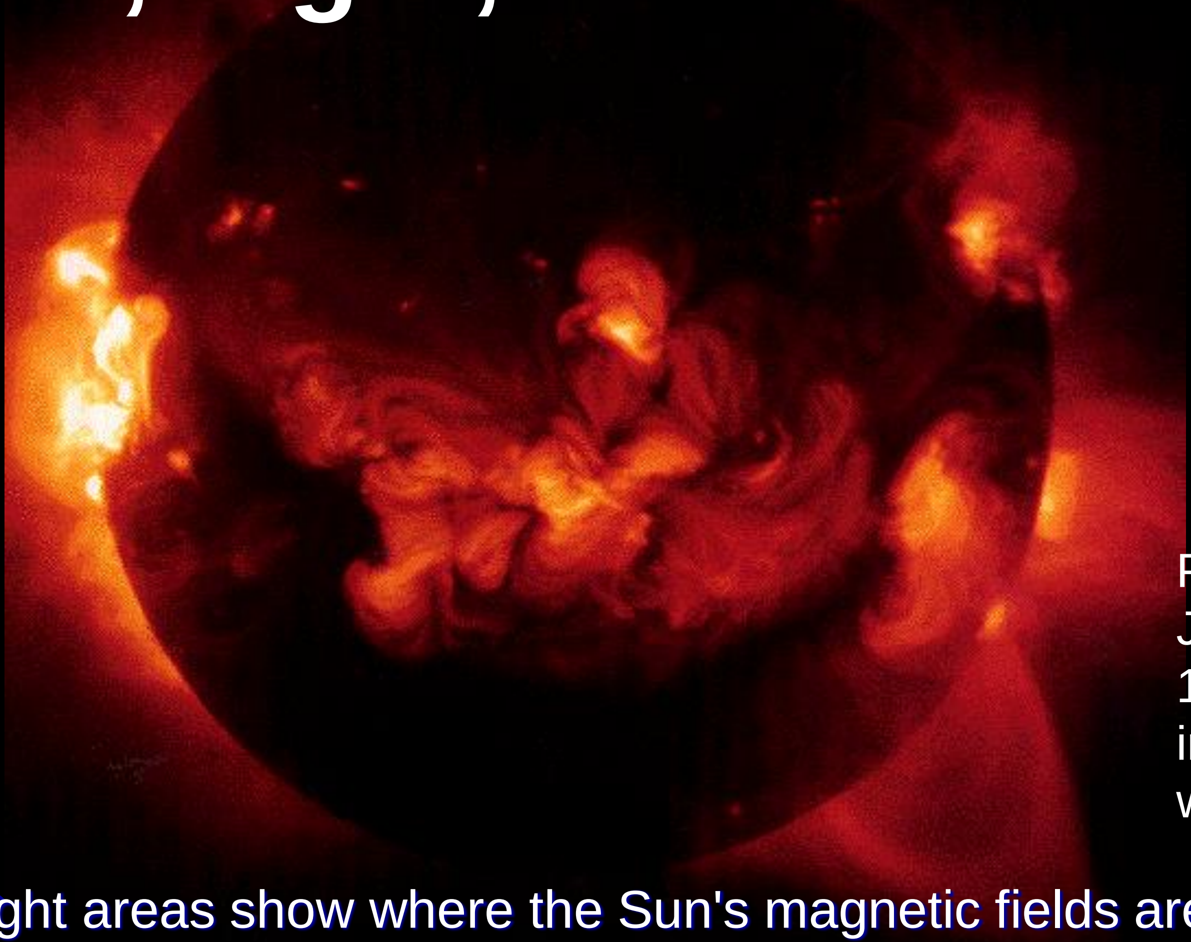
Stars, Light, and The Sun

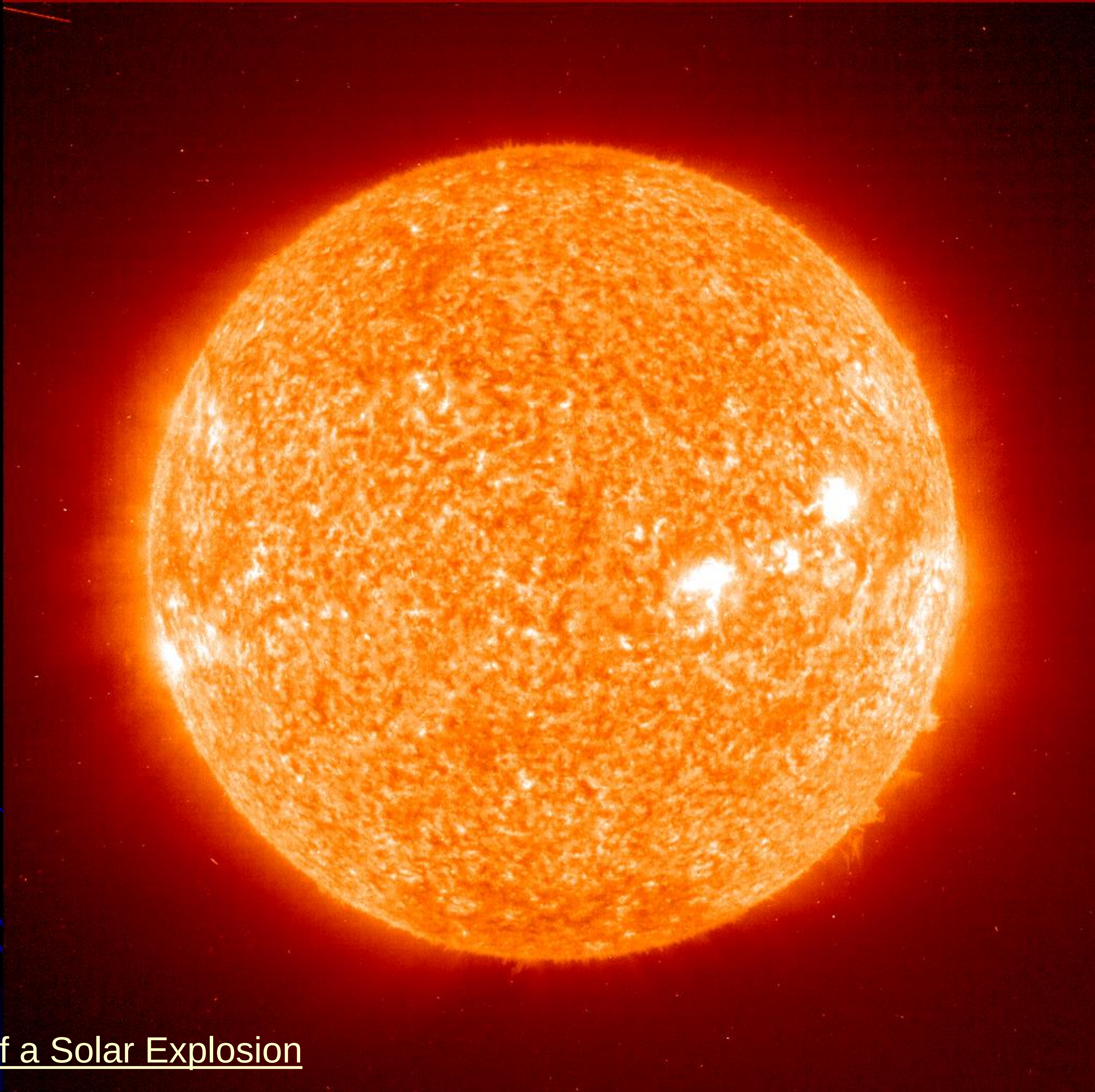


Solar prominences

Picture taken January 24, 1992. X-ray image wavelengths.

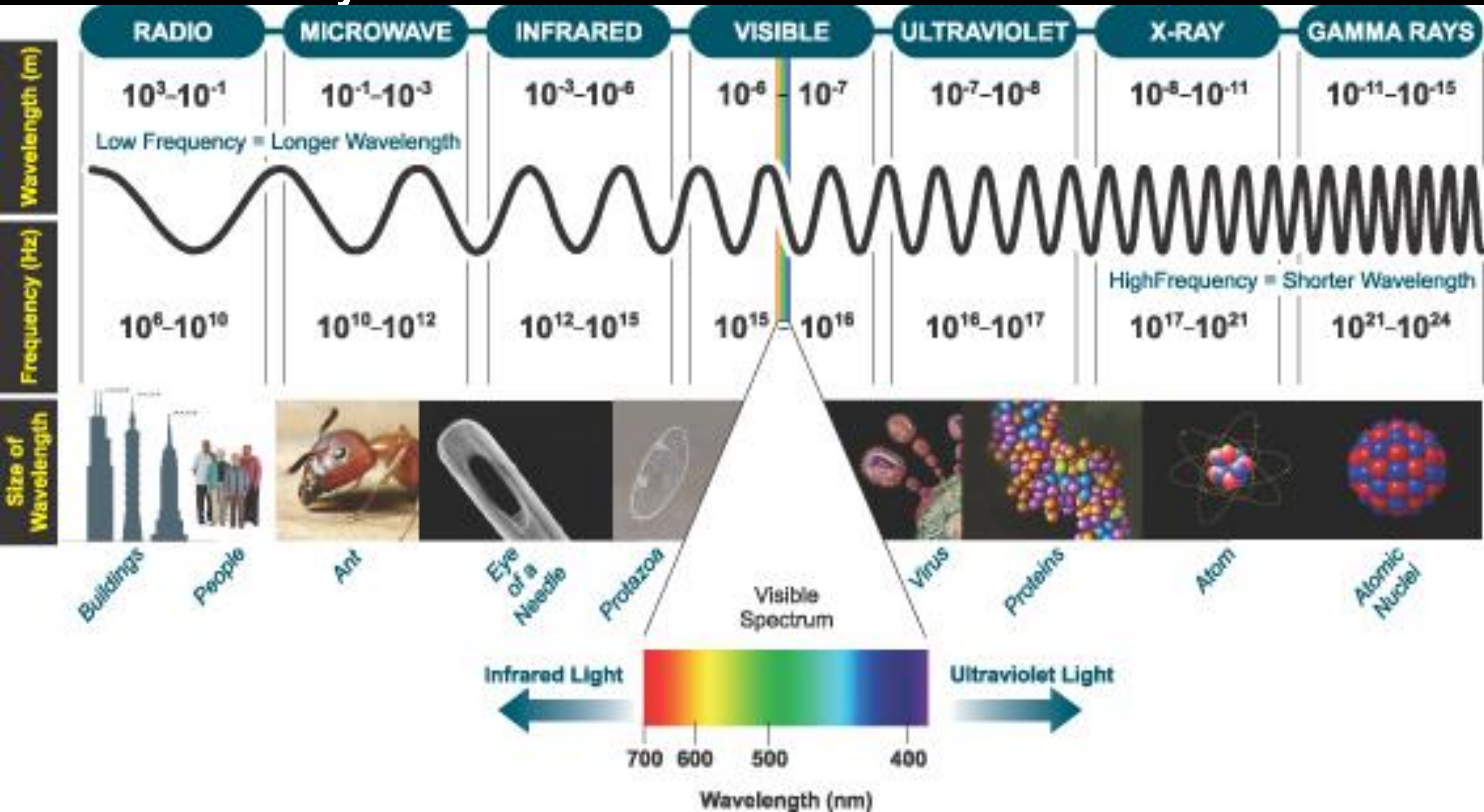
Bright areas show where the Sun's magnetic fields are strong enough to trap the hot gases in the corona of the Sun. The fields are not strong enough to do this at the poles of the Sun. Notice that the surface of the Sun is dark: the X-rays are from gases which are heated to millions of degrees. The surface of the Sun is much cooler than this, so it appears dark.

Stars are huge balls of hot **gas** that emit **light** and other types of radiation



[NASA _ Anatomy of a Solar Explosion]

Stars give off more than just visible light they also give off other types of waves as well as **heat**. Ultra violet rays, gamma rays as well as light waves are just a few.



Understanding Light

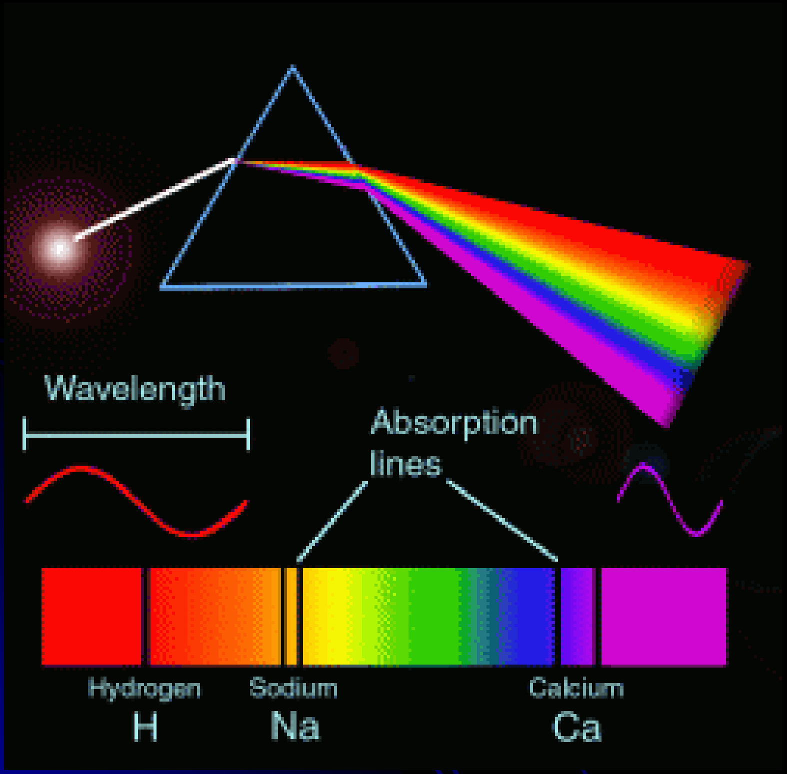
- What is light???
  - Electromagnetic radiation of any wavelength
    - Electromagnetic spectrum: gamma rays, X-rays, UV light, visible light, infrared radiation, microwaves, radio waves
  - *Visible Light*: the small portion of the electromagnetic spectrum that we can detect with our eyes

[The Electromagnetic Spectrum]

Studying Light

- Main instruments
  - Radio telescopes
    - Focuses on radio waves
    - Usually used in groups
    - Can be used during the day
    - Most astronomical objects emit radio waves
  - Spectroscopes
    - Spectroscopy studies how light and matter interact with each other
    - Used in astronomy for identifying the composition of objects in the universe

Spectroscopy: measuring light that is emitted, absorbed, or scattered by material

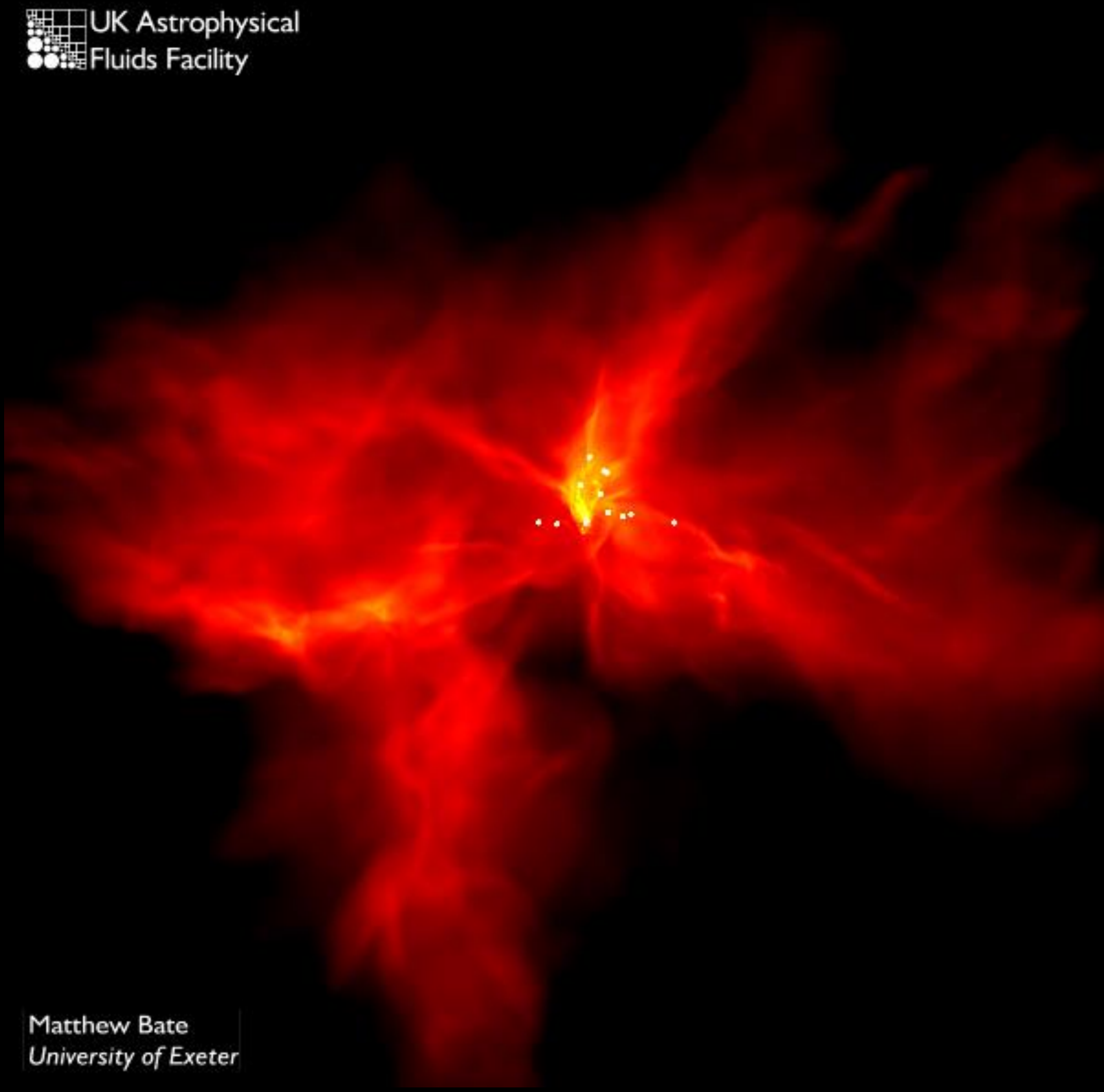


- an object's light can tell astronomers the physical properties of that object (such as temperature, mass, luminosity and composition)

Spectroscopy of Stars

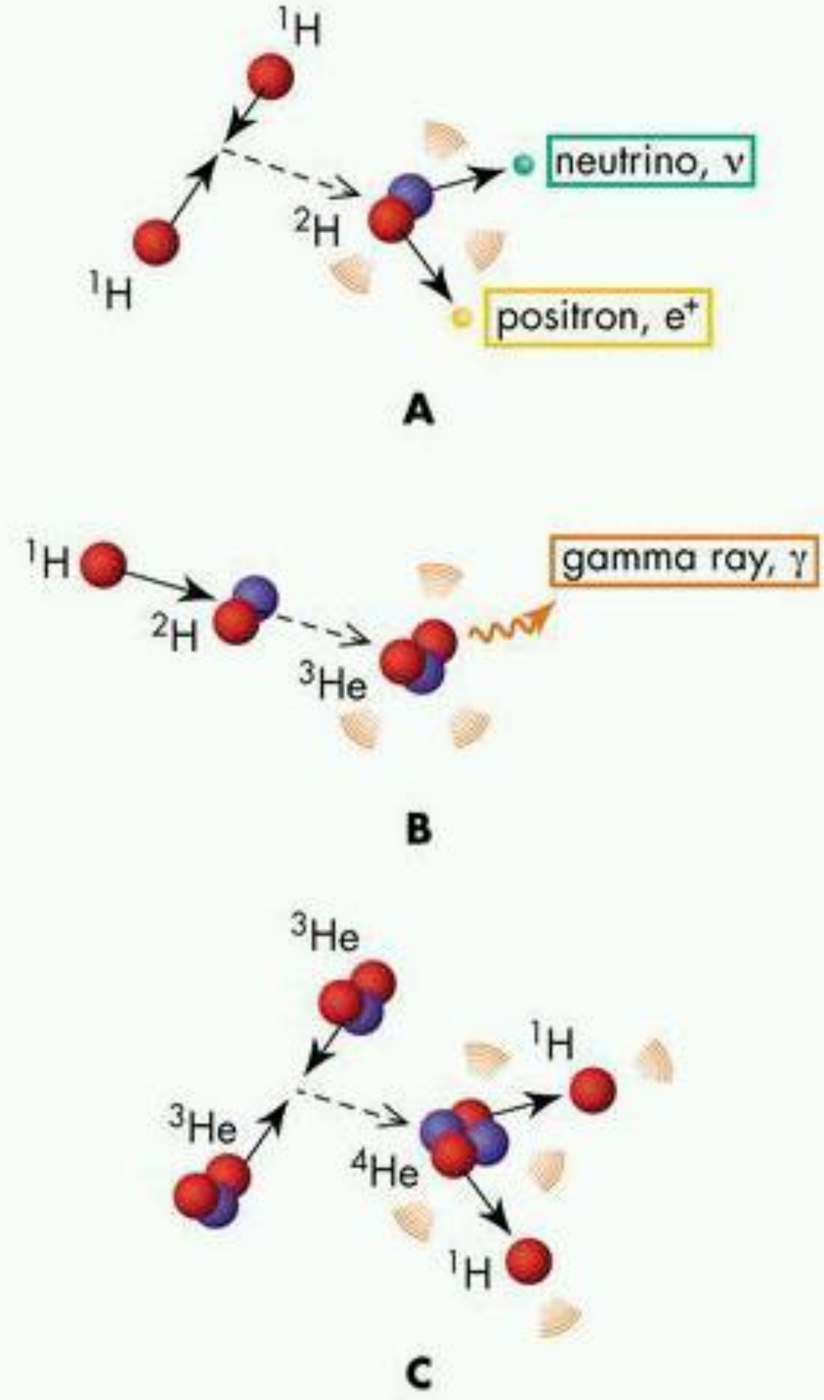
A star begins as a **nebula**, a cloud of gas and dust made up of about 70% hydrogen, 28% helium and 2% heavier elements.

A force, like an explosion from a nearby star, **<u>compresses</u>** some of the particles and the nebula begins to contract.



As the particles come together they **fuse** to become bigger particles. As these particles get bigger and more compact the **gravitational pull** of the nebula increases the **density** and **temperature** of the nebula's core. A **protostar** is formed in the center of the nebula.

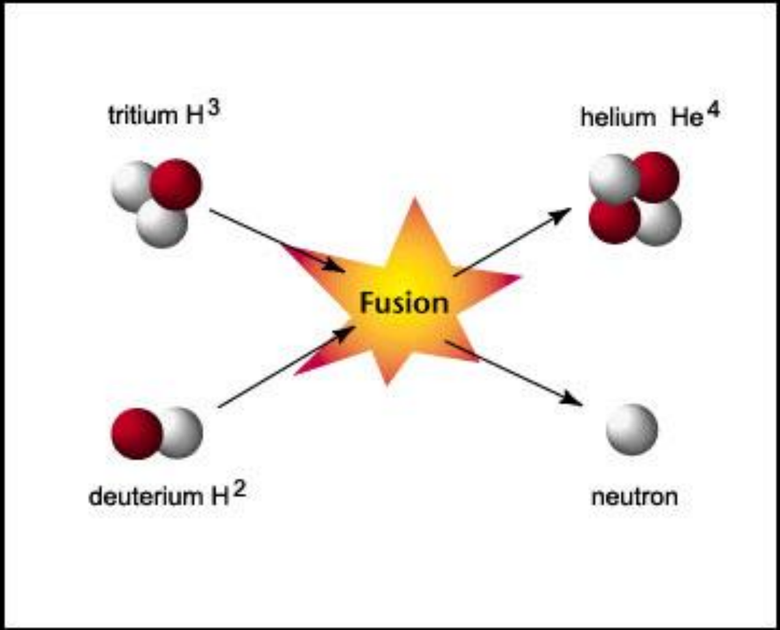
When the collisions and pressure increase to raise the temperature in the core of the protostar to over **18,000,000 °**F, **nuclear fusion** begins. Nuclear fusion in a star is the combining of smaller **hydrogen** atoms to become larger **helium** atoms giving off large amounts of **energy**.



The sun is powered by **nuclear fusion**, combining hydrogen atoms to create helium atoms

- Like all stars, the sun is a huge fusion reactor, pumping out 100 million times as much energy in a single second as the entire population of Earth uses in a year!

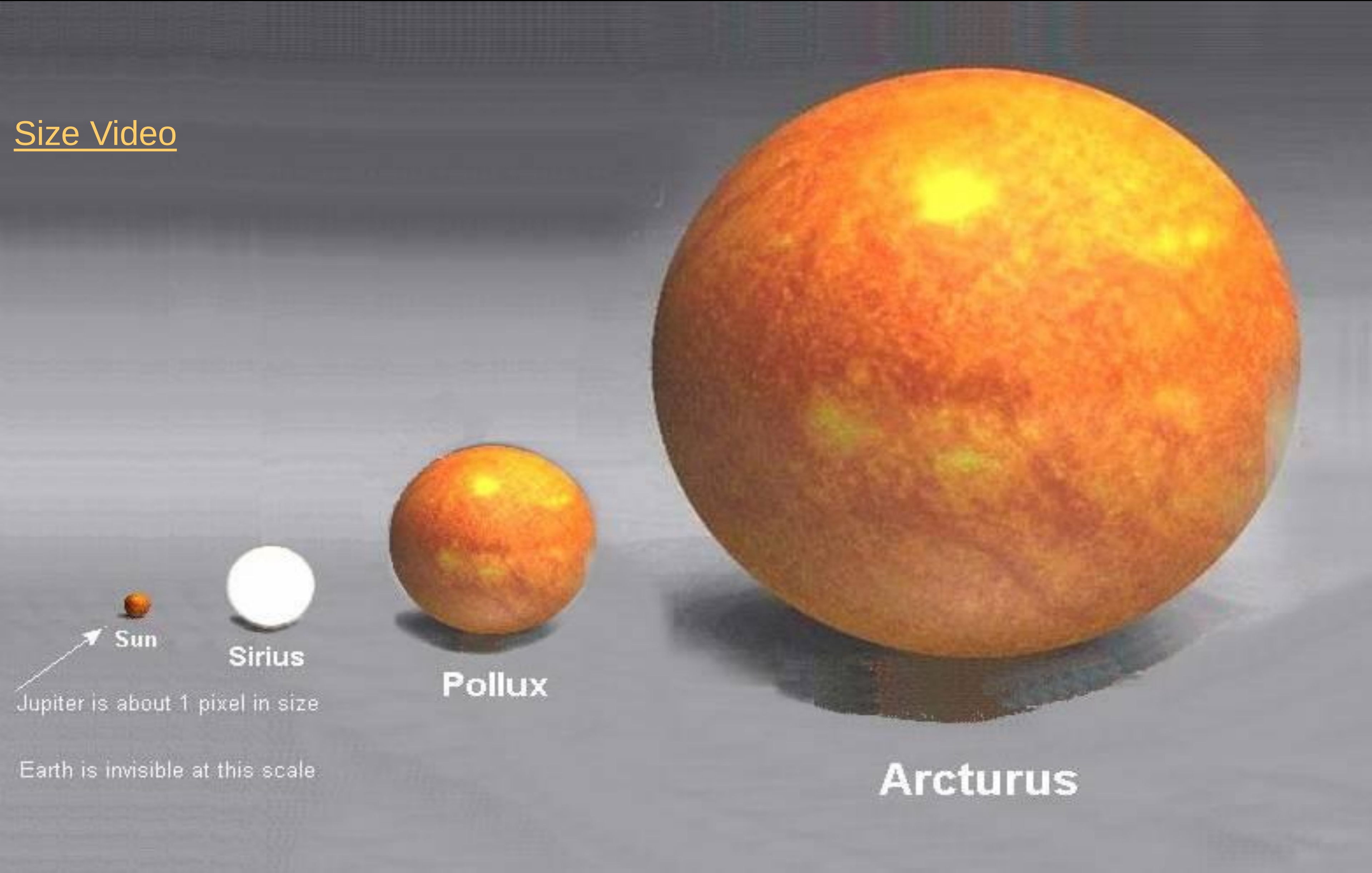
Power of the Sun



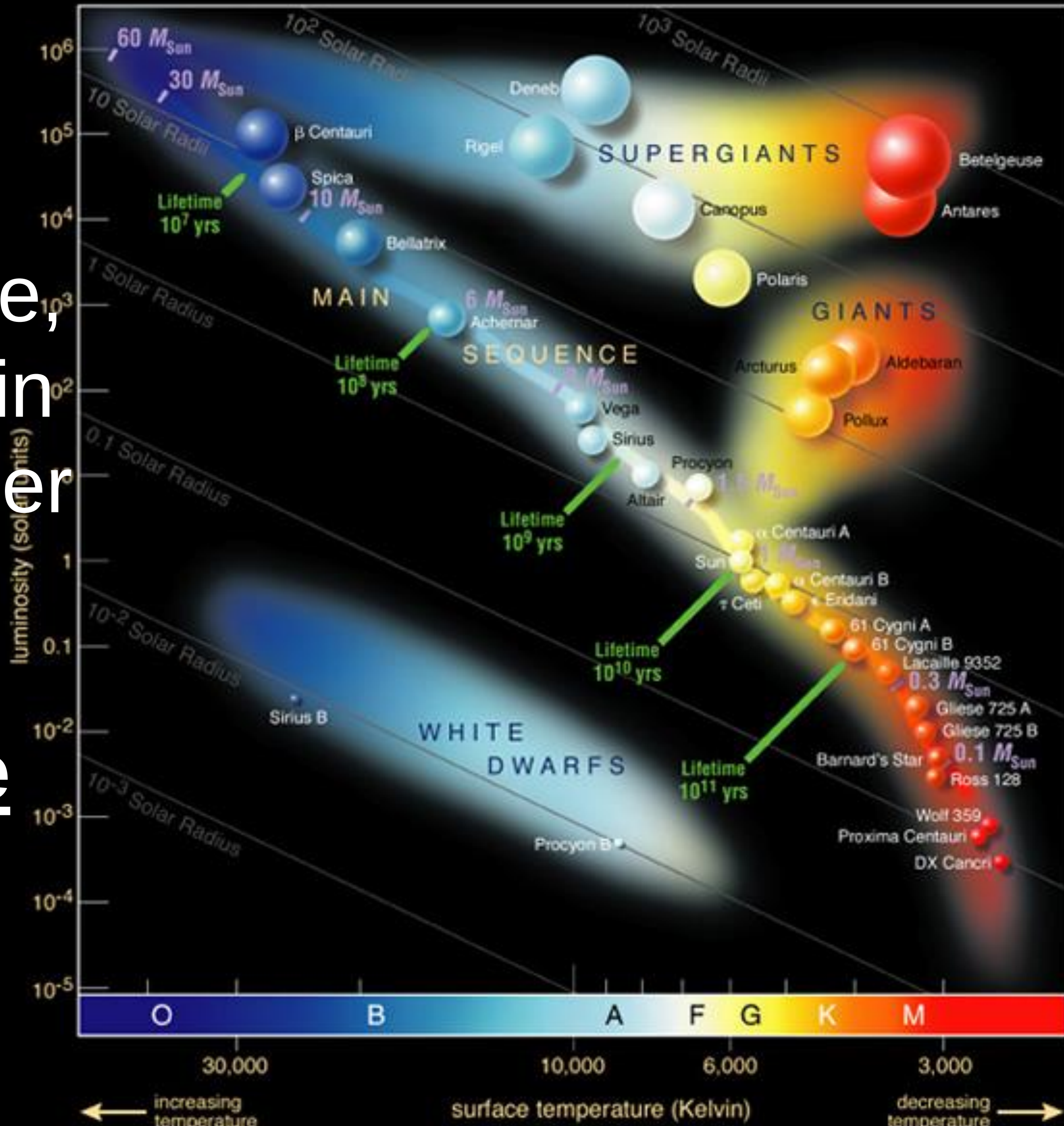
Stars vary in size from 13 miles wide to **1000** times that of the Sun. As far as stars go, our star, the Sun, is an average size star. It is **109** times the size of Earth (in terms of diameter) 332,000 times in mass and is **93** million miles from Earth or 1 **astronomical unit** (1AU).

A star's brightness and color depends on its **temperature**, **size**, and **distance** from Earth.

Size Video

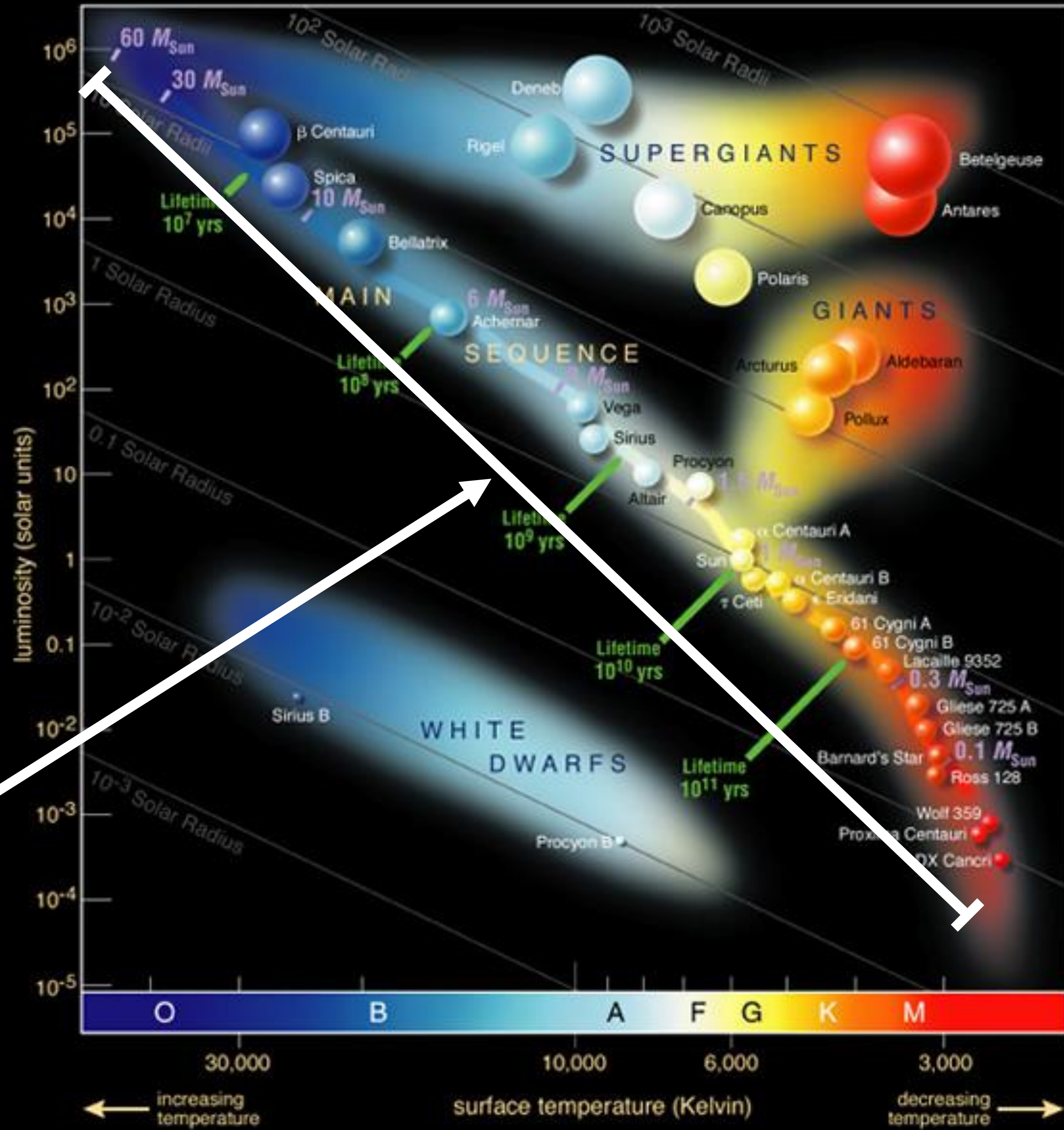


The color of a star is dependent on its temperature, the more **red** in color, the cooler the temperature, the more **blue** in color, the hotter the temperature.

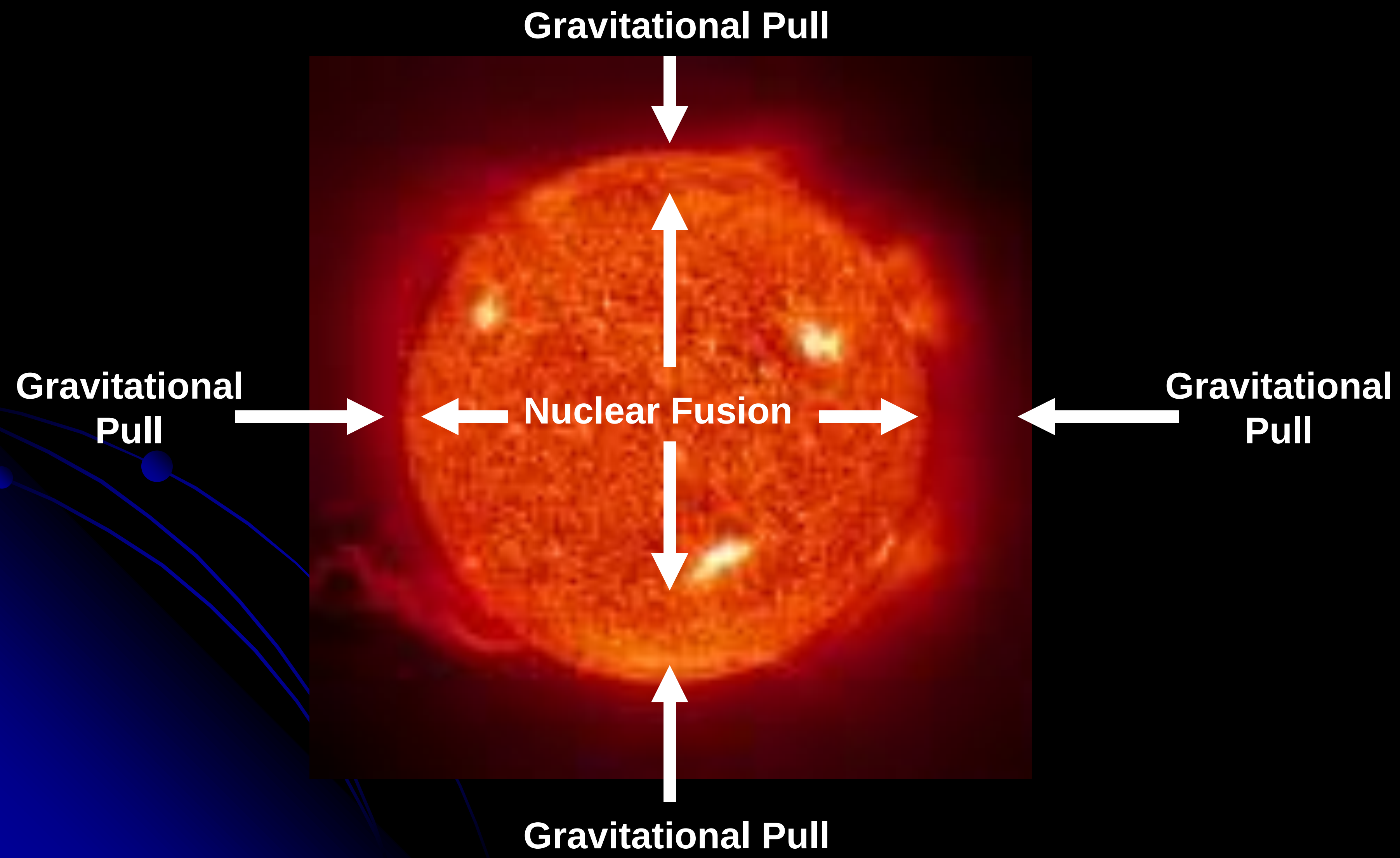


Types of Stars

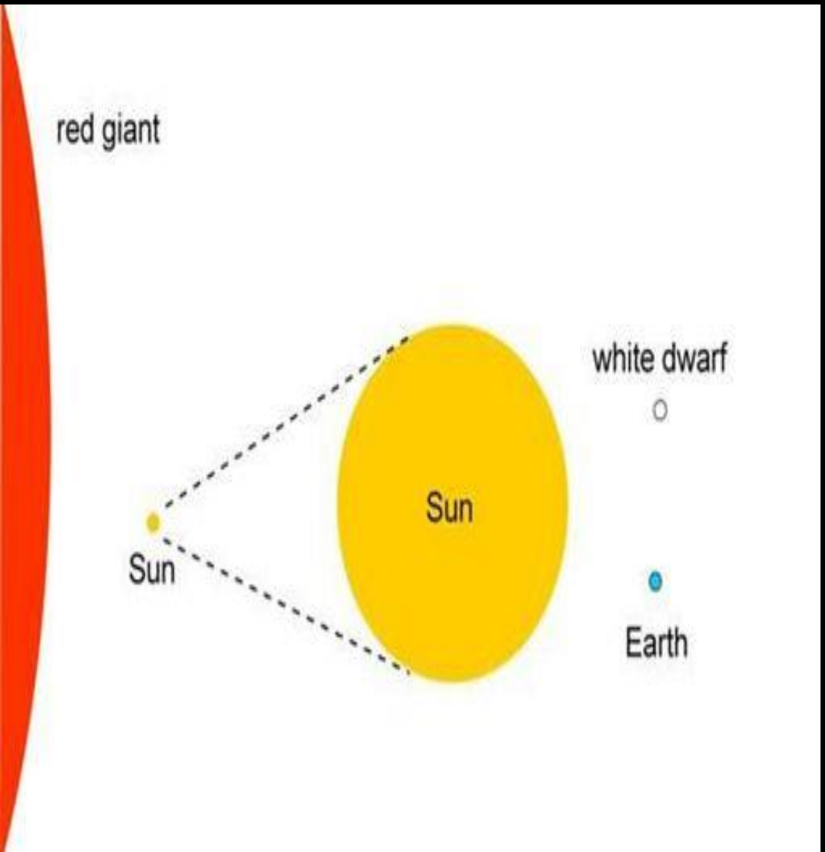
After a star is formed out of a nebula it enters its 2nd and longest stage called the **main-sequence**.

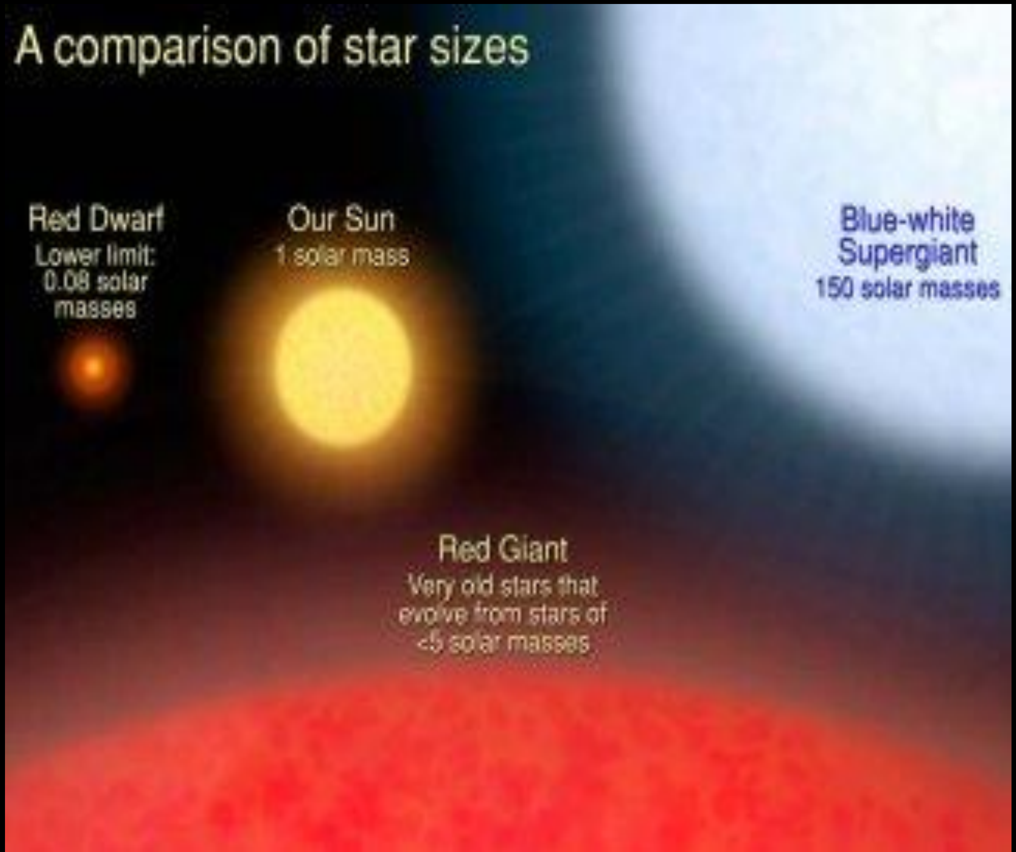


Nuclear fusion produces enormous amounts of radiant **energy**. The force of the nuclear fusion is balanced by the **gravitational pull**.

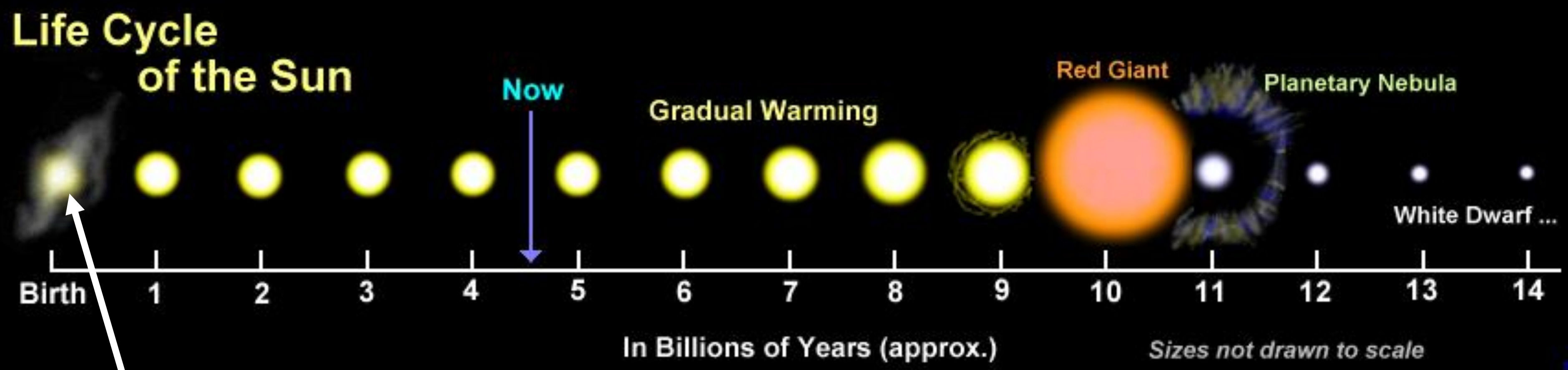


Other than average stars there are stars that are bigger and smaller. There are **red giants**, **supergiants**, and **white dwarfs**. These stars are in there 3rd stage of life when almost all of their hydrogen is used up. [Star Death and Element Creation]





Average size stars like ours turn into **red giants** before they die. Helium is then what is left over and it begins to fuse into carbon. When this stops the star turns into a **white dwarf**. Sometimes a white dwarf has an explosion called a **nova**.

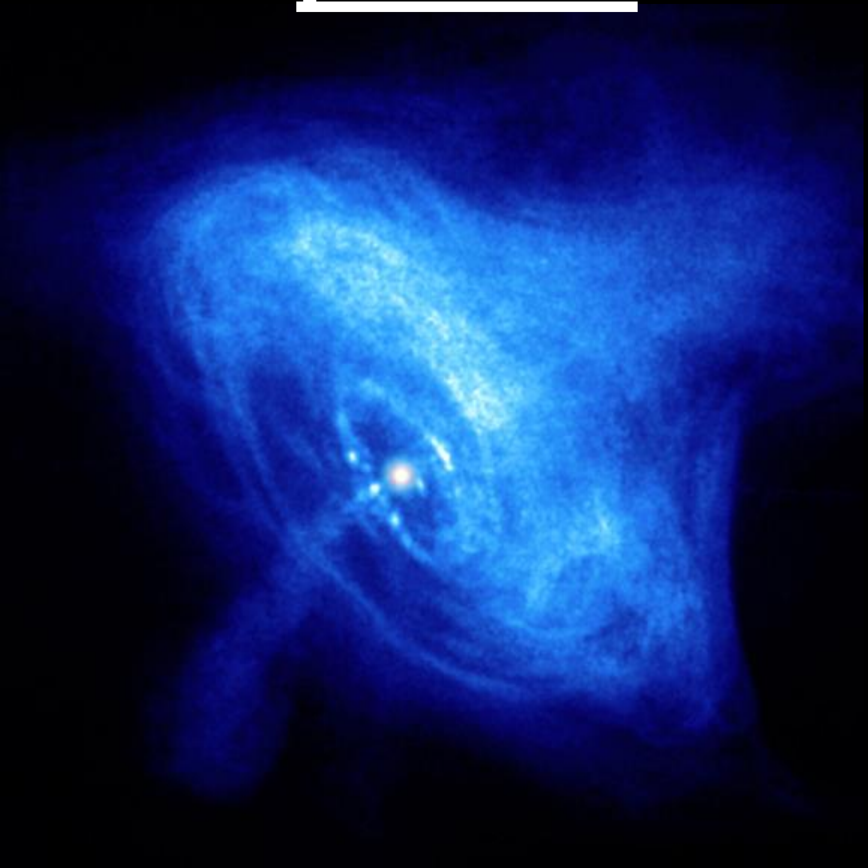


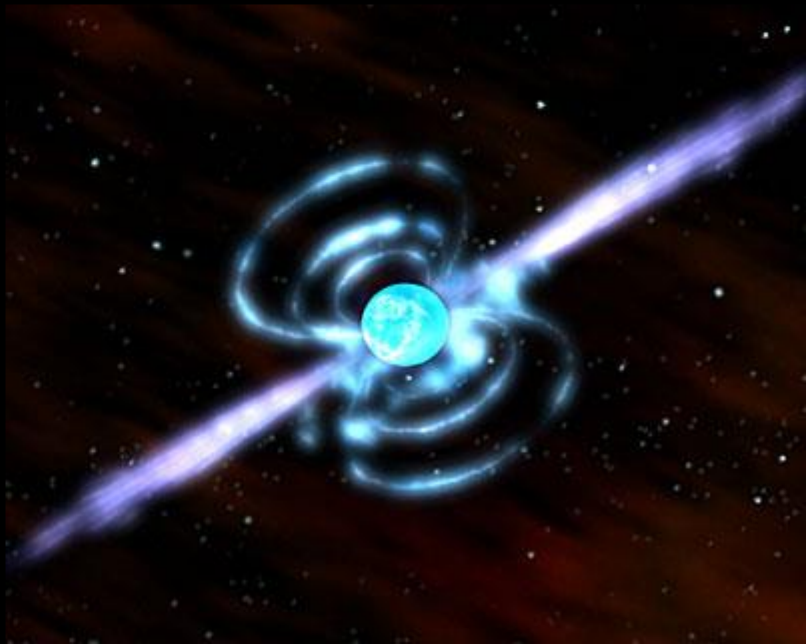
Nebula then into a protostar

A larger than average star turns into a **supergiant** before it dies. It swells to an enormous size then **explodes**. This explosion is called a **supernova**. Two results can come from a supernova a **neutron star** or a **black hole**.

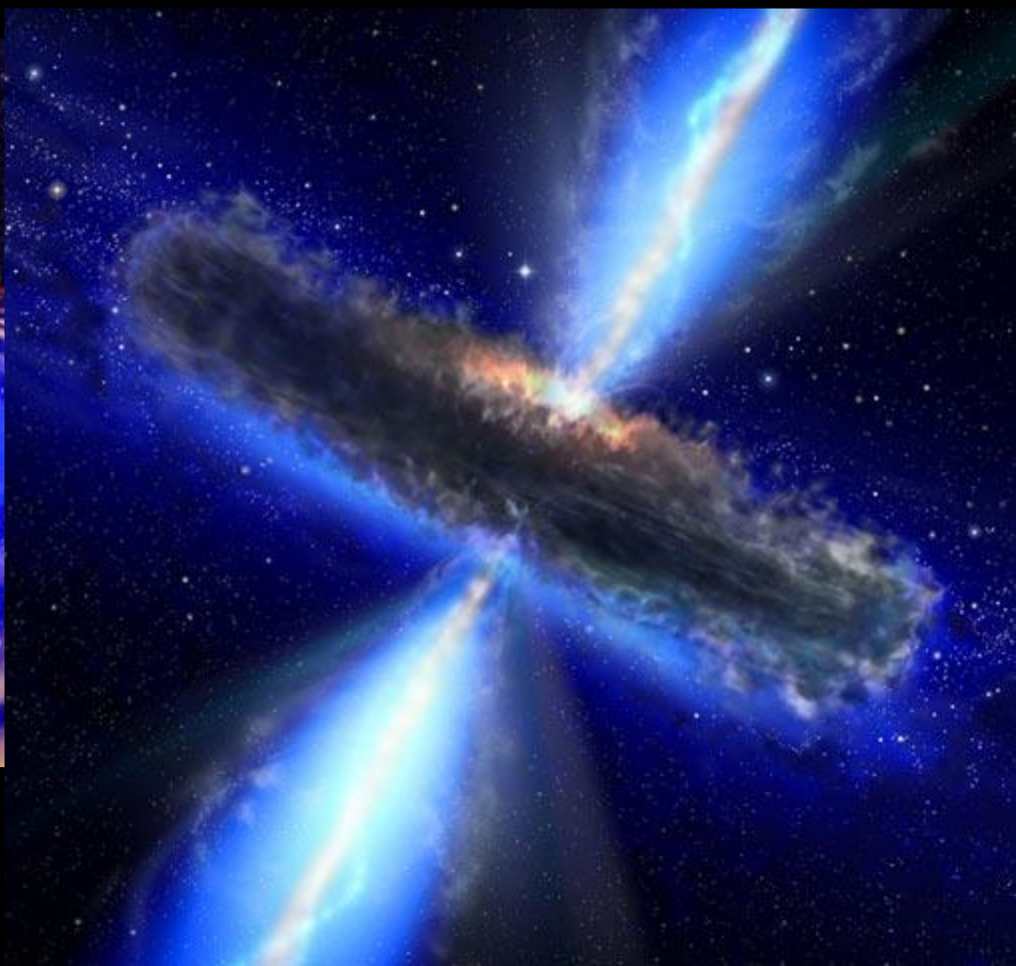
http://ed.ted.com/lessons/where-does-gold-come-from-david-lunney

A neutron star is a very small but incredibly dense ball of neutrons. A spoonful of matter would weigh **100** million tons on Earth. Neutron stars rotate rapidly and some called **pulsars** emit two beams of radiation.



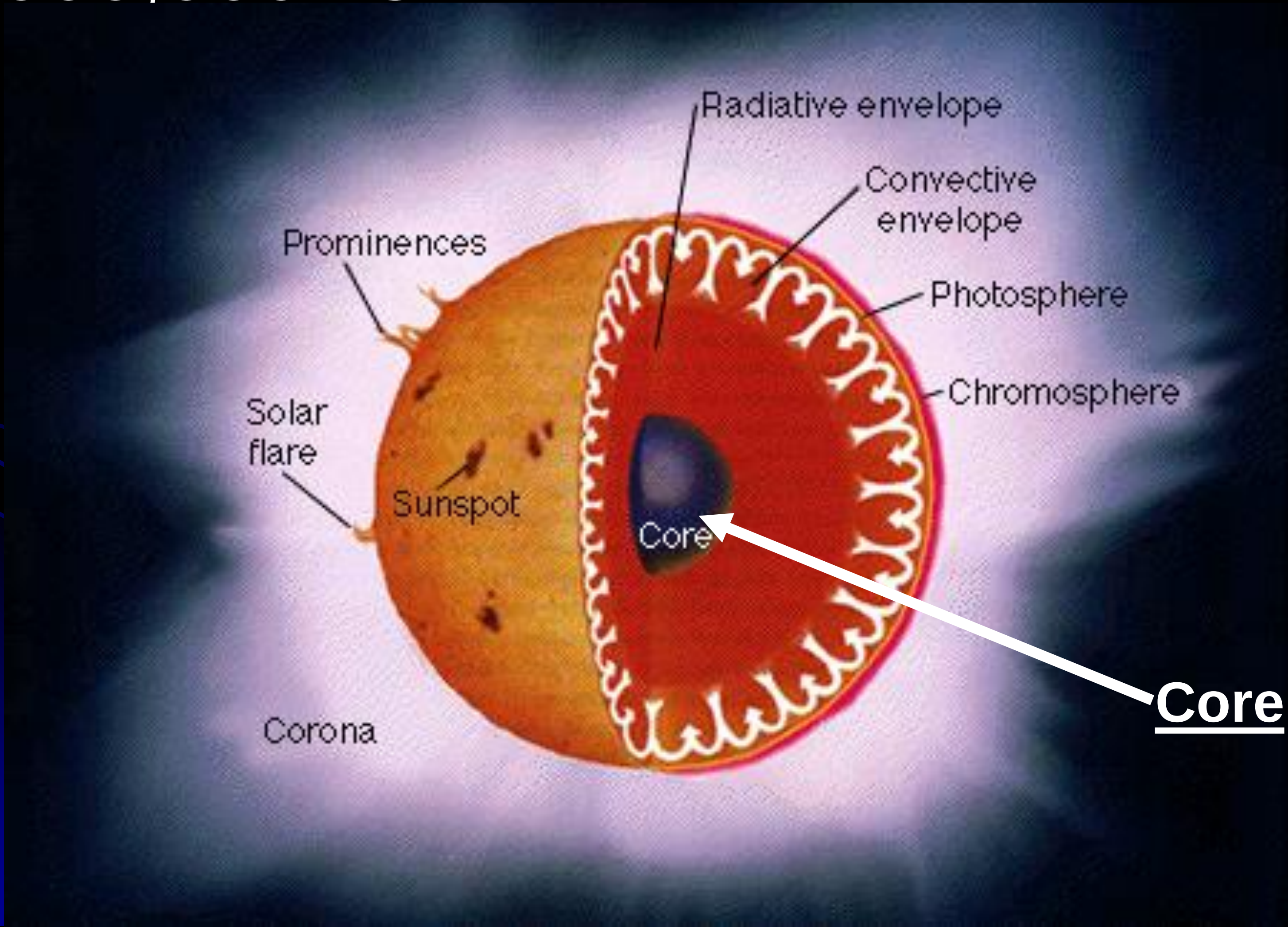


The other result from a supernova is a black hole. The **gravity** of a black hole is so great that not even **light** can escape.

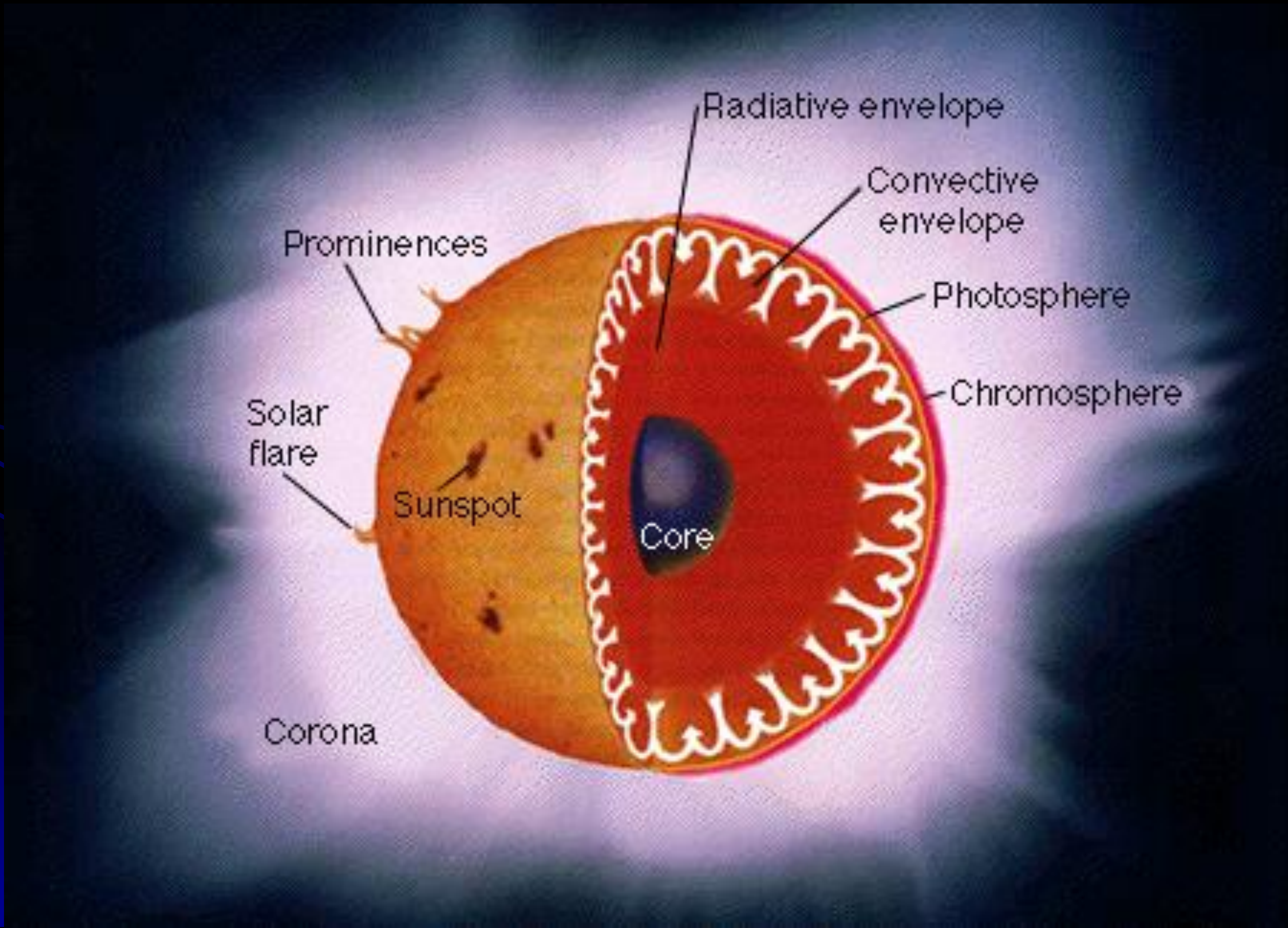


The Sun

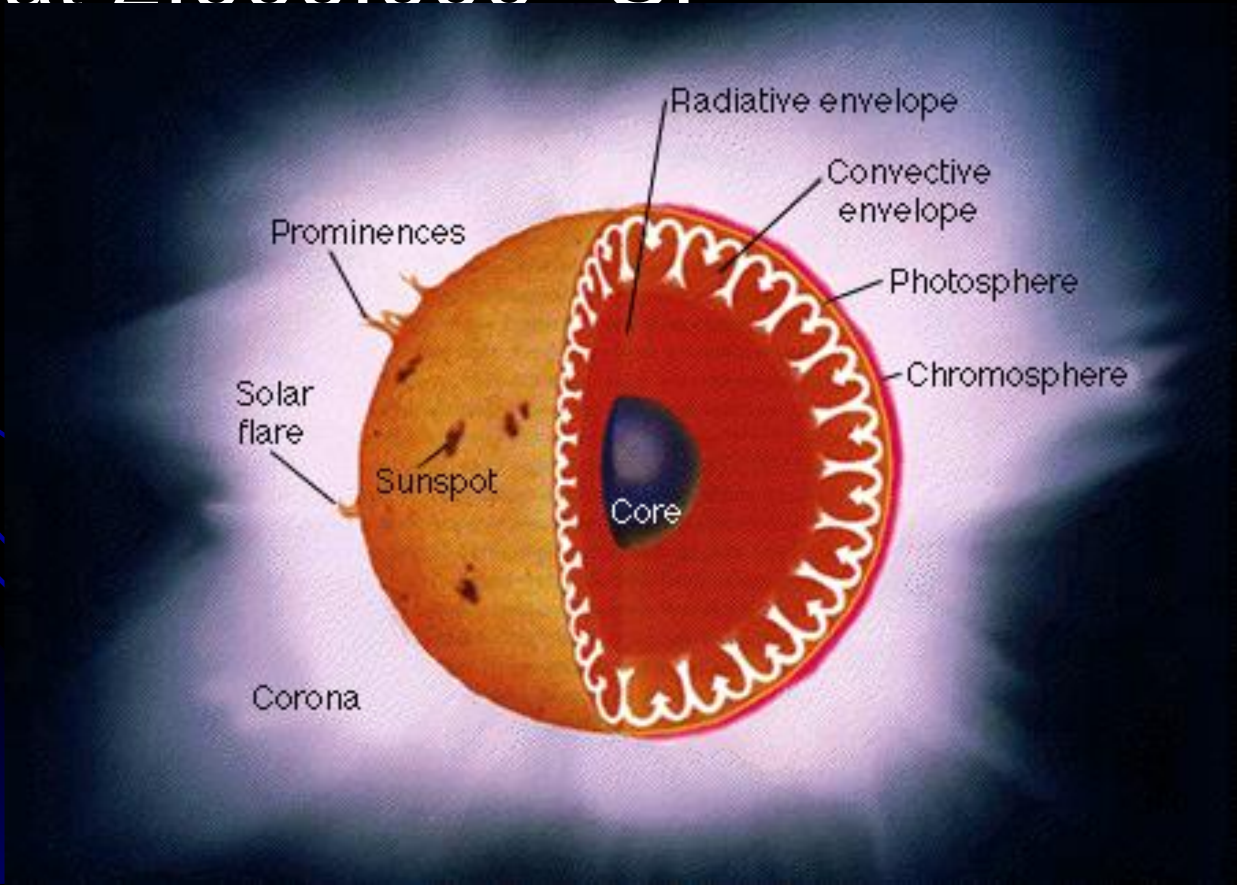
The sun has its own layers. The core is 15,000,000 °C.



The next zone is the **Radiative** zone, it is 2,500,000 °C.



The next layer is the convective zone at 1,000,000 °C, then the photosphere at 6,000 °C, then the **chromosphere** at 4,000-50,000 °C, then last but not least the **Corona** at 2,000,000 °C.



Sun Cycles

- The sun has 11 year cycles of maximum and minimum activity.
- 11 yr max/11 yr min