ASTRONOMY · NIGHT SKY

The Southern Night Sky

Planets, Moon phases, eclipses, the Southern Cross and the constellations a guide should be able to show guests on a dark Zimbabwean night.

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> On a clear, moonless night in the Zimbabwean bush, the sky is a revelation for most guests. Cities light up their night skies and wash out all but the brightest stars; out here there is little light pollution, and thousands of stars, the planets and the Milky Way are easy to see with the naked eye. A guide should be able to point out a few constellations, stars, planets and galaxies — and explain what guests are looking at.

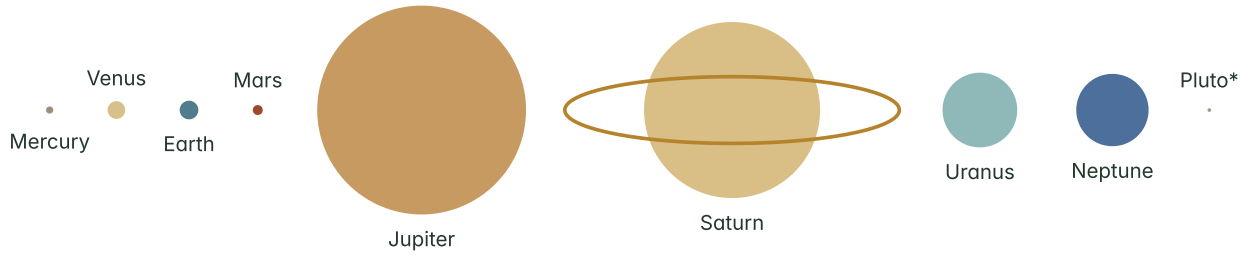
01 Ten ideas to explain the sky

Gravity	The invisible force that keeps us on the ground, holds our atmosphere in place and keeps Earth in orbit around the Sun. The orbit is a slightly stretched circle: Earth is about **147 million km** from the Sun in early January and about **152 million km** in early July.
Light-year	A distance, not a time: how far light travels in one year — **9,460,730,472,580.8 km**, or roughly 9.5 million million km.
Galaxy	A huge system of stars, gas and dust held together by gravity. Ours, the **Milky Way**, is about **100,000 light-years** across. We see it edge-on as the bright band across the sky.
Galactic centre	The centre of the Milky Way lies about **26,000 light-years** away in the constellation **Sagittarius**, next to Scorpius — not near the Southern Cross.
Solar System	The Sun and everything held in its gravity: **eight planets**, their moons, dwarf planets such as Pluto, asteroids, comets and dust.
Star	A giant ball of hot gas that makes its own light and heat. The Sun is our nearest star.
Planet	A body that orbits a star and shines only by reflected light. The planets we see with the naked eye are all in our own Solar System.
Twinkling	Stars are so far away that their light arrives as a thin pinpoint, which the moving air makes "twitch". Planets show a tiny disc, and the twitches across the disc average out — so planets **usually shine more steadily**.

Constellation	A pattern of stars named by people. Astronomers divide the whole sky into **88 official constellations**, each a defined area with fixed boundaries.
Nebula	A giant cloud of gas and dust. Stars are thought to form inside them.

02 The planets

THE PLANETS IN ORDER FROM THE SUN — SIZES TO SCALE, DISTANCES NOT



*Pluto has been classed as a dwarf planet since 2006. Diameters from NASA's Planetary Fact Sheet.

Pluto was one of the "nine planets" until **2006**, when the International Astronomical Union reclassified it as a **dwarf planet**. Three planets are especially easy to find:

VENUS — THE "EVENING STAR" AND "MORNING STAR"

After the Sun and Moon, Venus is the **brightest object in our sky**. It isn't a star at all, but it is often the first "star" to appear after sunset or the last to fade before dawn. Its full cycle takes about **584 days**:

Morning star about 263 days in the dawn sky	**Hidden** about 50 days behind the Sun	**Evening star** about 263 days after sunset	**Hidden** about 8 days passing in front of the Sun

JUPITER — THE GIANT

The largest planet, and usually one of the brightest objects at night: only the Moon, Venus and occasionally Mars outshine it. It is bright enough to stand out even at full moon. Steadily held binoculars will usually show **one or more of its four large moons** as tiny star-like dots beside it — the moons Galileo discovered in 1610. Jupiter also **gives off more energy than it receives** from the Sun.

MARS — THE RED PLANET

Easy to see with the naked eye and noticeably **red-orange**, an unusual colour among the bright lights of the night sky. The colour comes from **rusted iron minerals** in Martian dust.

03 The Moon and its phases



From southern Africa a waxing Moon is lit on the left and a waning Moon on the right — the opposite of northern-hemisphere diagrams.

PHASE	WHAT YOU SEE
New Moon	The sunlit side faces away from us; the Moon can't be seen.
Crescent	Less than half the face lit. *Waxing* = growing each night; *waning* = shrinking.
First / last quarter	Exactly half the face lit — the "half moon".
Gibbous	More than half lit, but not yet full.
Full Moon	The whole face lit. It sits opposite the Sun, so it rises around sunset.

THE CYCLE

29.5 days, not 28

New Moon to New Moon averages **29.5 days**. Because that is a little shorter than most calendar months, a month occasionally has two full moons — the second is popularly called a **blue moon**.

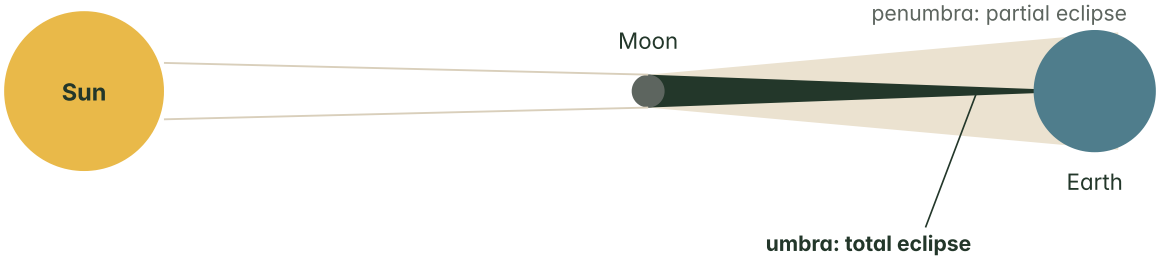
MOONRISE

About 50 minutes later

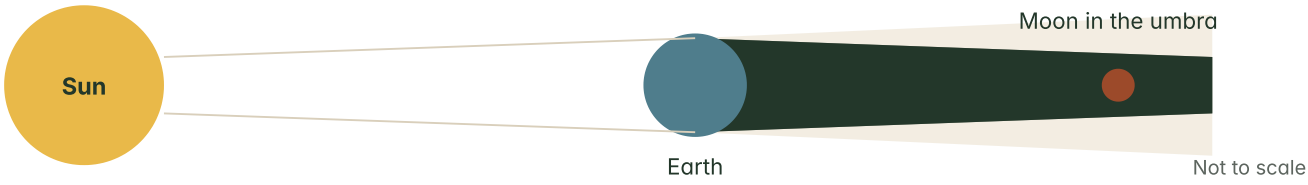
As the Moon moves along its orbit, it rises on average about **50 minutes later each day**. The actual delay varies through the month and the year.

04 Eclipses

SOLAR ECLIPSE — THE MOON'S SHADOW FALLS ON EARTH (NEW MOON)



LUNAR ECLIPSE — EARTH'S SHADOW FALLS ON THE MOON (FULL MOON)



SOLAR ECLIPSE · NEW MOON

The Moon blocks the Sun

The Moon's small dark **umbra** sweeps a narrow track across Earth: inside it the Sun is completely hidden (a total eclipse). In the wider, lighter **penumbra** only part of the Sun is covered (a partial eclipse). Elsewhere no eclipse is seen. Because the Moon's orbit is tilted by about 5°, its shadow misses Earth at most New Moons.

LUNAR ECLIPSE · FULL MOON

Earth's shadow on the Moon

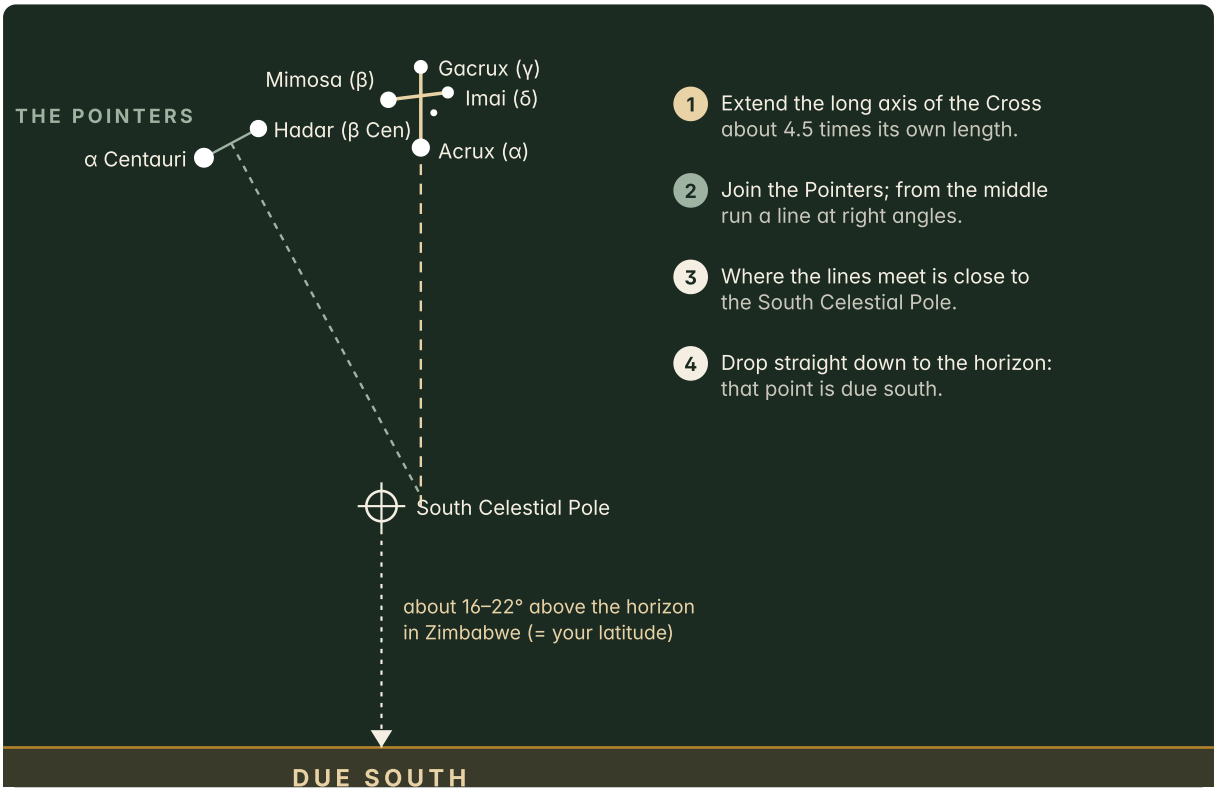
Earth passes directly between the Sun and Moon, and the Moon moves into Earth's umbra. It rarely vanishes: sunlight bent and scattered through Earth's atmosphere lights it a coppery **red**. A lunar eclipse is safe to watch with the naked eye.

EYE SAFETY

Never look at the Sun, even partly eclipsed, without proper solar eclipse viewers (look for **ISO 12312-2**). Ordinary sunglasses, however dark, are not safe. Only during the brief total phase is it safe to look without protection.

05 Finding south with the Southern Cross

Crux, the Southern Cross, is the **smallest of the 88 constellations**, but one of the most famous. Next to it are two bright stars in Centaurus, **the Pointers**: **Alpha Centauri**, the nearest star system to the Sun at about **4.37 light-years** (its faint companion Proxima Centauri, at 4.24, is the closest single star), and **Hadar**. There is no bright "south star", so guides use the Cross to find the **South Celestial Pole** — the point the whole sky seems to turn around.



Star positions plotted from their catalogue coordinates, with the Cross upright. As the night goes on, the whole pattern turns clockwise around the pole — the method works at any angle.

THREE WAYS TO FIND THE POLE

1. **Long axis:** extend the line from the top of the Cross (Gacrux) through its foot (Acrux) about **4.5 times** the Cross's length.
2. **Pointers:** join the two Pointers, and from the midpoint draw a line at right angles until it crosses the long axis line.
3. **Pointers and Achernar:** the pole lies about halfway along a line from the dimmer Pointer to the bright, lonely star Achernar.

From the pole, drop straight down to the horizon: that point is **due south**. The pole always sits as high above the horizon as your latitude — about 16–22° across Zimbabwe.

Look just beside the Cross for the dark **Coalsack Nebula**, a cloud of dust blotting out the Milky Way behind it, and — with binoculars — the **Jewel Box** cluster (NGC 4755), about 6,500 light-years away, near the star Mimosa.

06 Constellations through the year

Evening sky from southern Africa. The Southern Cross is visible in the evening for most of the year, except in early to mid summer, when it is low or below the horizon.

SEASON	CONSTELLATION	WHAT TO SHOW GUESTS
Summer Dec–Feb	Orion	High in the north and seen "upside down" from the south. The three belt stars are the **Three Kings**; **Betelgeuse** is a red supergiant about 600 light-years away; the Orion Nebula sits in the sword.
Summer	Canis Major & Canis Minor	**Sirius**, the brightest star in the night sky, only **8.6 light-years** away, overhead on January–February evenings. **Procyon** ("before the dog", about 11.5 light-years) marks the Lesser Dog.
Autumn Mar–May	Corvus, the Crow	A small four-star "quad", overhead from April to June. It takes imagination to see a crow.
Winter Jun–Aug	Scorpius	A true scorpion shape. Red **Antares** ("rival of Mars"), a red supergiant about 550 light-years away, marks its heart; the tail curls into the richest part of the Milky Way, towards the galactic centre in Sagittarius.
Most of the year	The Magellanic Clouds	Two faint glowing patches in the southern sky on dark nights — whole **galaxies** orbiting the Milky Way, about 160,000 (Large) and 200,000 (Small) light-years away. Moonless nights only.

UNDER THE STARS — HOW TO SAY IT

"See that band of light right across the sky? That's our own galaxy, the Milky Way — we're inside it, looking along its disc. Now find the little kite of four stars: that's the Southern Cross. Run your eye from the top star down through the bottom one and keep going about four and a half times as far, then drop straight down to the horizon — you're looking due south. And the brighter of those two Pointers next to the Cross? Its light left there just over four years ago. It's our nearest neighbour among the stars."

In summary

- Dark bush skies show thousands of stars, the Milky Way and the planets with the naked eye.
- Eight planets; Pluto is a dwarf planet. Venus, Jupiter and Mars are the easiest to find.
- Stars twinkle; planets usually shine steadily because they show a tiny disc.
- The Moon's cycle is 29.5 days; in the south the waxing Moon is lit on the left.
- Solar eclipses happen at New Moon, lunar eclipses at Full Moon.
- Use the Southern Cross and the Pointers to find the South Celestial Pole and due south.

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