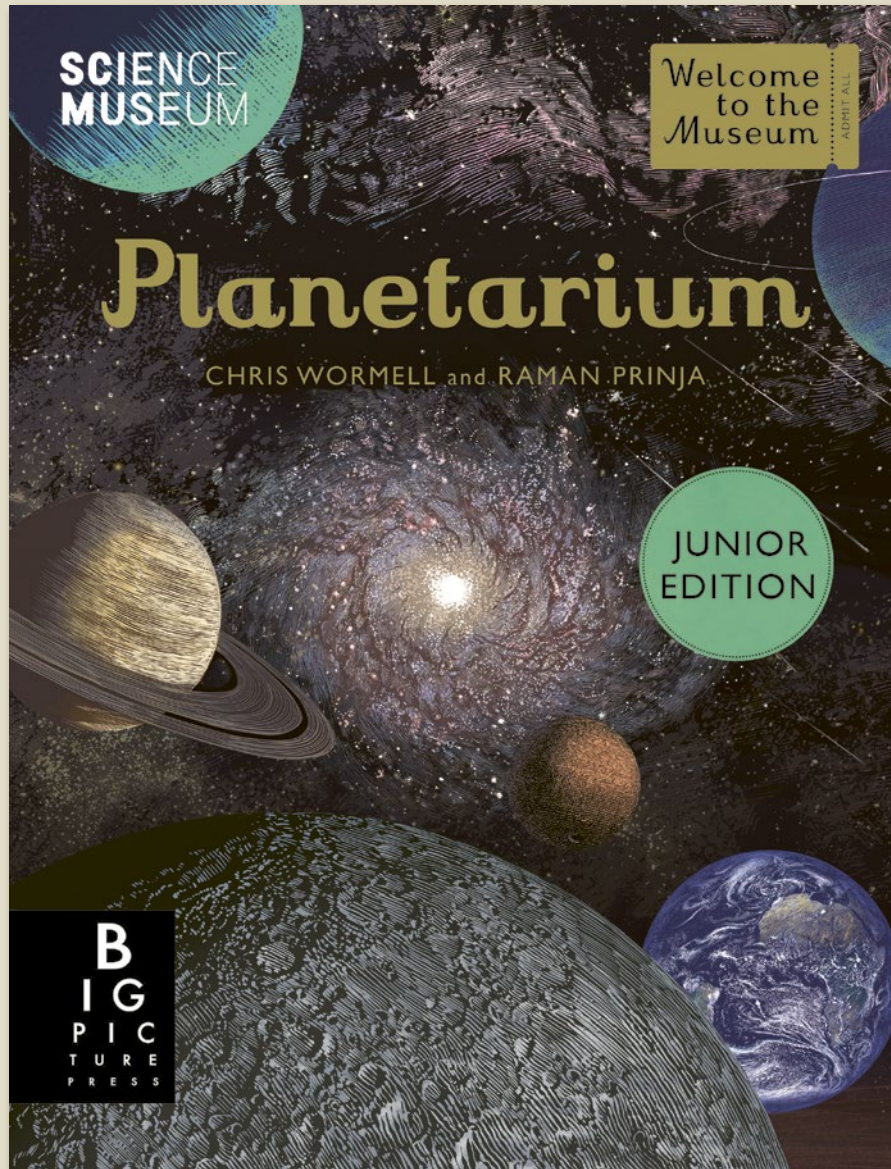


# Planetarium (Junior Edition)



**With specially written text for younger readers, step inside the museum to explore the Universe in all its glory.**

- *Planetarium* has sold over 210,000 copies worldwide (as of July 2022)
- The core *Welcome to the Museum* books have sold a combined quantity of over 1 million copies in 48 languages (as of July 2022)
- Intricate woodcut artwork by Chris Wormell, illustrator of award-winning title *H is for Hawk* (Vintage, 2015) and *La Belle Sauvage: The Book of Dust* (Penguin Random House, 2017)
- Written by Professor Raman Prinja, professor of astrophysics at University College London

# Planetarium (Junior Edition)

LOOKING AT SPACE

## Telescopes

Objects in space, such as stars and galaxies, are very far away and only a tiny amount of their light reaches Earth. This is because light spreads out as it moves further from its starting point. To look at space in any detail, we rely on telescopes – special instruments which make distant objects appear much larger.

Telescopes act like funnels for collecting light. Just as a bigger bucket catches more rainwater, a bigger telescope gathers more light. The pupils of our eyes are barely 5mm across, but modern telescopes can be more than 10m wide – a telescope that can see one object four million times further than those we can see just with our eyes.

Telescopes work by collecting light using a lens or mirror. The light is focused into a small sharp image and this image is magnified (made bigger). The two main types of telescope are refractors and reflectors. Refracting telescopes use lenses to bend or collect light. The light enters through the front lens and travels through the telescope to the eyepiece, where it is magnified. Reflecting telescopes use mirrors to collect light. Light enters the telescope, bounces off a curved primary (flat) mirror that is reflected off a smaller secondary mirror, which magnifies the image.

**Key to plate**

**1 Galileo's first telescope**  
The first telescope was made by Galileo in 1609. It was a simple refracting telescope with a lens 47mm in diameter and a focal length of 30cm.

**2 Newton's reflecting telescope**  
Newton's reflecting telescope was the first to use mirrors. It was built in 1672 and had a primary mirror 100mm in diameter and a focal length of 1800mm.

**3 James Clerk Maxwell's reflecting telescope**  
The first reflecting telescope to be used in astronomy was built by James Clerk Maxwell in 1845. It had a primary mirror 1800mm in diameter and a focal length of 1800mm.



THE SOLAR SYSTEM

## Saturn

Saturn is the sixth planet from the Sun. It is a huge gas giant, surrounded by beautiful, bright rings. Although the rings look solid from a distance, up close they are made of billions of ice particles, along with fine dust and frozen-ice boulders. Scientists think the rings formed when a moon drifted too close to Saturn and was broken up by the planet's gravity.

Like the other gas giants, Saturn is a huge ball of gas and liquid. It is mostly made up of hydrogen and helium, which are some of the lightest gases

in the Universe. In fact, Saturn would float in water if you could find a bathtub big enough to hold it!

Saturn is surrounded by more than 140 moons. Its moon, Titan, is the second largest in the Solar System. Scientists are very interested in the moon because it looks a bit like Earth. At the time when life first appeared on our planet – it might even be known to extraterrestrial life.

**Key to plate**

**1 Saturn**  
Diameter: 120,536km  
(94.5 Earth diameters)  
24.46 Earth radii

**2 Titan**  
Mass: 96.26 Earth masses  
2894 Earth radii

**3 The rings**  
The rings extend Saturn's diameter by 10,000km.

THE STARS

## Star Life Cycles

Stars shine by converting hydrogen atoms into helium atoms inside their cores. But at some point, every star will run out of helium fuel. What happens next depends on how big the star is.

The smallest stars (or lightweight stars) burn brighter than our Sun to begin with, but as they run out of fuel, they spend several years making energy before running out of fuel. Then they swell into red giants and burn into white dwarf stars.

Middlesized stars start off 8 to 20 times the mass of the Sun. They burn much faster than smaller stars, using up their fuel supply in less than a billion years. At the point they swell into supergiants, then die in a huge explosion called a supernova. The only thing left behind will be a very dense, city-sized core called a neutron star.

The most massive (heavyweight) stars are more than 20 times the mass of the Sun. They burn so fast that they can use up all their fuel in just a few million years. They explode into enormous blue supergiants, then just as quickly collapse in the end up to a superdense explosion. The life cycle of heavyweight stars ends with the creation of a black hole (see page 22).

**Key to plate**

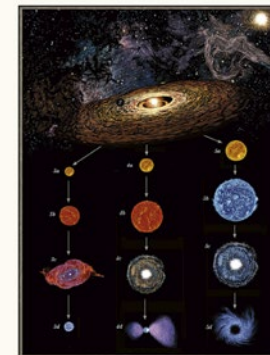
**1 Intermediate weight**  
These stars spend most of their lives as main sequence stars. At the end of their lives, they become red giants, then white dwarfs.

**2 Protostar**  
This is the stage where a cloud of gas and dust is forming into a star.

**3 Lightweight star life cycle**  
All the stars that are less than 8 times the mass of the Sun end their lives as white dwarfs.

**4 Middlesized star life cycle**  
All the stars that are 8 to 20 times the mass of the Sun end their lives as neutron stars or black holes.

**5 Heavyweight star life cycle**  
All the stars that are more than 20 times the mass of the Sun end their lives as black holes.



PLANETARIUM

## Our Place in the Universe

The Universe contains absolutely everything, from tiny atoms to giant galaxies. It is so big that it can be hard for us to imagine its size. But one way of doing this is imagining Earth's 'cosmic address'. So, instead of writing down a house number, street, town and country, we replace each line with larger and larger structures in space.

Our cosmic address starts with our planet, Earth. Earth is one of eight planets in the Solar System, so that is the next line. The Sun is at the centre of the Solar System and is one of 200 billion stars in the Milky Way Galaxy; the Milky Way is one of about 50 galaxies in a cluster called the Local Group; this is one of many galaxy clusters in the Virgo Supercluster; and finally the Virgo Supercluster is part of a region in space called Laniakea. This means that our cosmic address is: Earth, Solar System, Milky Way Galaxy, Local Group, Virgo Supercluster, Laniakea, Universe.

While this helps us imagine the Universe, scientists still need ways of measuring its sheer size. Miles and kilometres are no help at this scale. Instead, astronomers use light years – the distance light travels in one year. Since light has a speed of 300,000km per second, the distance it travels in a year is 9.5 trillion km. The distance between our Sun and the planet Neptune is 0.0005 light years. The Milky Way is 100,000 light years across. But largest of all, the Universe is 93 billion light years wide.

**Key to plate**

**1: Our place in the Universe**  
a) Earth  
b) Solar System

**c) Milky Way Galaxy**  
d) Local Group  
e) Virgo Supercluster

**f) Laniakea**  
g) Universe

6



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