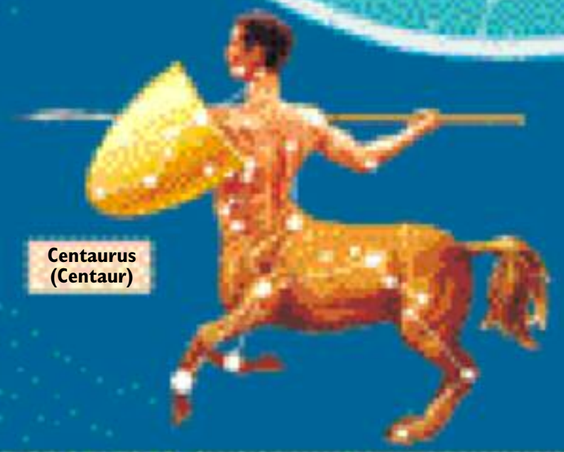
1 Sirius
2 Canopus
3 Alpha Centauri
4 Arcturus
5 Vega
6 Capella
7 Rigel
8 Procyon
9 Achernar
10 Hadar
11 Altair
12 Betelgeuse



Orion



This chart shows the stars you can see if you live in the northern hemisphere. Turn the book around so the present month is at the bottom. Then face south at 10 pm. You should then be able to locate many of the stars on the chart.



Centaurus (Centaur)

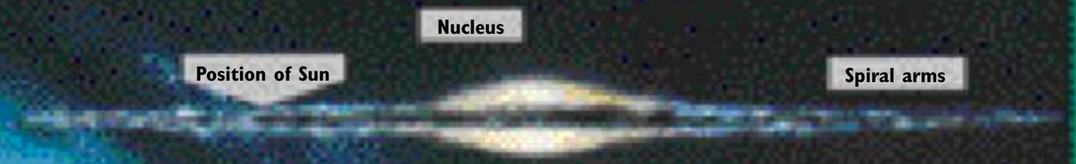
Nearest stars

The first people from Europe to see the southern hemisphere skies were explorers, sailing the southern Atlantic and Pacific Oceans. To constellations they had never seen before they gave new names such as The Painter (Pictor), The Crane (Grus) and The Dove (Columba). The constellation of Centaurus, the Centaur, contains the nearest stars to Earth apart from the Sun: Proxima Centauri and Alpha Centauri (the nearest visible). They are 'only' 4.2 light years away—a mere 40 trillion kilometres! You can also see one of the nearest galaxies to our own, the Large Magellanic

Milky Way

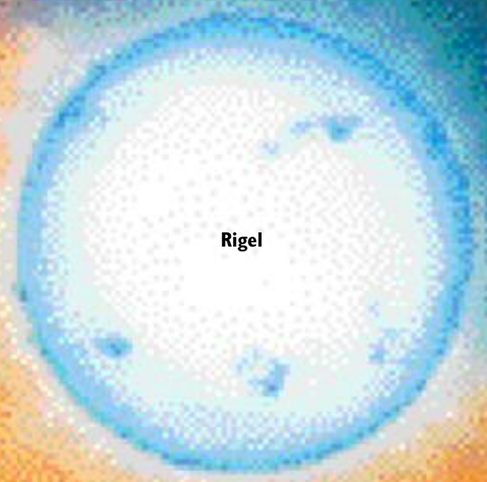
ON A CLEAR, dark night, you should be able to make out a faint, luminous band reaching right across the sky. It is our side-on view of part of our galaxy, a gigantic spiral of stars, gas and dust revolving in space. It is known as the Milky Way Galaxy, after the misty trail we can see. In fact, every star you see in the night sky (and billions more besides) belongs to the Milky Way.

A very few points of light in the sky are not stars in our galaxy, but other galaxies that lie many billions of kilometres away from us. They, too, are collections of billions of stars. In fact, there are billions more galaxies in space, all making up what we call the Universe.



Sideways on

Seen from the side, our galaxy looks like two fried eggs back to back. The bulge (or 'yolks') in the middle is called the nucleus. The disc (or 'whites') is made of the arms that spiral out from the nucleus. The nucleus is a mass of old red and yellow stars, while the arms are rich in dust and gas in which new, blue stars are forming. Our Sun is just over halfway out from the centre.



Giants and dwarfs

Stars can be of widely varying sizes and colours. The oldest stars are swollen, red giants. Betelgeuse (in the constellation of Orion) is a red supergiant. Old stars are much bigger—and cooler—than young, blue ones like Rigel (also in Orion), even though Rigel is 40 times bigger than the middle-aged Sun. A white dwarf, the collapsed core of an old star, is, however, tiny when compared to

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