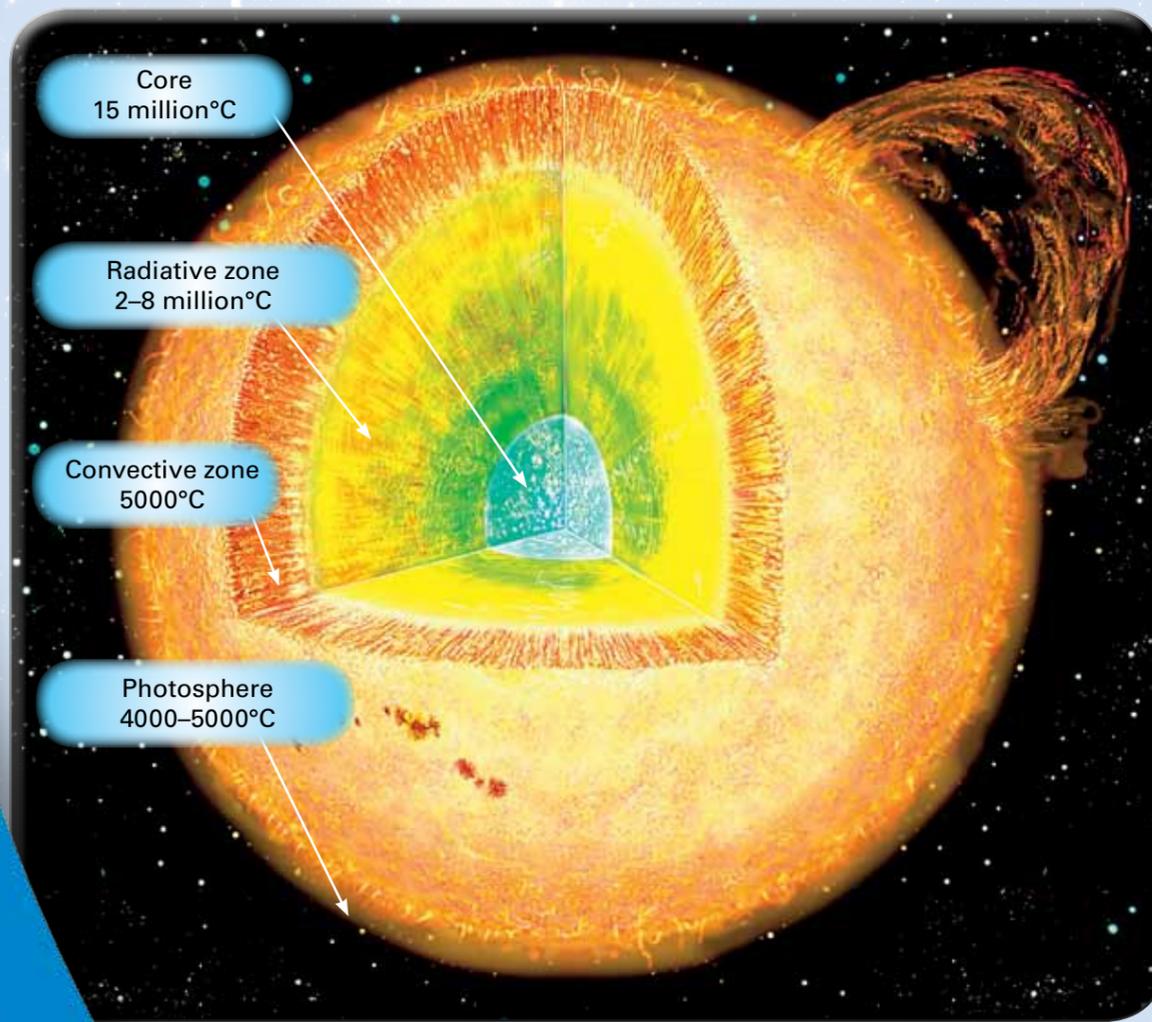


# WHAT ARE STARS MADE OF?

Scientists have discovered that stars are made of **gases**. They have a **core of hot, thick gas**. This is surrounded by **two layers of cooler gas** and a **surface, called a photosphere**.

## Stars have a core

The centre of a star is called the core. Although the core is small, it is heavy because it is full of tightly packed gases. The core is where energy is made by **nuclear fusion**.



**A** This is the make-up of our Sun, which is a typical star.

## Stars have two layers of gas around the core

Stars have two layers of cooler gases that lie between the core and the surface. They are called the radiative and convective zones. Energy made in the core travels very slowly through these zones to the star's surface.

## Stars have a surface

The surface of a star is called the photosphere. This is where the star's energy flows out into **space**. The photosphere is also the beginning of a star's **atmosphere**. A lot of solar activity takes place in this zone.

- V** It can take hundreds of thousands of years for energy from the core to reach a star's surface. It is this energy we see shining from stars billions of kilometres away.

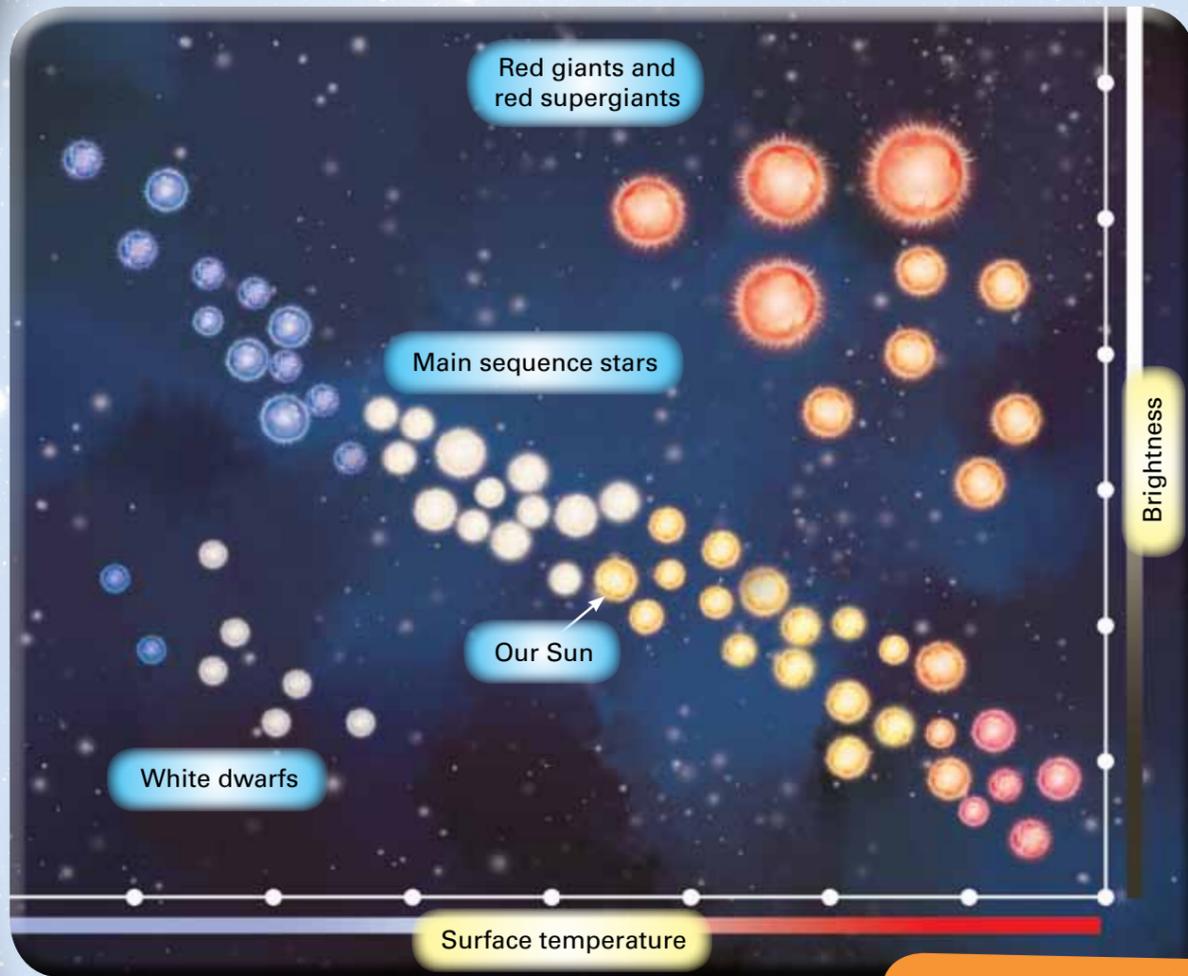
## Star fact

Conditions on the surface of a star are violent. The heat from the centre of a star boils up on the photosphere. Stars send out huge spikes, called spicules, and loops of gas, called prominences. They can reach thousands of kilometres into space.

# ARE ALL STARS THE SAME?

Stars come in many colours, temperatures and sizes. Astronomers can find a star's temperature and age by looking at its light.

Astronomers group stars according to their colour and **luminosity**. Most stars are main sequence stars, some sit in clusters and many are in pairs, known as binary stars.



**A** A graph called a Hertzsprung–Russell diagram helps astronomers to place stars into particular groups. This is done by plotting a star's brightness against its temperature, as well as noting its colour.

**WHAT DOES IT MEAN**



**luminosity** the amount of energy given off by a star in the form of brightness

## Star fact

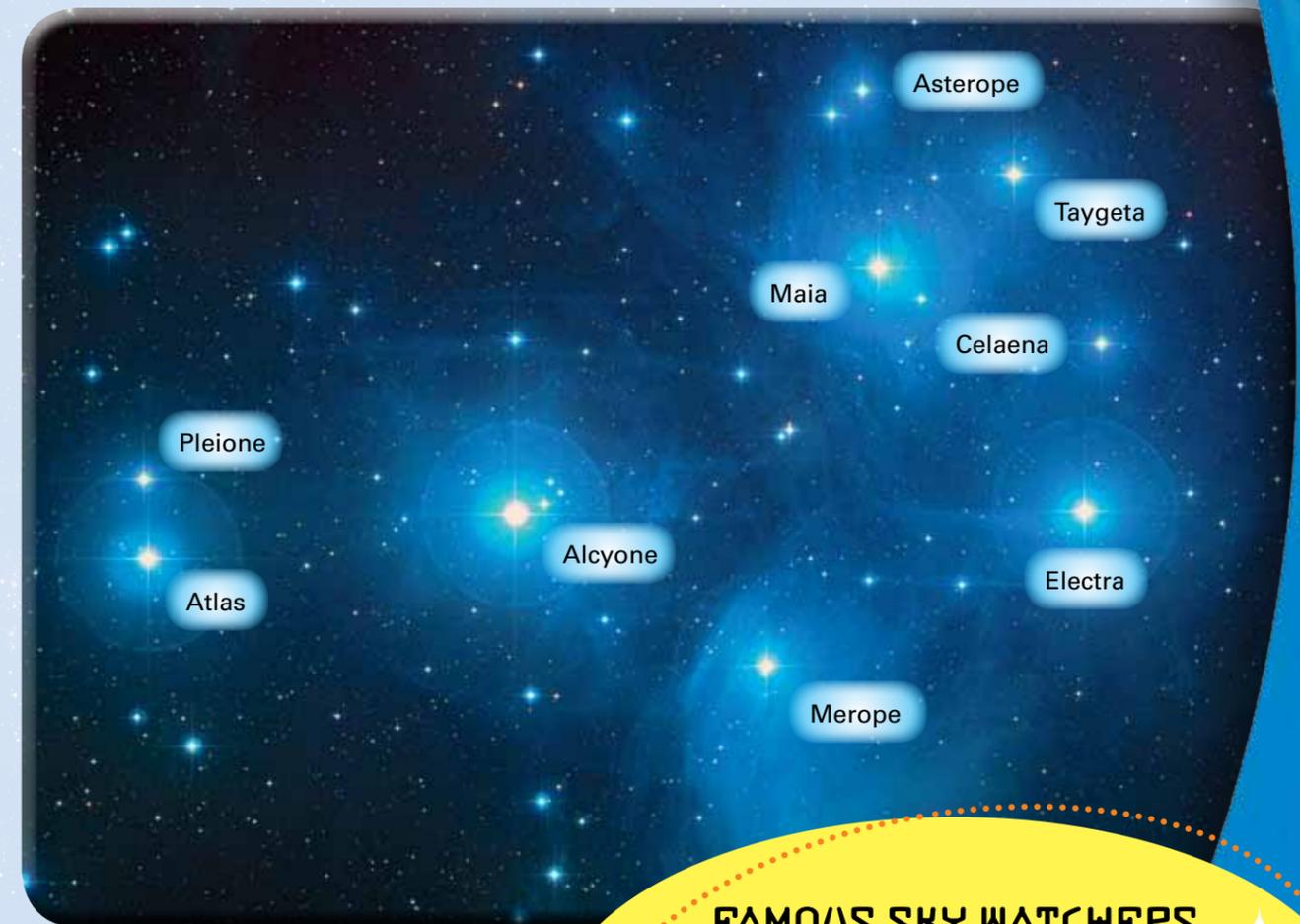
Small yellow or orange stars live for longer than large blue or white stars. This is because large stars burn their fuel about ten times more quickly than small stars.

## Most stars are main sequence stars

Stars begin their lives as main sequence stars. They burn **hydrogen** in their cores, creating **nuclear fusion**. Some of these stars are average in size and some are huge. Main sequence stars are grouped by astronomers according to the colours they give out. Stars that look blue and white are the hottest. Yellow, orange and red stars are the coolest.

## The hottest stars are blue and white

Blue and white stars are the hottest main sequence stars. Smaller bluish-white stars have a surface temperature from about 7500°C to 10000°C. The surface of larger, brighter blue stars can be as hot as 60 000°C.



**A** This group of blue-white stars is called the Pleiades. These stars are about 375 light-years from Earth.

## FAMOUS SKY WATCHERS



Cecilia Payne-Gaposchkin was a British-American astronomer who studied the temperature of stars. In 1925 she became the first astronomer to suggest that hydrogen was the most common element within a star.

### Cooler stars are yellow, orange and red

Yellow, orange and red stars have cooler surface temperatures than blue or white stars. The hottest of the yellow stars has a surface temperature of about 7500°C. Orange stars have a surface temperature of between 3500°C and 5000°C. Red stars are the coolest, at between 2000°C and 3500°C.

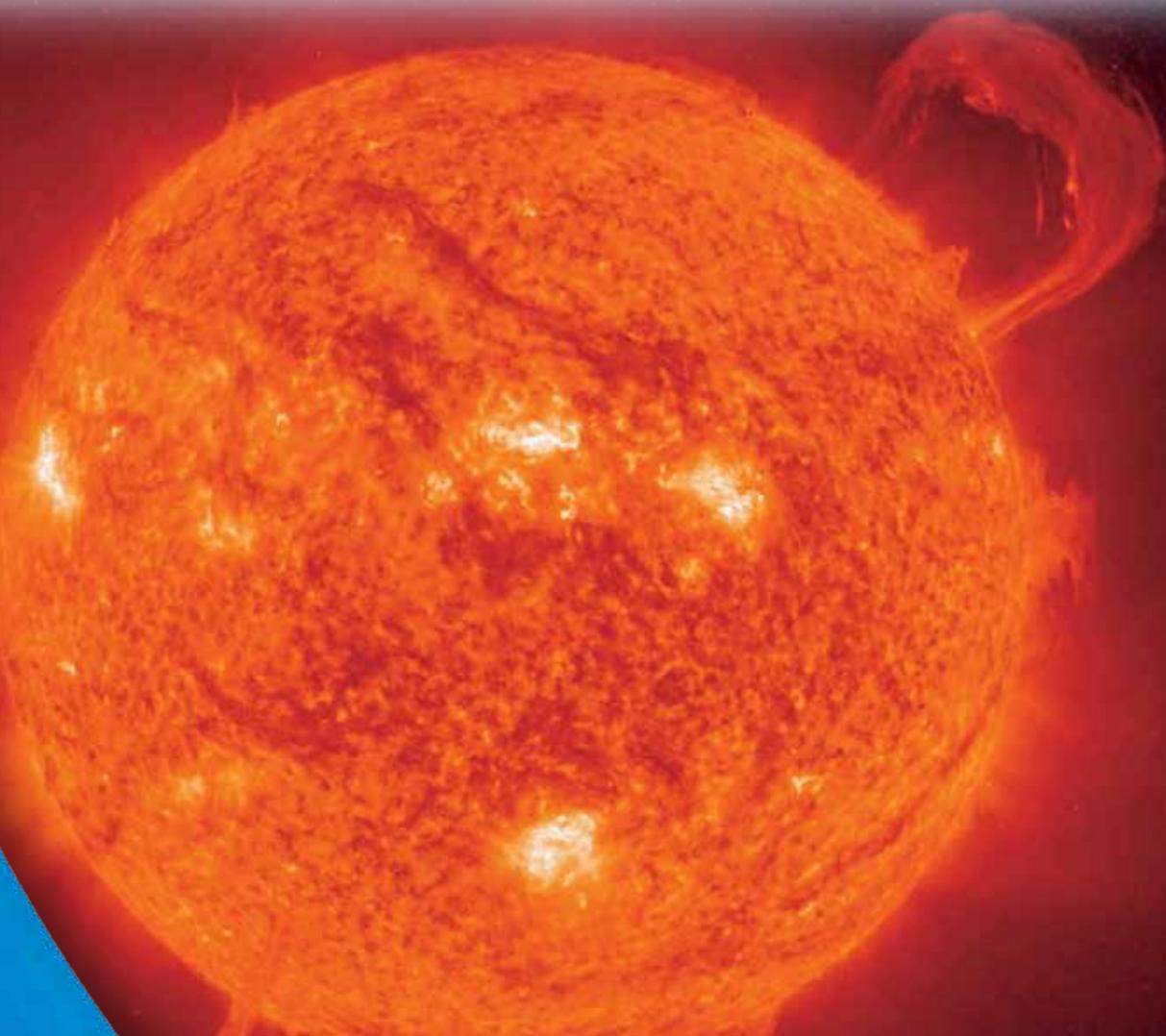
### Some stars are part of a cluster

Astronomers have found many large groups, or clusters, of stars in our galaxy and beyond. They are known as global clusters and open star clusters.

### Gravity brings global clusters together

Global clusters are large groups of stars that are held together by their own gravity. These groups of stars are very old and often have millions of members.

✓ Our Sun is a yellow main sequence star. It has a surface temperature of about 5500°C.

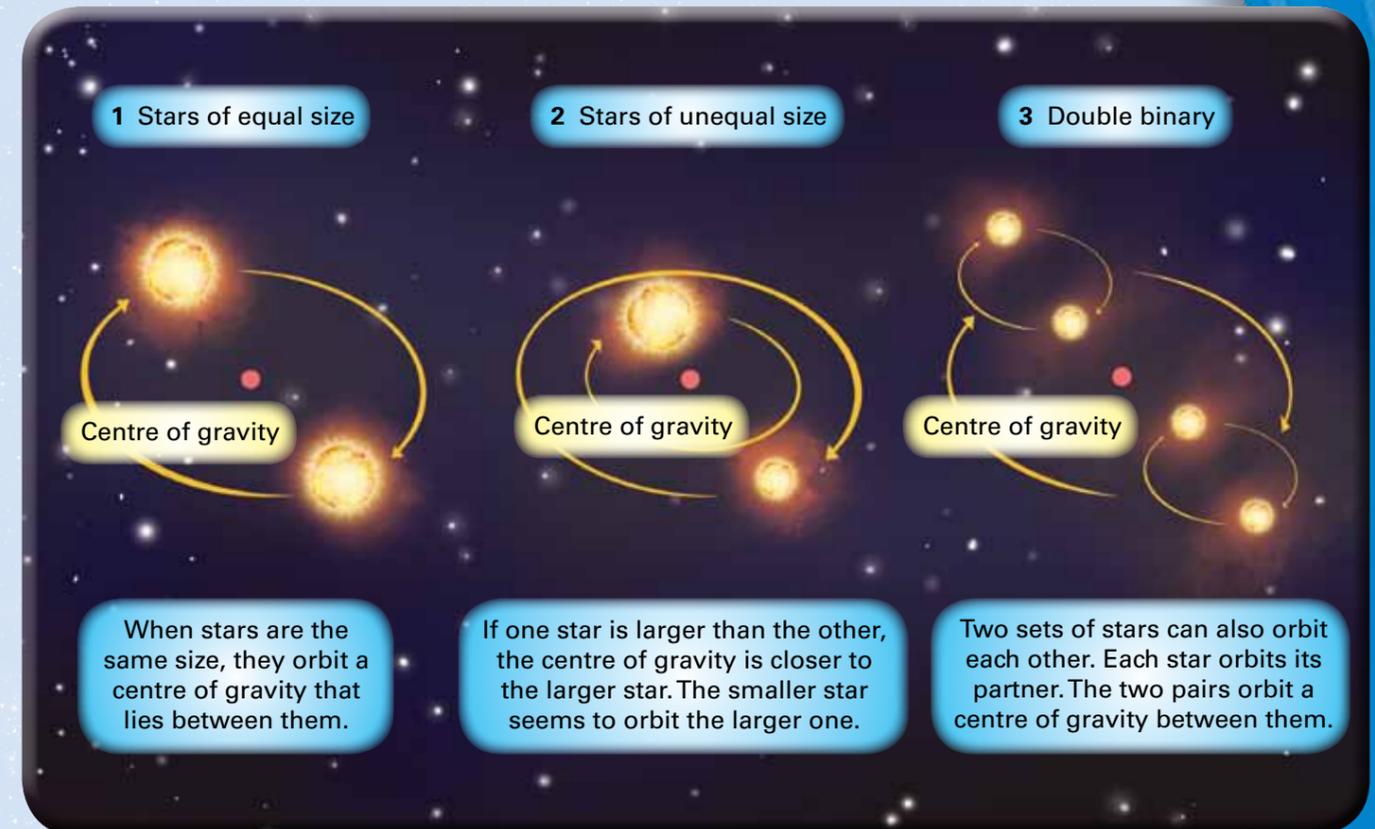


### Open star clusters are groups of young stars

Open star clusters are young stars that were formed from the same nebula. As these stars grow older, they move further apart.

### Many stars are binary stars

Many stars are double stars, or binary stars. They are stars that orbit each other. Astronomers believe that more than half of the stars in the galaxy are binary stars.



⚠ There are different types of binary stars. They can change from one to another as they grow older. Some stars orbit so close that gases can pass between them.

### FAMOUS SKY WATCHERS



The earliest known observation of a double, or binary star, was made by Giovanni Riccioli in 1650. Using a telescope, he was able to see that Mizar, which is a star in the constellation of Ursa Major, was actually not one but two stars.