

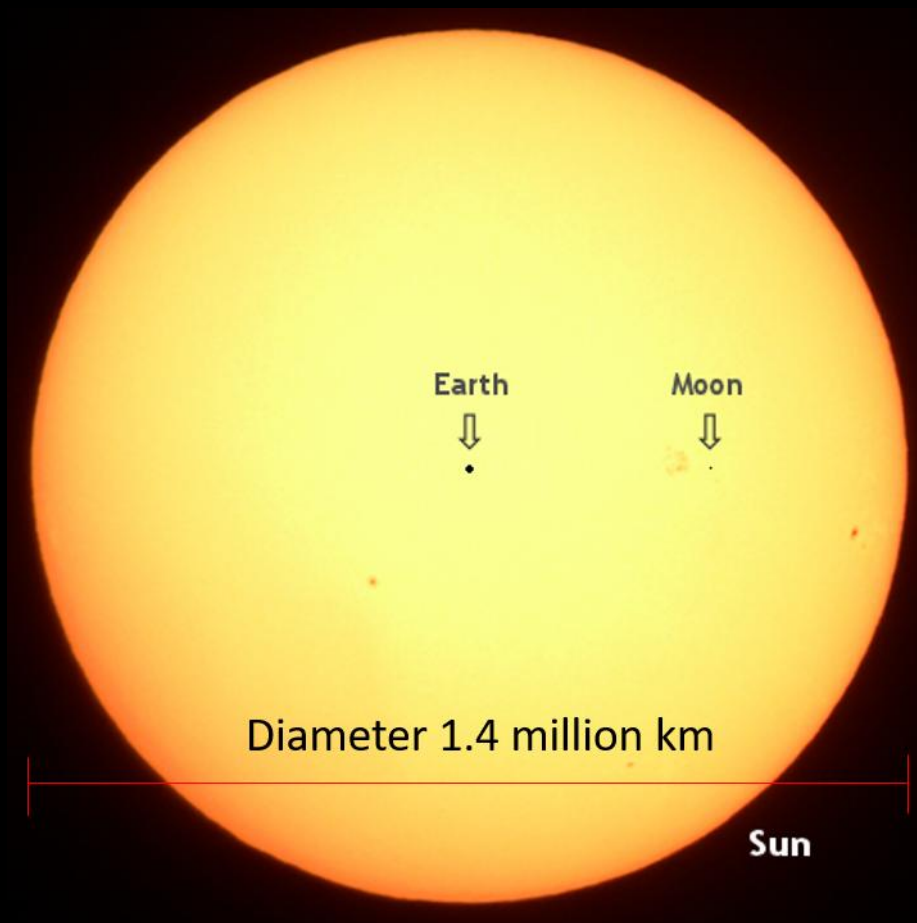
The Sun

The Sun – our nearest star

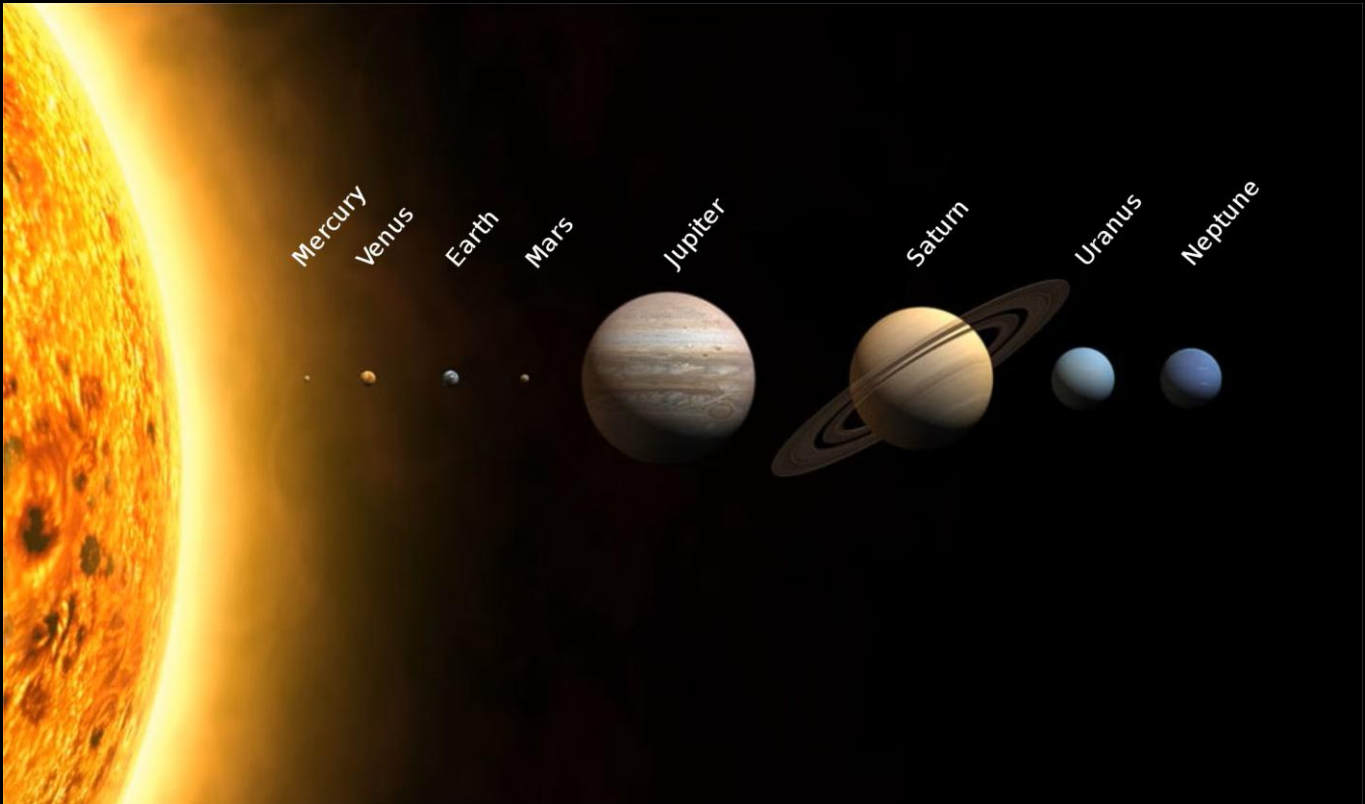
- The Sun is a star, located at the centre of our Solar System, and is the only star in our system.
- It is about **4.6 billion years old** and is classified as a **G-type main-sequence star (G2V)**, often called a “yellow dwarf” in astronomy.
- The term “Main Sequence” means the **Sun is converting hydrogen to helium** via the **thermonuclear fusion** process which is occurring in its core.

How big and how far is the Sun?

- The Sun is a sphere with radius of 696,000km (a diameter of about **1.4 million km**, which is roughly **109 times the diameter of Earth**).
- The average distance from the centre of Earth to our Moon is 384,000km. This means the **radius of the Sun is about 312,000km farther than the distance from the centre of the Earth to the Moon**. The Sun is enormous!
- On average, the Sun is about **150 million km** from Earth; light from the Sun takes **about 8 minutes** to reach us.



The Sun



The planets shown to scale with the Sun

What the Sun is made of

- The Sun is made mostly of **hydrogen** (about 74–75%) and **helium** (about 23–24%), with small amounts of heavier elements such as oxygen, carbon, nitrogen, and iron.
- These gases are in the form of a very hot **plasma** (a gas so hot that the atoms are broken apart into separate electrons and protons).

How the Sun produces heat and light

- In the Sun's core, **nuclear fusion** converts hydrogen nuclei into helium, releasing a huge amount of energy in the form of light and heat.
- Every second, the Sun converts about **600 million tonnes of hydrogen** into helium, turning roughly **4 million tonnes** of matter into energy.
- The Sun's huge mass produces enormous gravitational compression of the core. Heat released by thermonuclear fusion makes the plasma particles move extremely fast and crash into each other. These collisions stop the core collapsing due to gravity. The balance between inward gravity pressure and outward thermal pressure is called **hydrostatic equilibrium**. This equilibrium must be maintained to avoid the Sun collapsing inward or exploding outward.

The Sun

Layers of the Sun

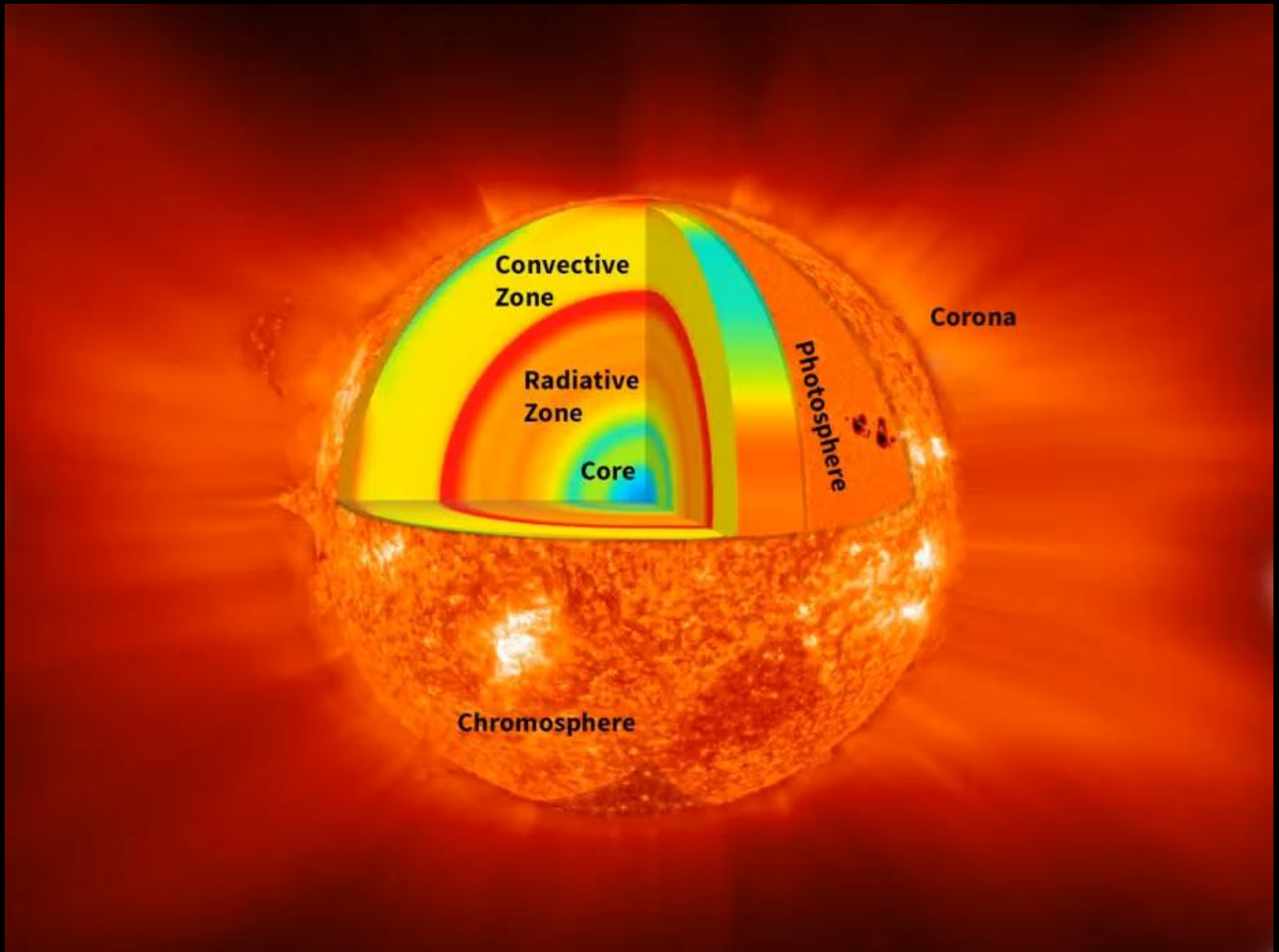
- The Sun has several main layers:
 - **Core:** hottest part central, where fusion happens (around **15 million °C**). The huge mass of the Sun (About 330,000 times the mass of Earth) generates tremendous gravitational forces that compress the plasma at the centre of the Sun.
 - While plasma is much like a gas, **the density of the plasma at the centre of the Sun** is being squeezed by such enormous gravitational pressure that it has **a density 13 times that of lead or 19 times the density of steel**.
 - That central pressure is equivalent to about **250–340 billion times** the atmospheric pressure at Earth's sea level.
 - **Radiative and convective zones:** layers surrounding the core. Energy (radiation, light, and heat) works its way outward from the core through these layers.
 - **Photosphere:** the visible “surface” we see, with a temperature of about **5,500–5,800 °C**.
 - **Chromosphere and corona:** outer, thinner layers that become visible during a total solar eclipse as a red rim and a faint white “crown” surrounding the Sun.

Sunspots, flares, and solar activity

- **Sunspots** are cooler, darker regions on the photosphere caused by strong magnetic fields. They often appear in groups and can be larger than Earth.
- **Solar flares** and **coronal mass ejections** are huge explosions of energy and plasma that blast off the Sun and can affect Earth's magnetic field, radio signals, and power grids (a phenomenon called **space weather**).



The Sun



The Sun's "life cycle" and future

- The Sun has been fusing hydrogen into helium, and shining, for about **4.6 billion years** and is expected to continue in its current "main-sequence" phase for about **another 5 billion years**.
- Eventually, as its hydrogen fuel runs low, the Sun will expand into a **red giant star**, then shed its outer layers to form a **planetary nebula**, leaving behind a hot, dense core called a **white dwarf star**.

The Sun and life on Earth

- The Sun is the main source of **light and heat** for Earth, driving weather, climate, photosynthesis in plants, and the water cycle.
- The Sun's gravity holds the entire Solar System together, keeping planets, moons, asteroids, and comets in orbit.

The Sun

Our Sun and the other stars

- Our Sun is a star. Every star we can see in the night sky is essentially just another “Sun” with its own system of planets in orbit.
- No one knows for certain, however there are an estimated 1 septillion (that is a 1 followed by 24 zeros: **1,000,000,000,000,000,000,000,000**) stars in the observable universe. So, our Sun is just one star of countless many other stars, and even more planets.

Observing the Sun safely

- The Sun is **dangerous to look at directly** with the naked eye or through binoculars or telescopes without proper solar filters. Do not look directly at the Sun.