Dr Matt's Guide to Life in Space

by Matt Agnew

Accompanying PDF to Audiobook

Figure 1: The different layers of the Earth.

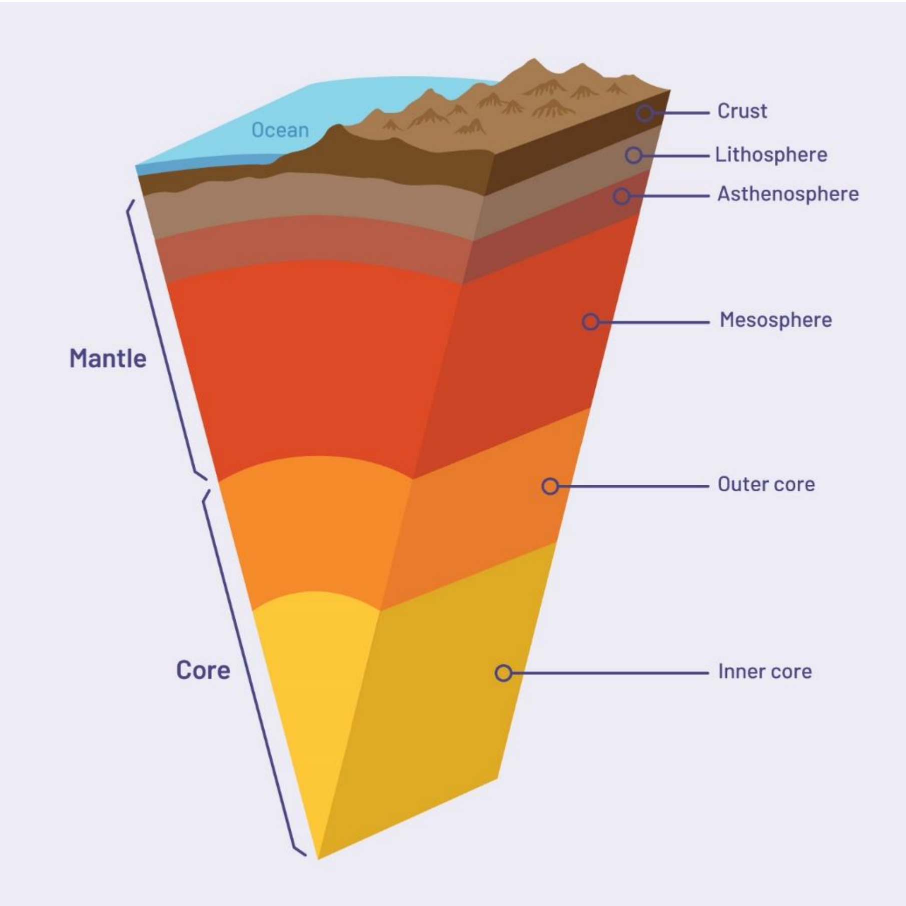


Figure 2: A diagram of what the Grand Tack looked like. See how more blue objects are dragged inwards to where Earth forms? That's Jupiter 'watering' our Earth. (Adapted from Walsh et. al, 2011; and Carroll, 2017.)

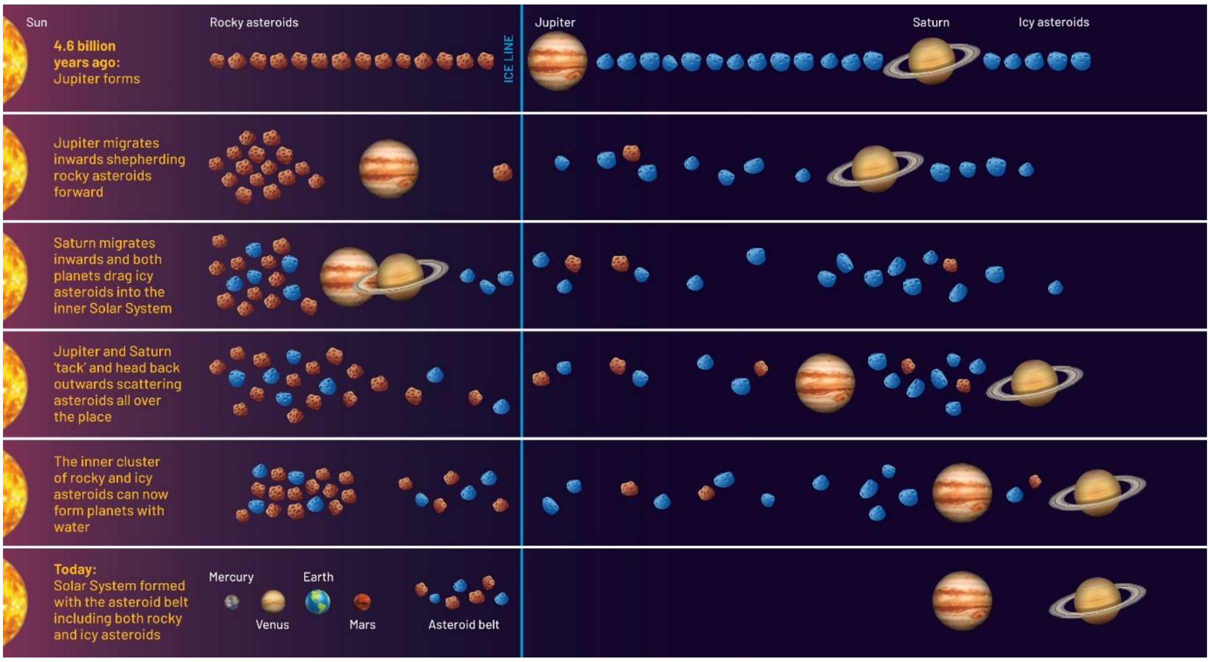


Figure 3: A planet's orbit is different for different eccentricities. Notice that, as an orbit's eccentricity increases, there is a 'near' side of the orbit (where the planet is near to the star) and a 'far' side (where the planet is far away).

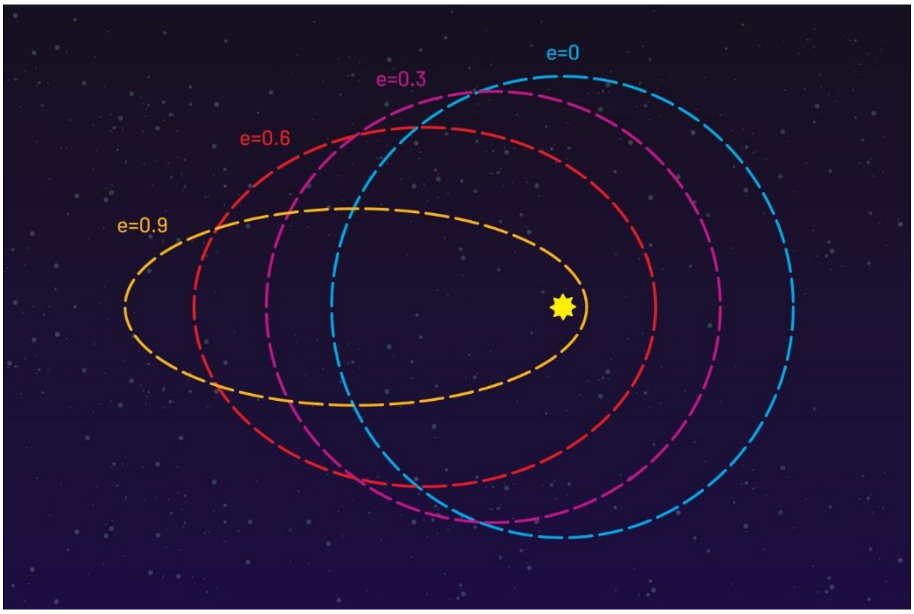


Figure 4: The axial tilt of (left) a spinning top and (right) Earth.

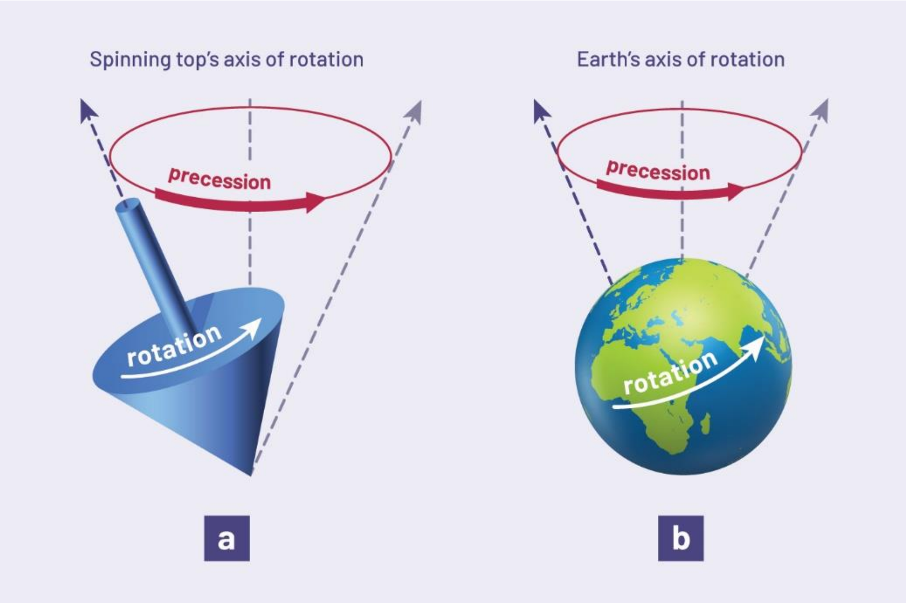


Figure 5: The timeline of Earth highlighting some of the key stages from creation through to the diverse life we see today.

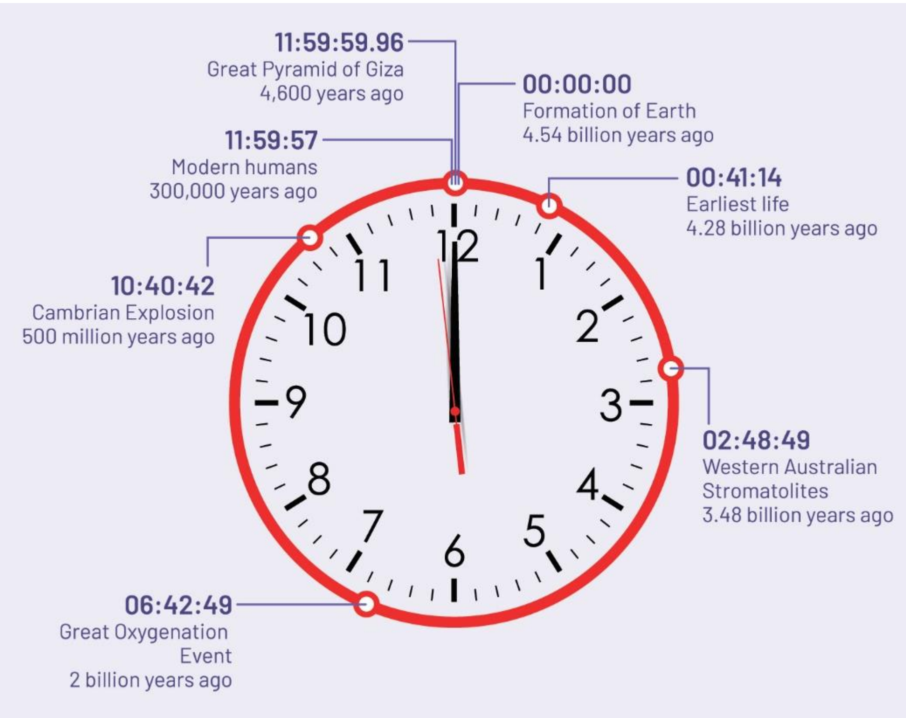


Figure 6: The Habitable Zone in our Solar System—a doughnut-shape, or annulus, that exists around the Sun.

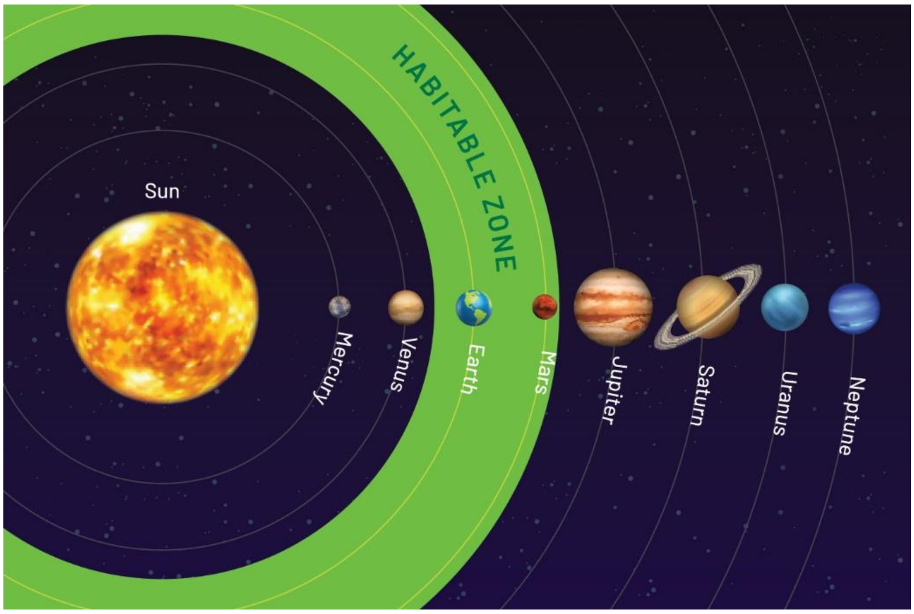


Figure 7: The trajectory of *Cassini-Huygens* from Earth to Saturn. The mission launched in late 1997 and passed by several planets to utilise gravity assists. Adapted from: Matson et al. 2002.

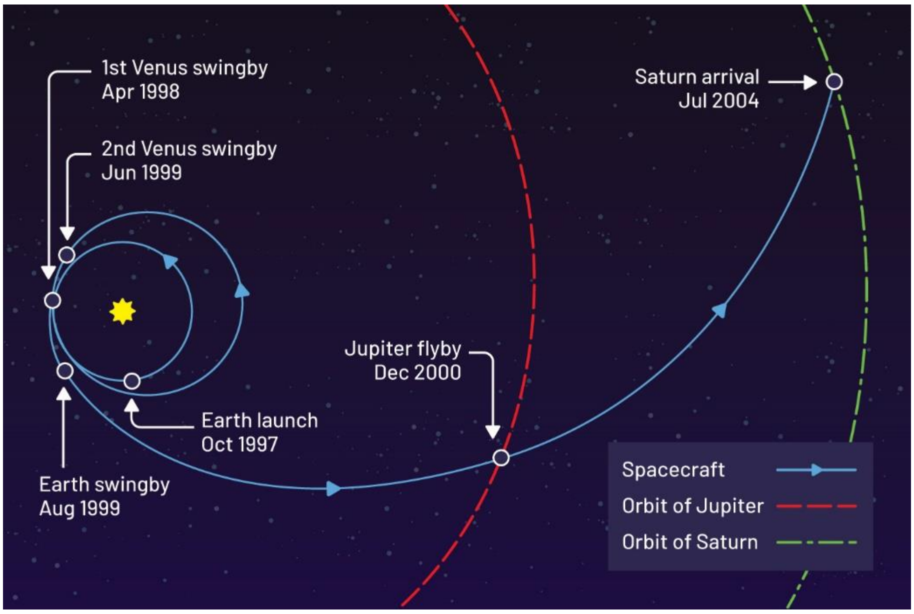


Figure 8: A comparison between several spectra to show how different chemicals have different spectral features. When white light is split it will show as the continuous spectrum like a rainbow (top), whereas if an element like hydrogen (middle spectrum) or oxygen (bottom spectrum) absorbs white light, the light that has transmitted through will be missing certain colours when it is split, and these show up as spectral features or lines.

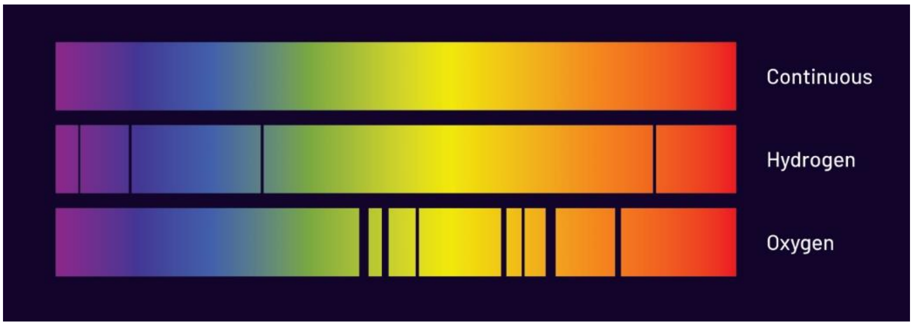


Figure 9: You can see the Doppler effect when a duck swims through water. The waves (or ripples) formed by the duck are squashed in the direction the duck is travelling towards (the blue lines), while the waves (or ripples) are stretched in the direction the duck is travelling from (the red lines).

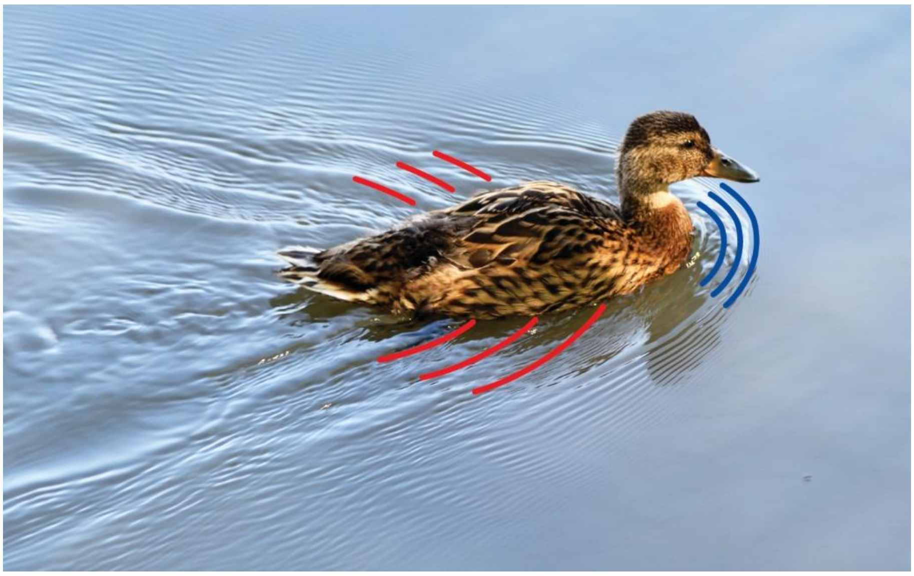


Figure 10: How the orbit of a planet changes the colour of the light we see of the star it is orbiting.

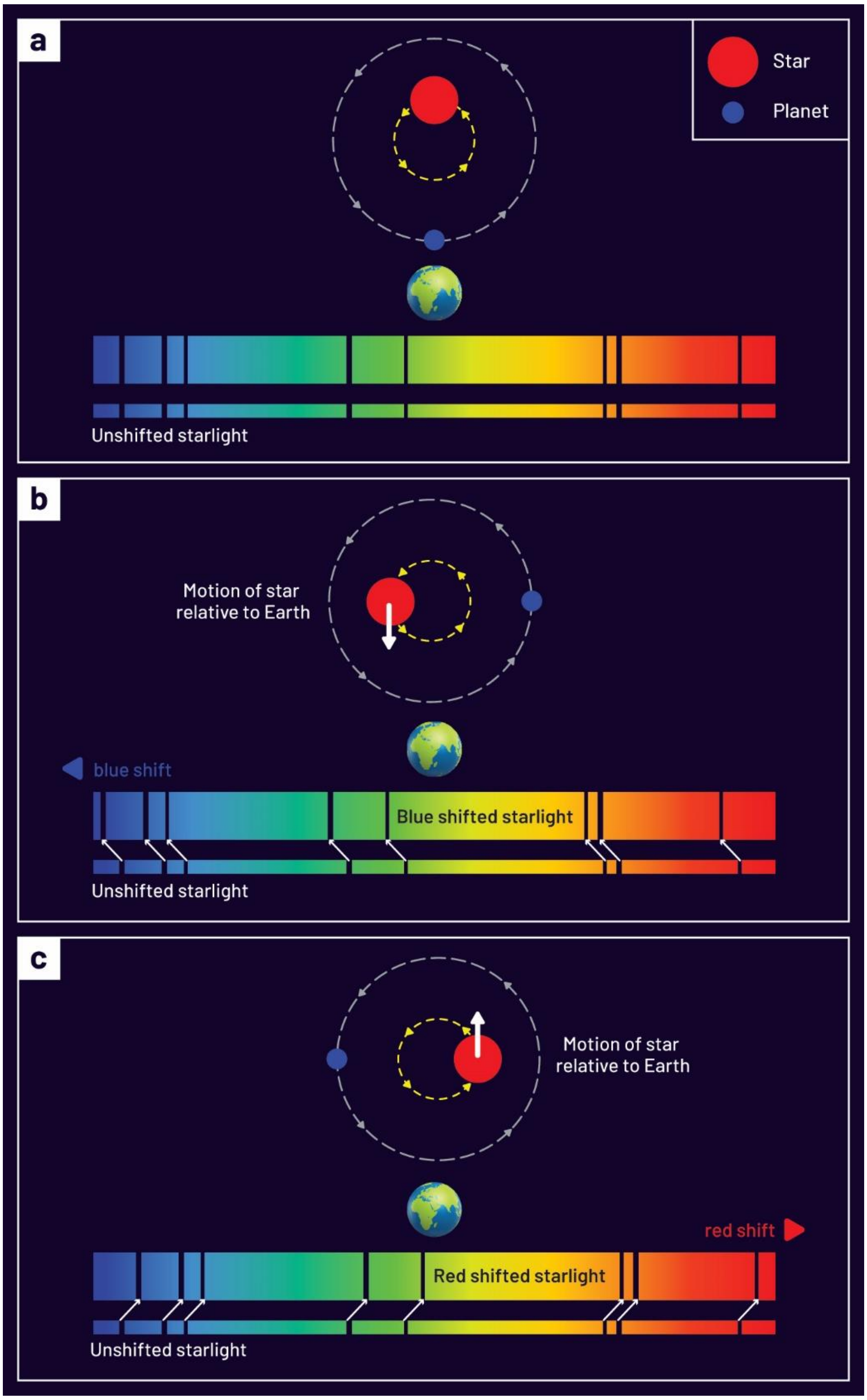


Figure 11: As a planet and star orbit a centre of mass, the host star goes through periods of approaching and retreating from Earth, during which the light of the star will be compressed (blue-shifted) or stretched (red-shifted), thus inferring the presence of an exoplanet.

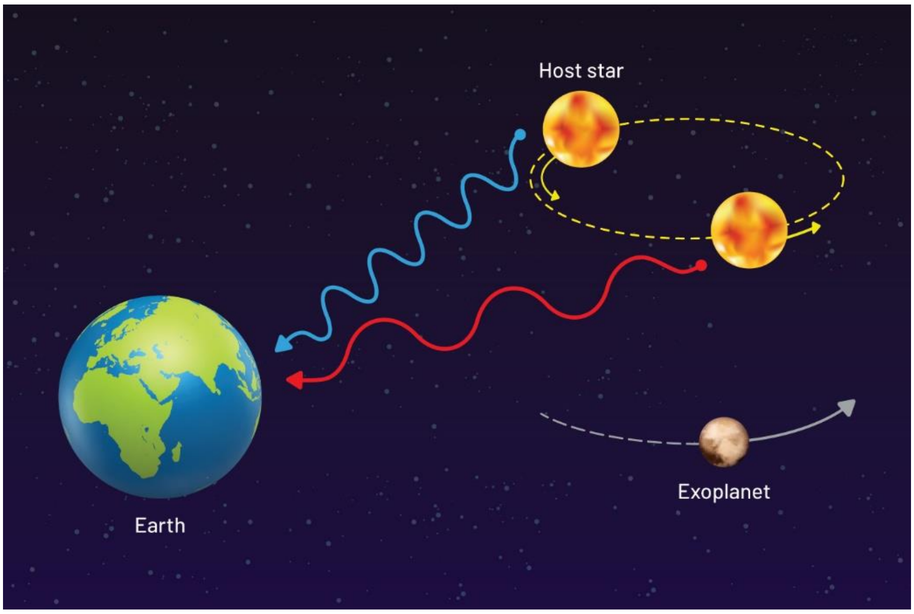


Figure 12: When an object transits in front of a star, it causes the brightness of the star to 'dip' as the object 'blocks out' and stops some of the light reaching us here on Earth.

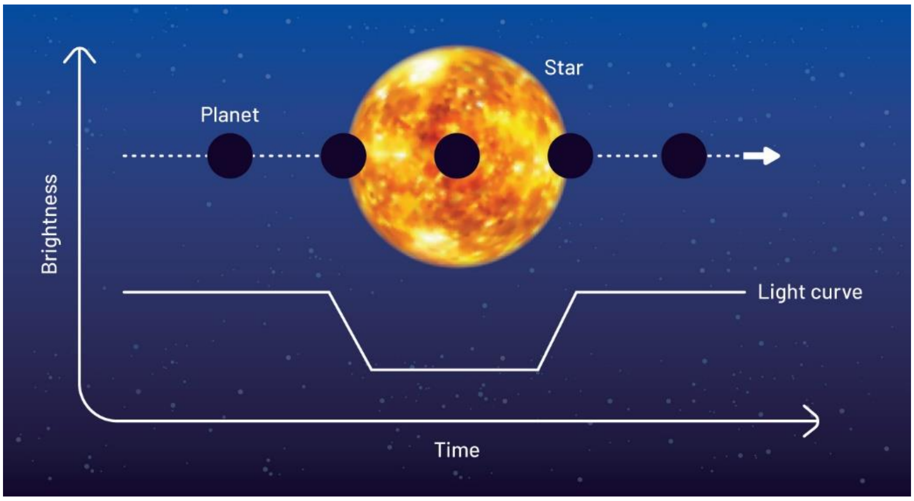


Figure 13: In a primary eclipse, a planet passes in front of the star we're observing, causing the star's light to shine through the atmosphere and illuminate it.

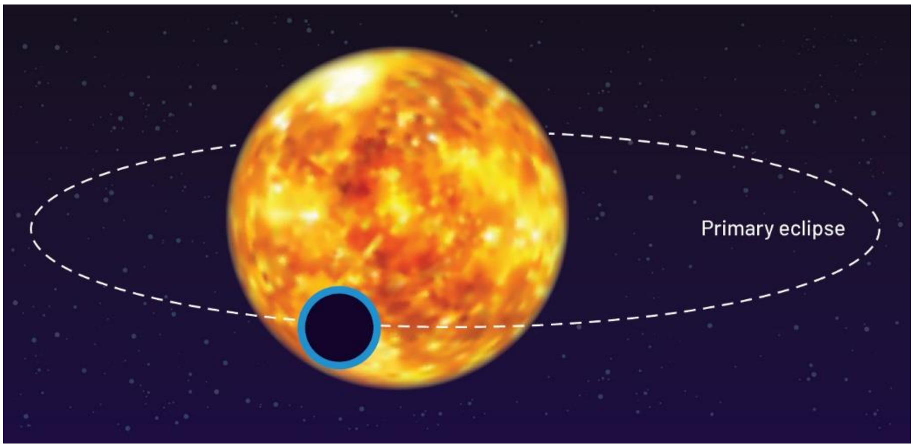


Figure 14: A diagrammatic representation of how the light from a star interacts with the atmosphere of an orbiting planet before it reaches Earth.

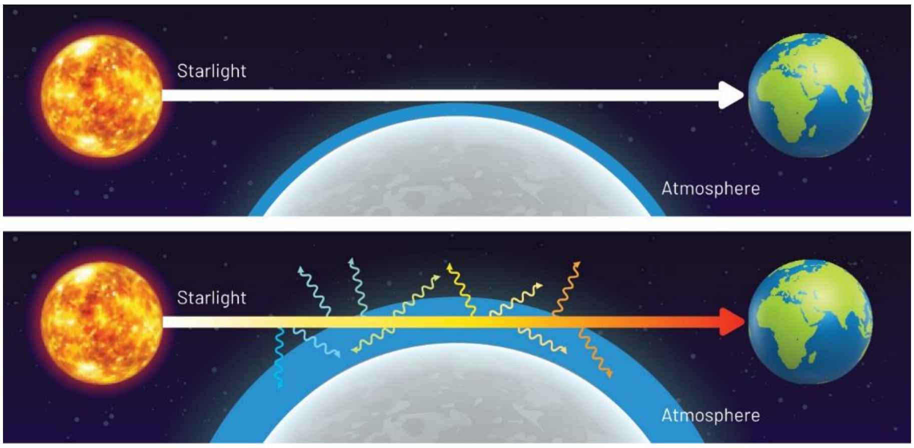


Figure 15: Figure The Drake Equation

$$N = R_* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

Figure 16: The distribution of the global population between countries of different populations. Over one-third of the world's population is concentrated in countries that have a population of more than 1 billion (China and India).

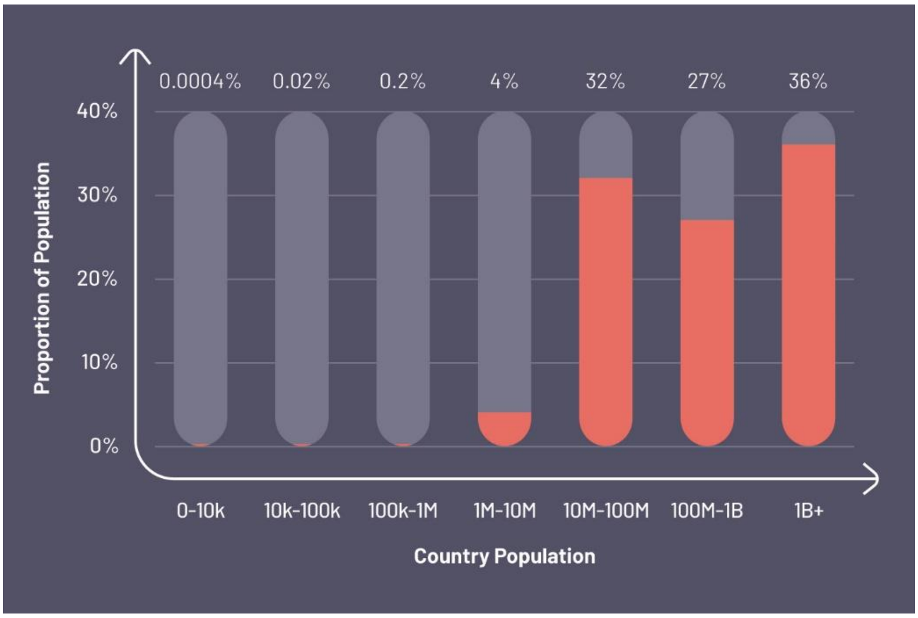
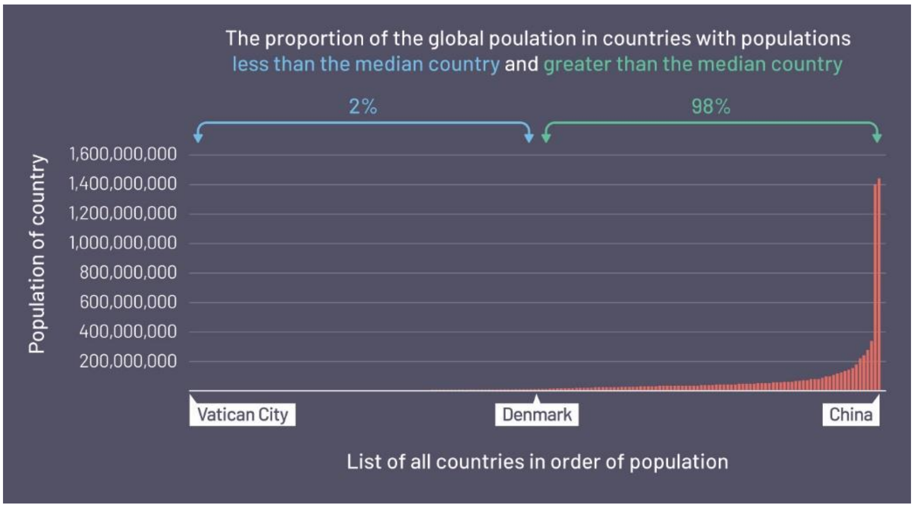


Figure 17: The proportion of countries with different populations. Countries with more than 1 billion people make up only 1% of all countries; most have populations of either 1 million–10 million (29%), or 10 million–100 million (34%).

Figure 18: All the countries lined up in order of population, with Vatican City having the smallest population, Denmark in the middle, and China having the largest population. You can see that even though Denmark is in the middle, larger countries make up 98% of the global population.



Additional images relevant to the audiobook

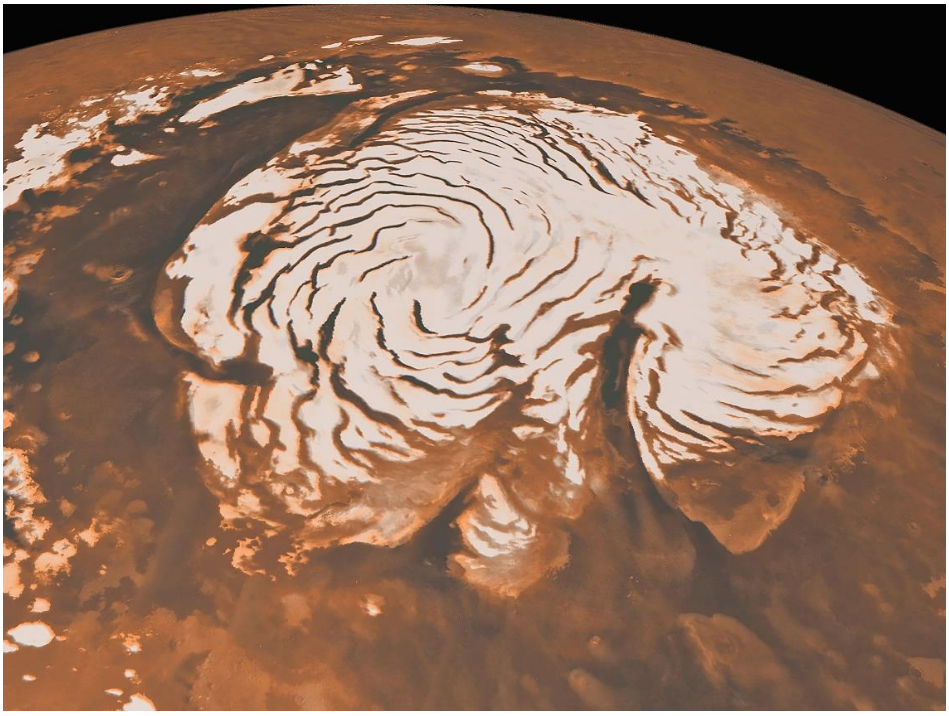
The famous 'Earthrise' photo taken during *Apollo 8*—the first human spaceflight mission to the Moon. In contrast to being on Earth, looking over the Moon's horizon yields the pitch-black void of space.

A photo of the Aurora Borealis as seen from Chena Lake, Alaska.

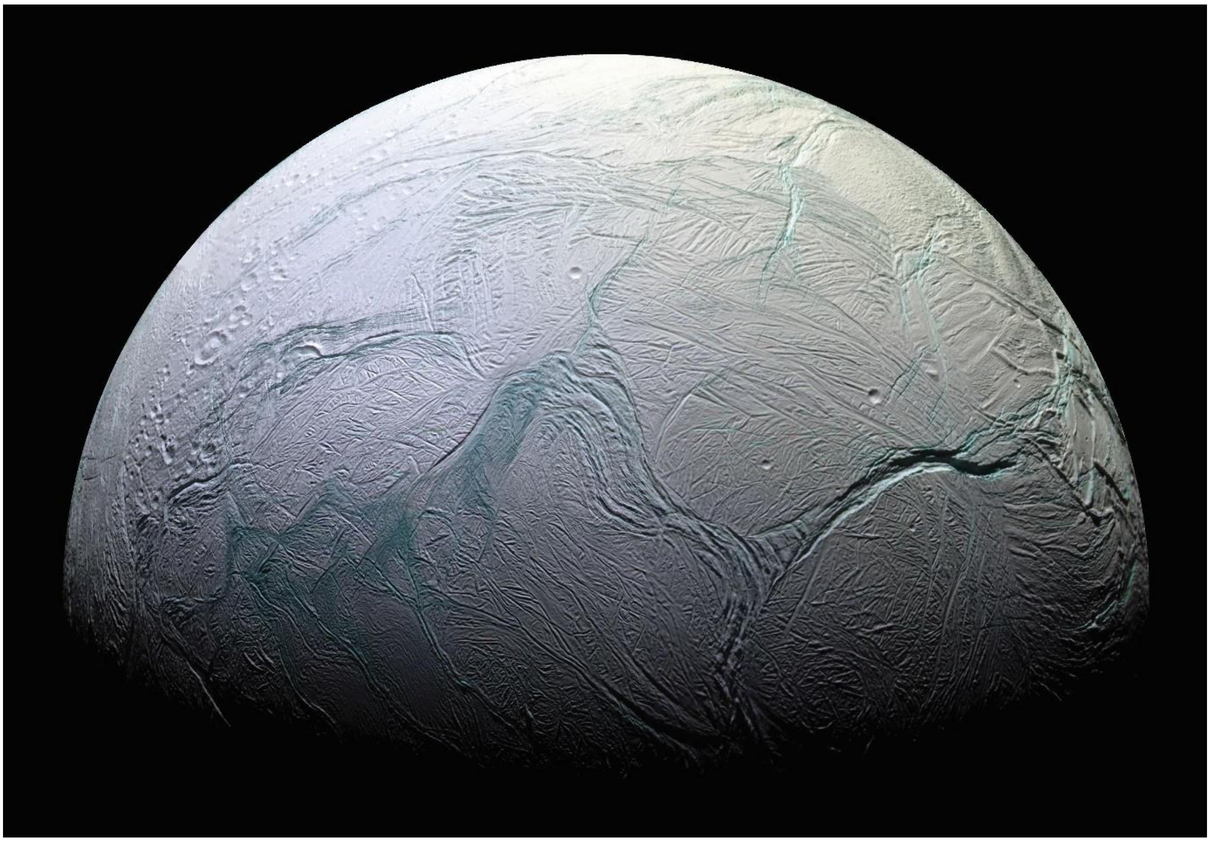
The Aurora Australis photographed from the International Space Station.

A photo of the Hale-Bopp comet taken on 14 March 1997. Two tails are clearly visible: the white dust tail (brighter and slightly curving) and the blue ion tail (fainter and pointing in a straight line).

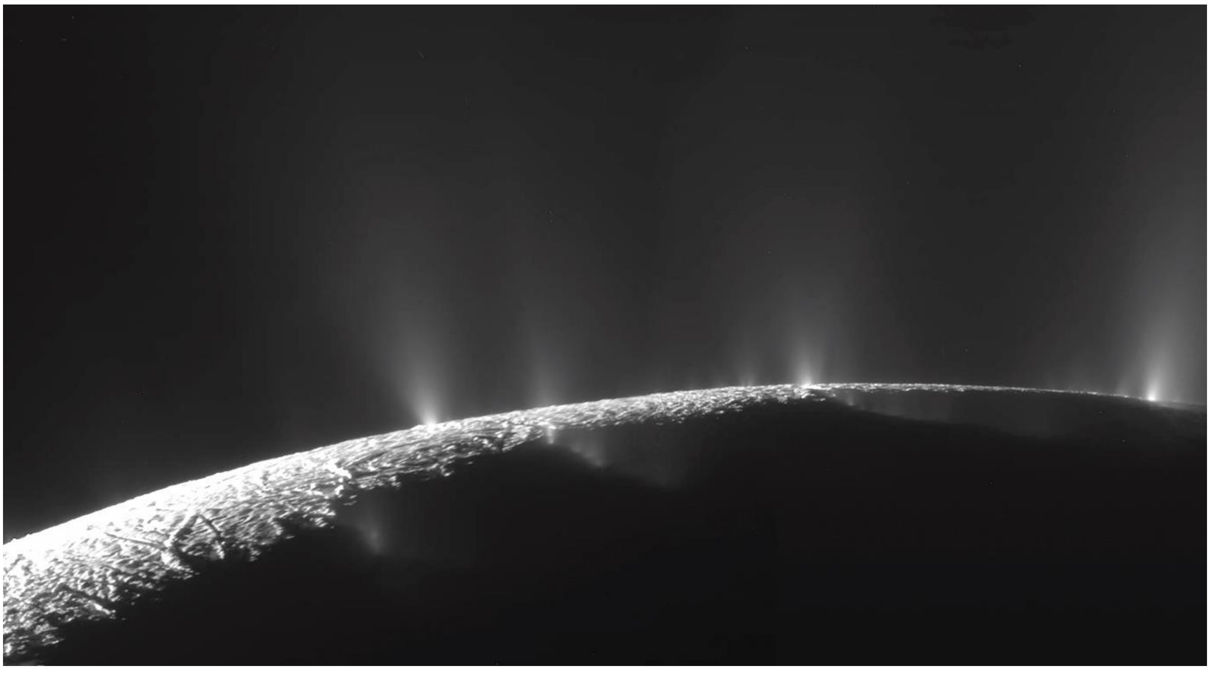
This beautiful imagery, captured by NASA's Mars Global Surveyor, shows the magnificence of the Martian north pole.



Enceladus as captured by *Cassini*. Images like this are often many images stitched together (known as composites). The images are taken in different wavelengths and this information is then used to colour the image according to what we think it would look like.



The ‘water volcanoes’ of Enceladus. Scientifically, they are referred to as *cryovolcanoes*.



Mercury (left) and Venus (right) transiting the Sun. Can you spot the two of them? (Ignore the blurry, discoloured sunspots — these are different 'little storms' that flare up on the Sun from time to time.)