Chapter 11: The Sun

Chapter 11 Reading Assignment due today at 10:45am

In-class/HW Assignment due Monday, October 15th
(or today for +5pts bonus)

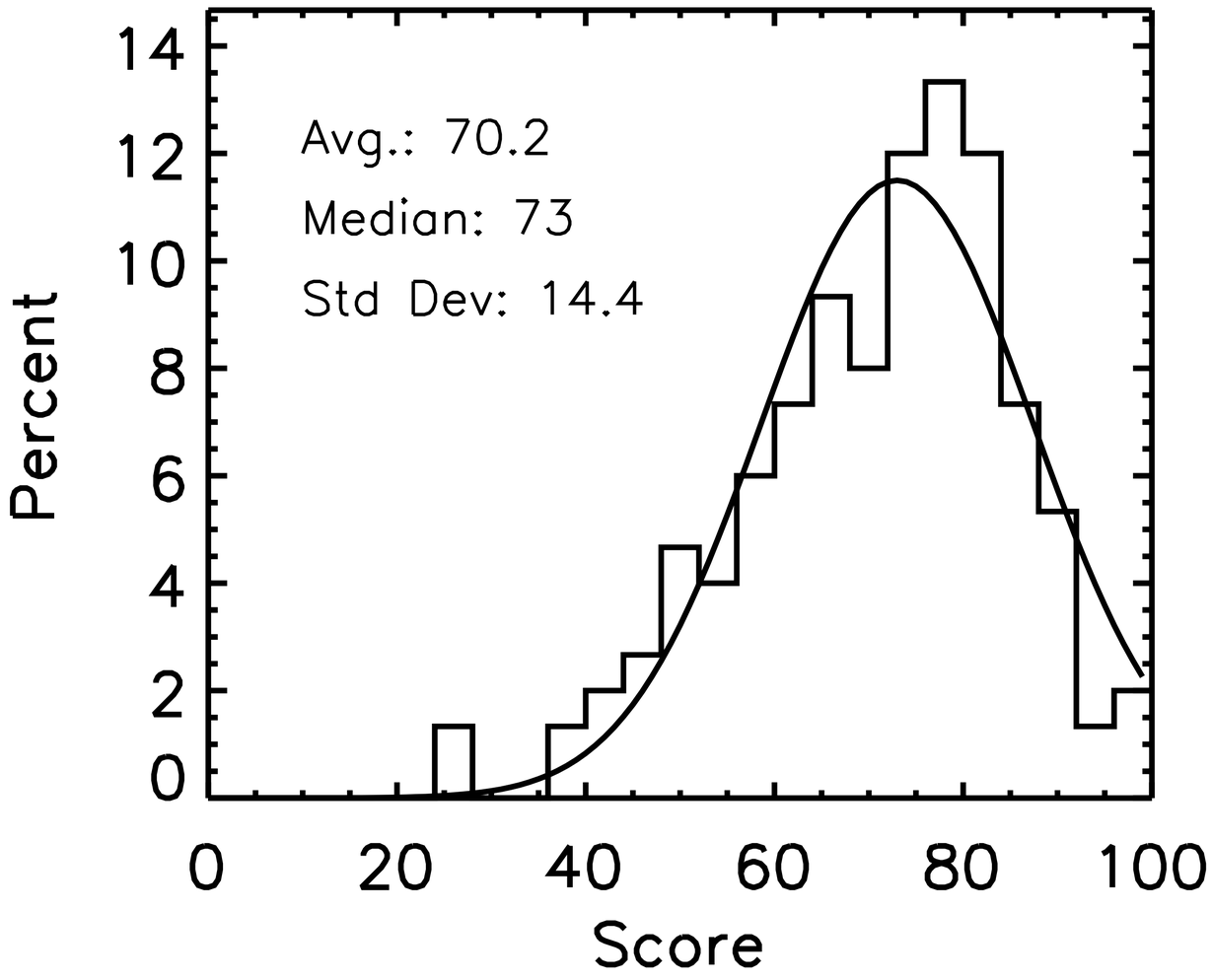
Are your grades in Canvas correct???

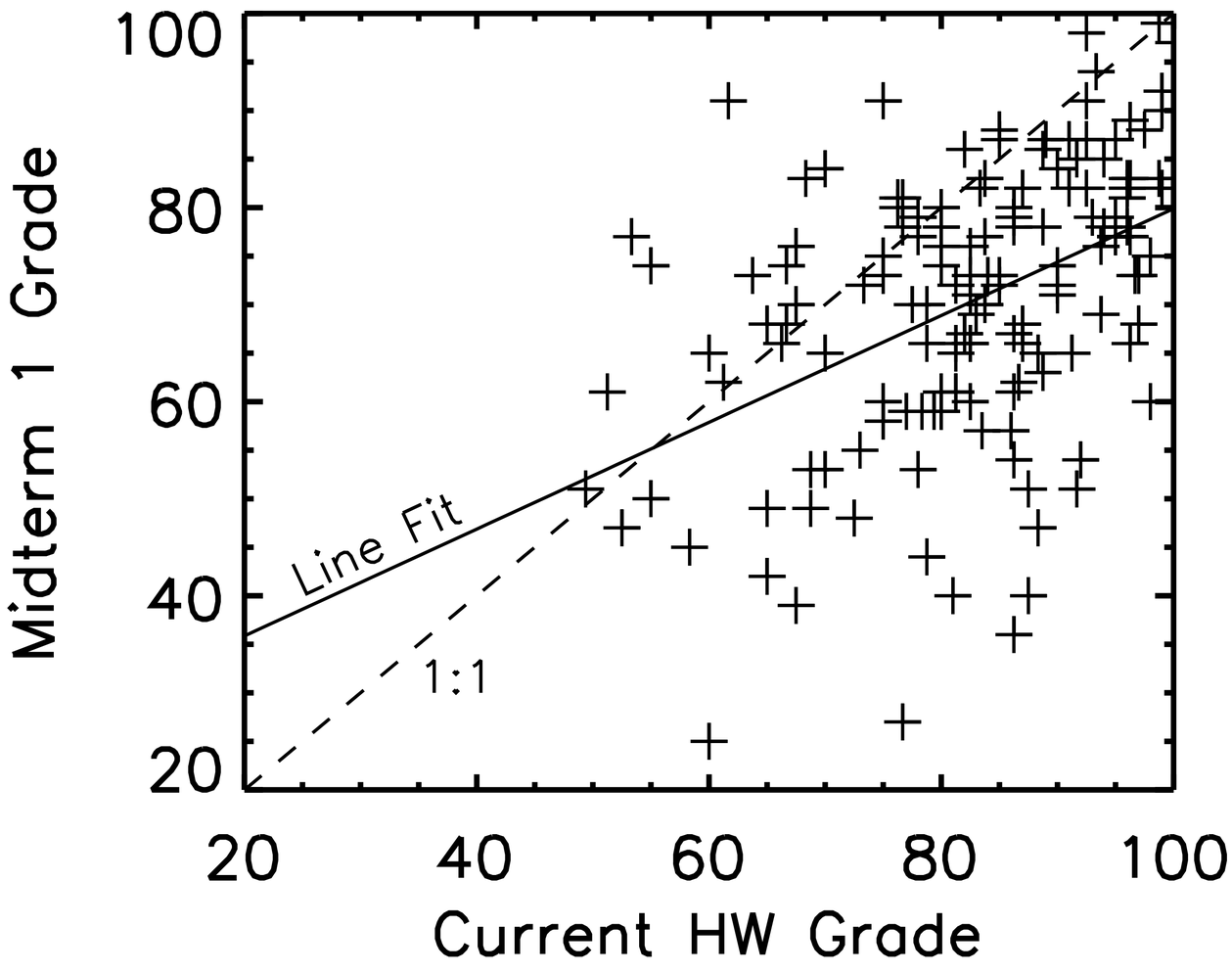
Planetarium Extra Credit Opportunity!
(see the syllabus)

Oct. 11th or 13th at 6:45 pm for the "Gateway to the Stars Program."

Free tickets available here, $2 otherwise

Midterm 1 Results





Multiple Choice Questions

_____ The diffraction limit of a 4-meter telescope is _____ than that of a 2-meter telescope.

A. two times smaller

B. four times smaller

C. four times larger

D. two times larger

pacecraft feel weightless in space because:

bit.

B. the added gravitational pull of the Moon balances Earth's gravitational pull.

C.

D.

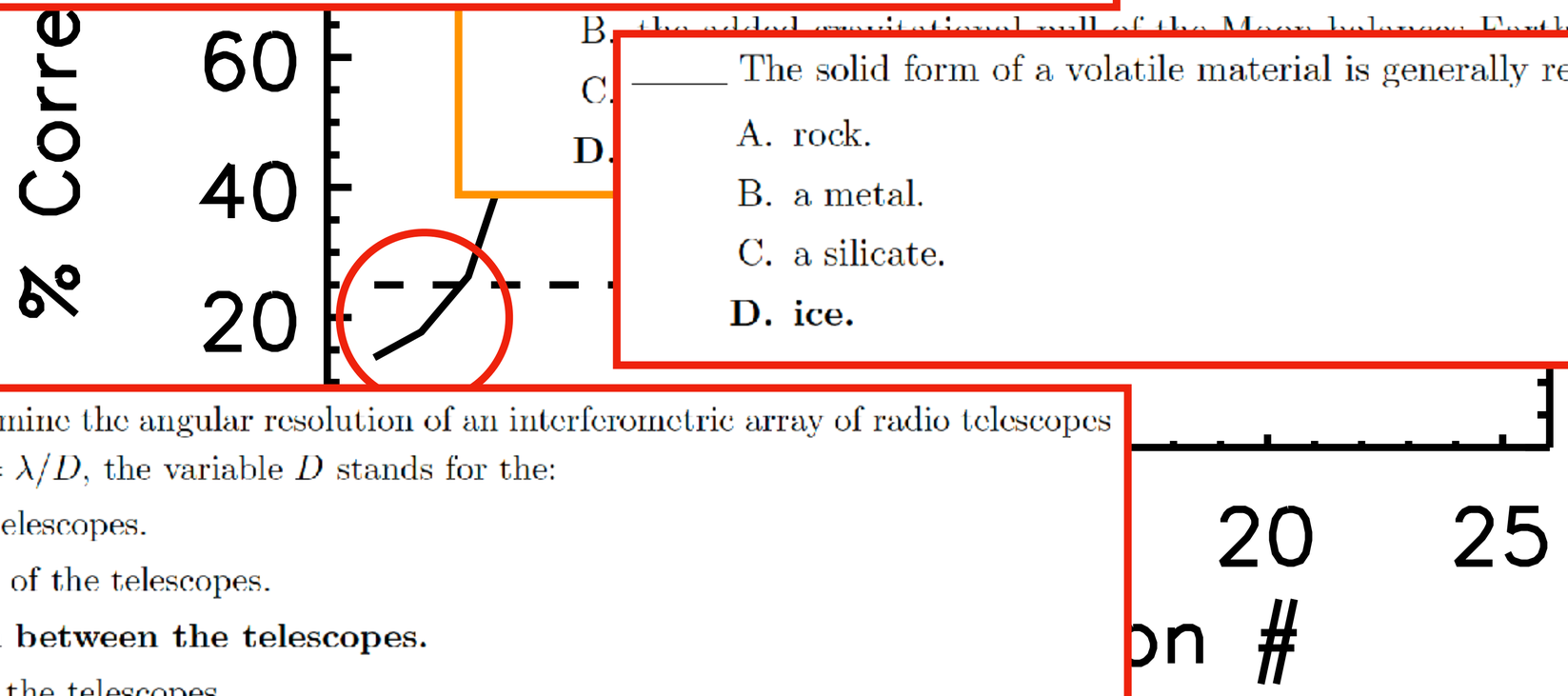
_____ The solid form of a volatile material is generally referred to as:

A. rock.

B. a metal.

C. a silicate.

D. ice.



_____ When we determine the angular resolution of an interferometric array of radio telescopes using the formula $\theta = \lambda/D$, the variable D stands for the:

A. number of telescopes.

B. focal length of the telescopes.

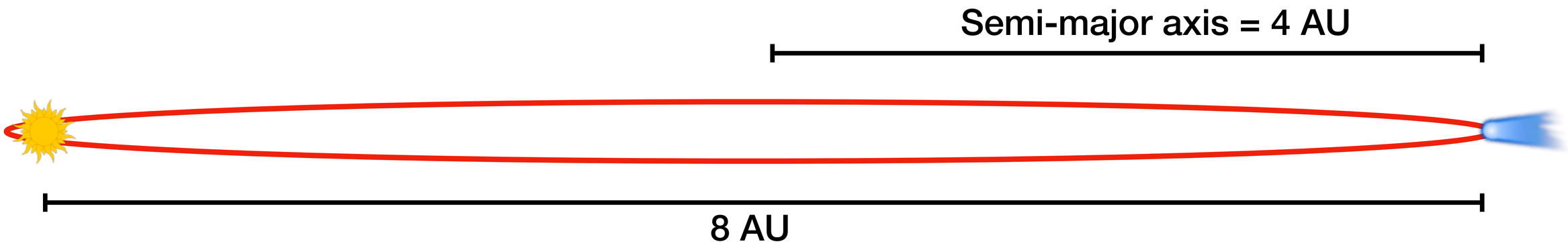
C. separation between the telescopes.

D. diameter of the telescopes.

Kepler's Law Short Answer Question

28. An asteroid is discovered to have an extremely elliptical orbit, such that its major axis is much much larger than its minor axis. It is found that its farthest distance from the Sun is 8 AU. How long does it take to complete one orbit?

Solution: Because the orbit is highly elliptical, the foci are close to the outer edges of the ellipse, with the Sun at one of the foci. This means that the asteroid passes very near the Sun on closest approach, so its farthest distance of 8 AU corresponds to the entire length of the major axis, yielding a semi-major axis $a = 4$ AU. Plugging this into Kepler's third law, $P(\text{in years})^2 = a(\text{in AU})^3$, we find the asteroid's period $P = \sqrt{4^3} = \sqrt{64} = 8$ years.

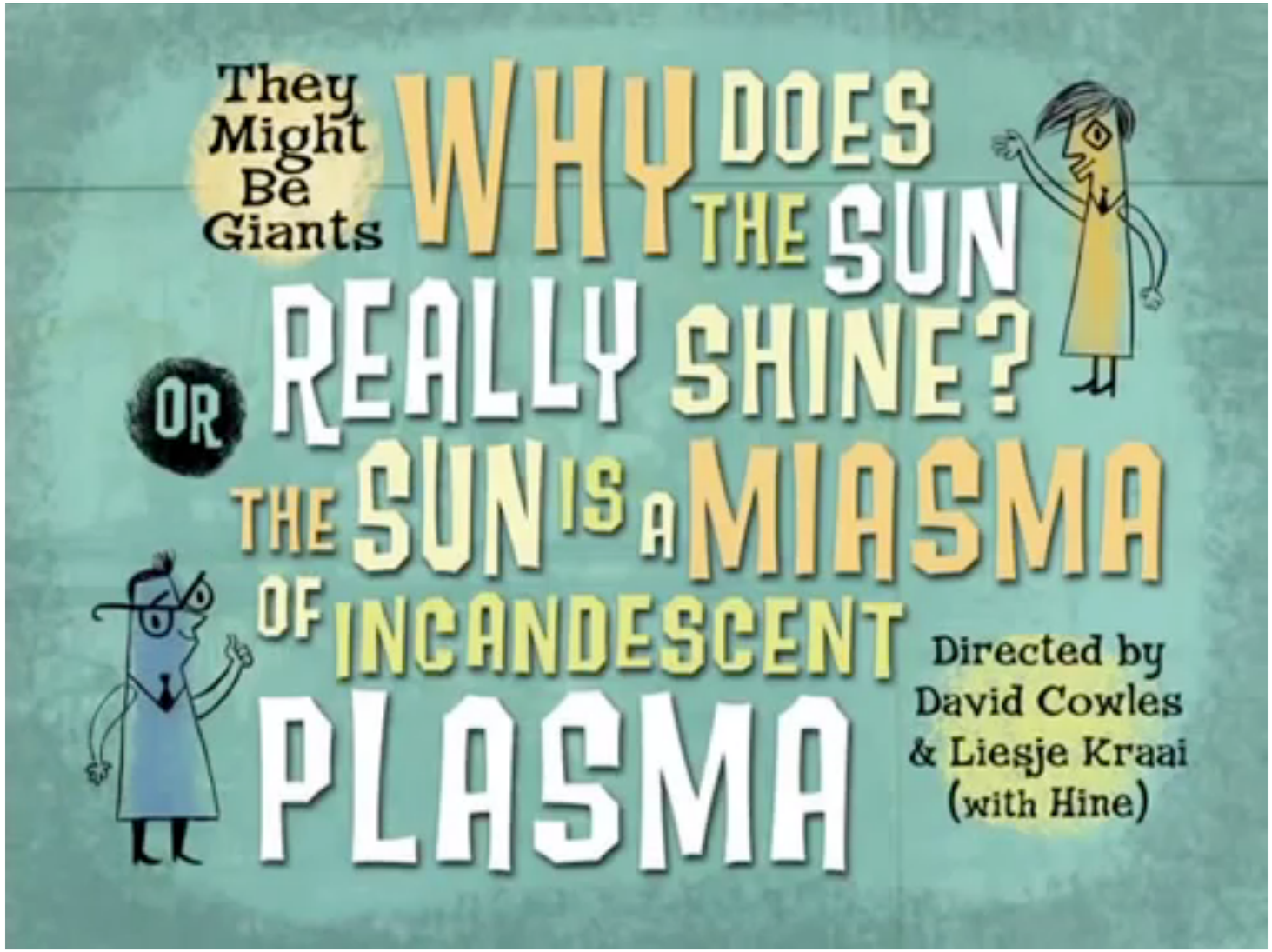


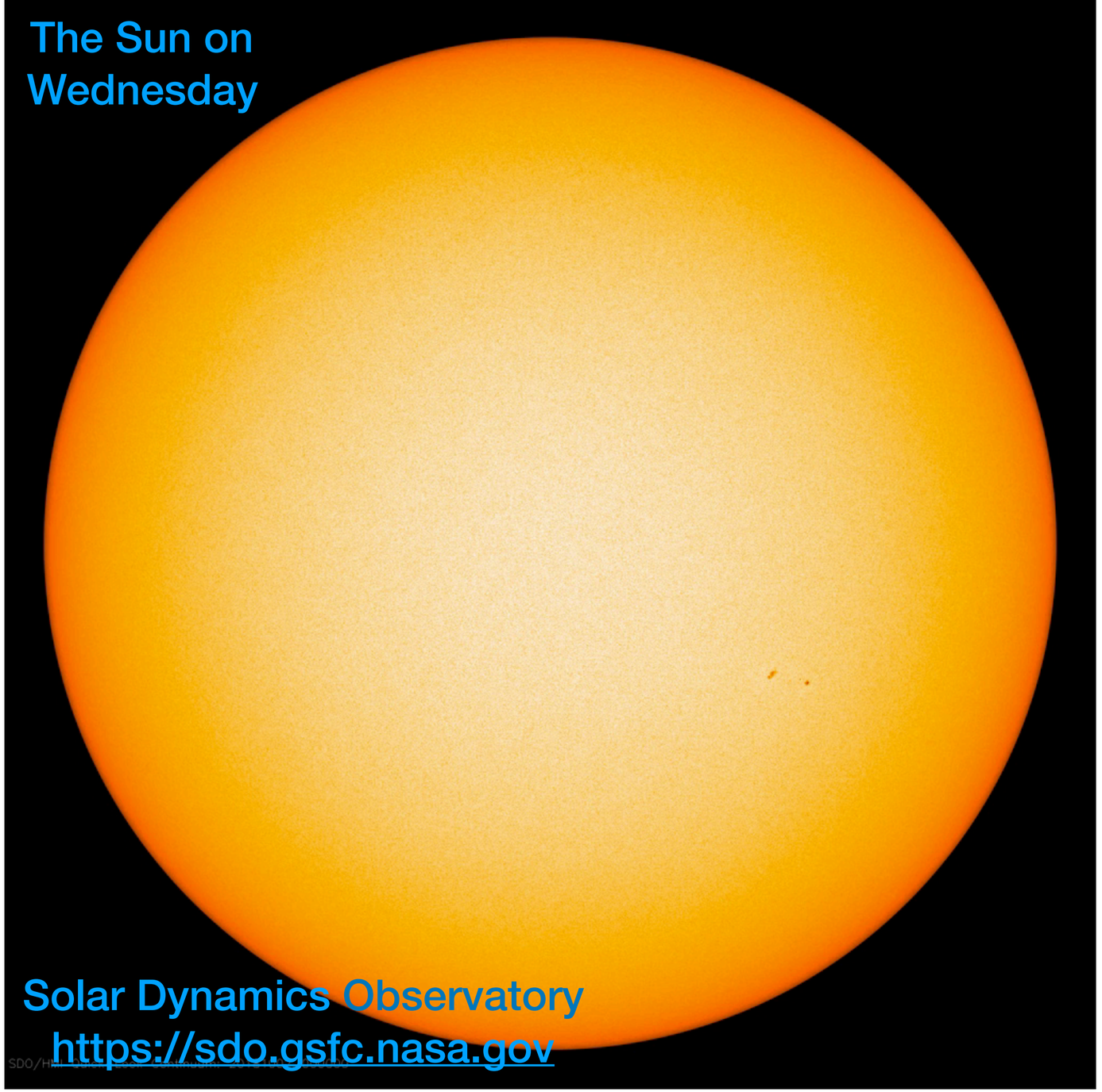
Why does the Sun shine?

https://www.youtube.com/watch?v=3JdWISF195Y

A Small Correction…

https://www.youtube.com/watch?v=sLkGSV9WDMA





Sun Facts

- Diameter: 1.4 million km (~100x Earth's)
- Mass: 2×10^{30} kg (300,000x Earth's)
- Total Luminosity: 4×10^{26} Watts
- Energy Reaching Earth: 1400 Watts/meter^2
- Surface Temperature: 5800 K

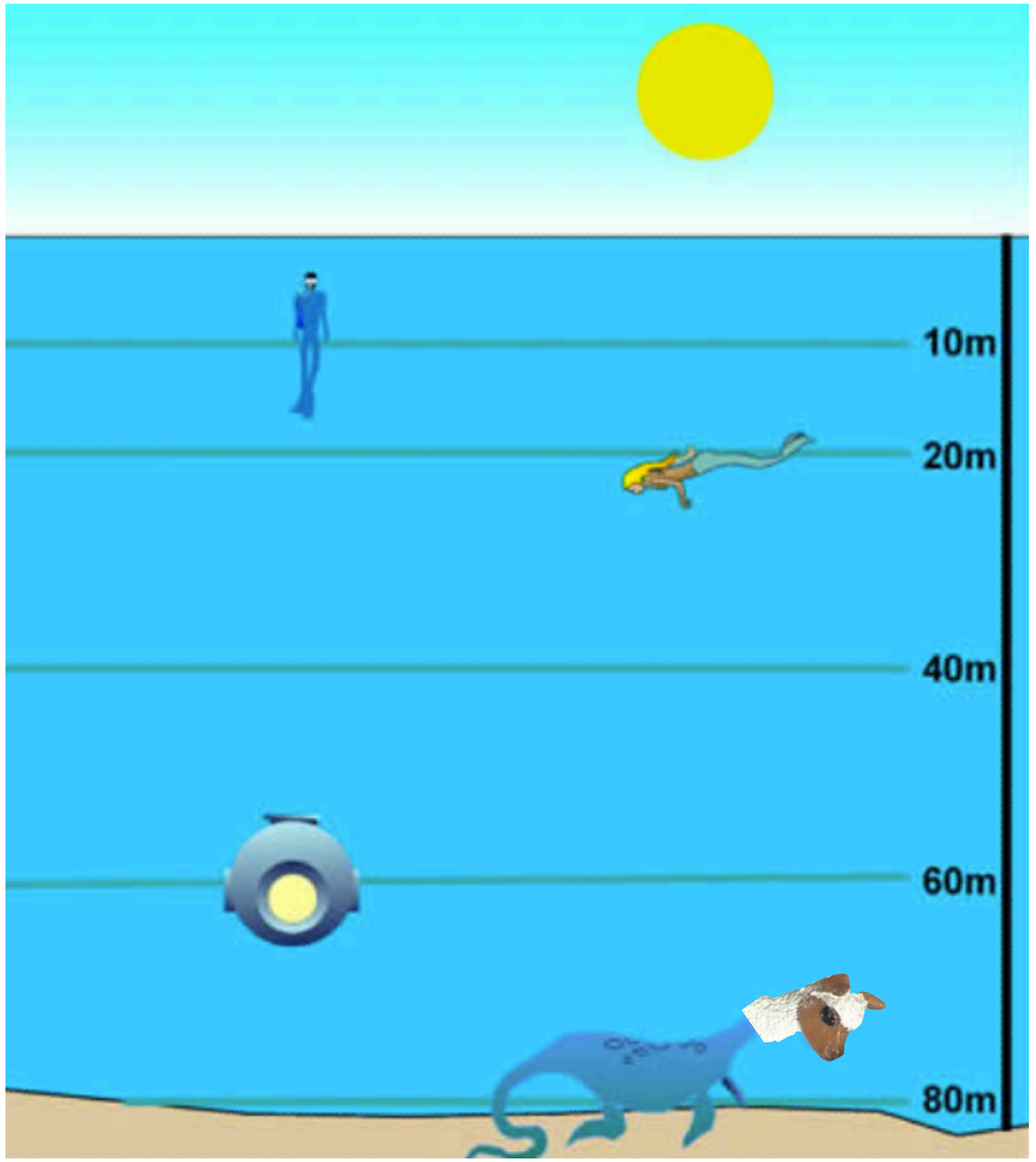
The greatest pressure is experienced by the…

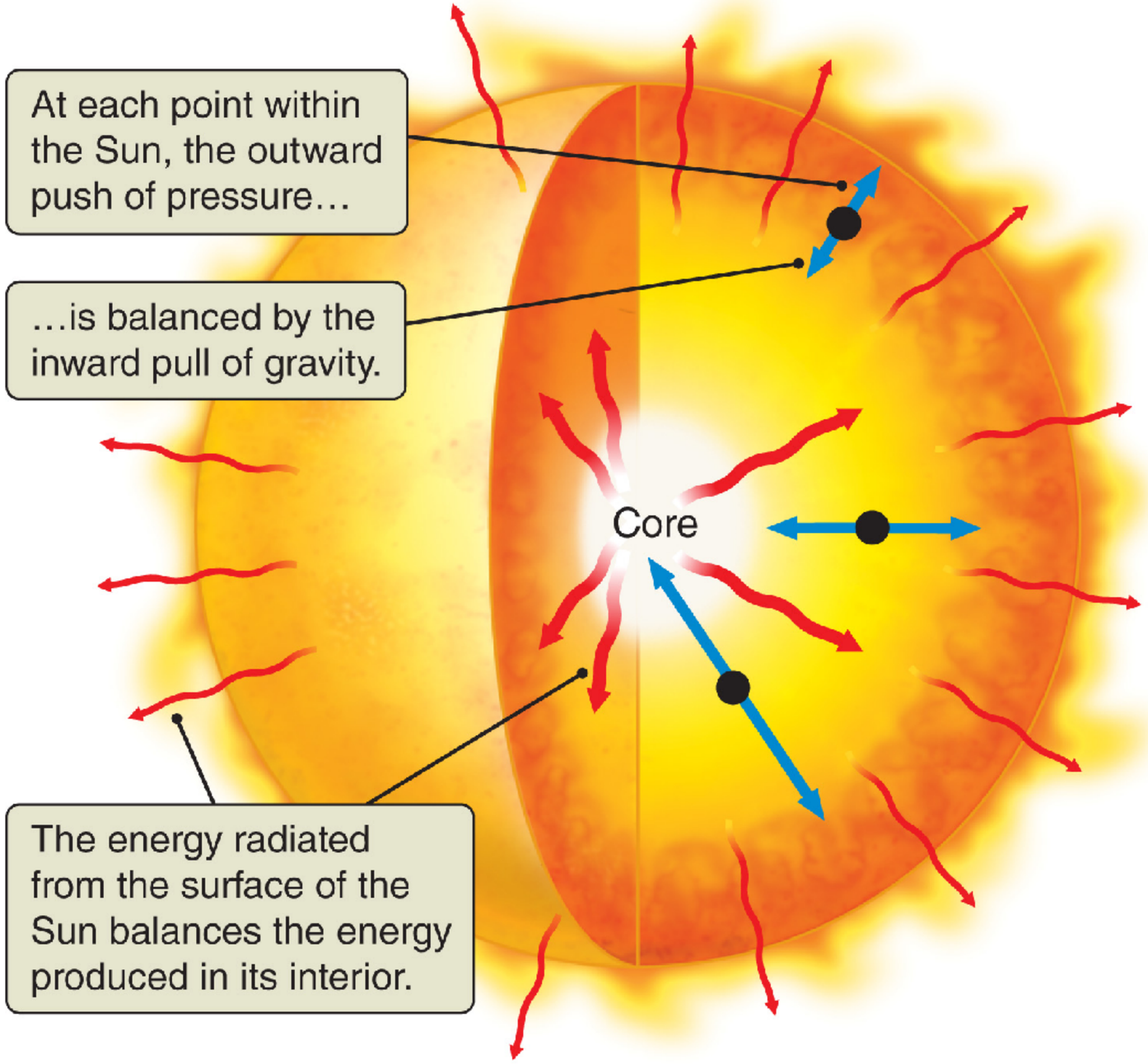
A) Diver

B) Mermaid

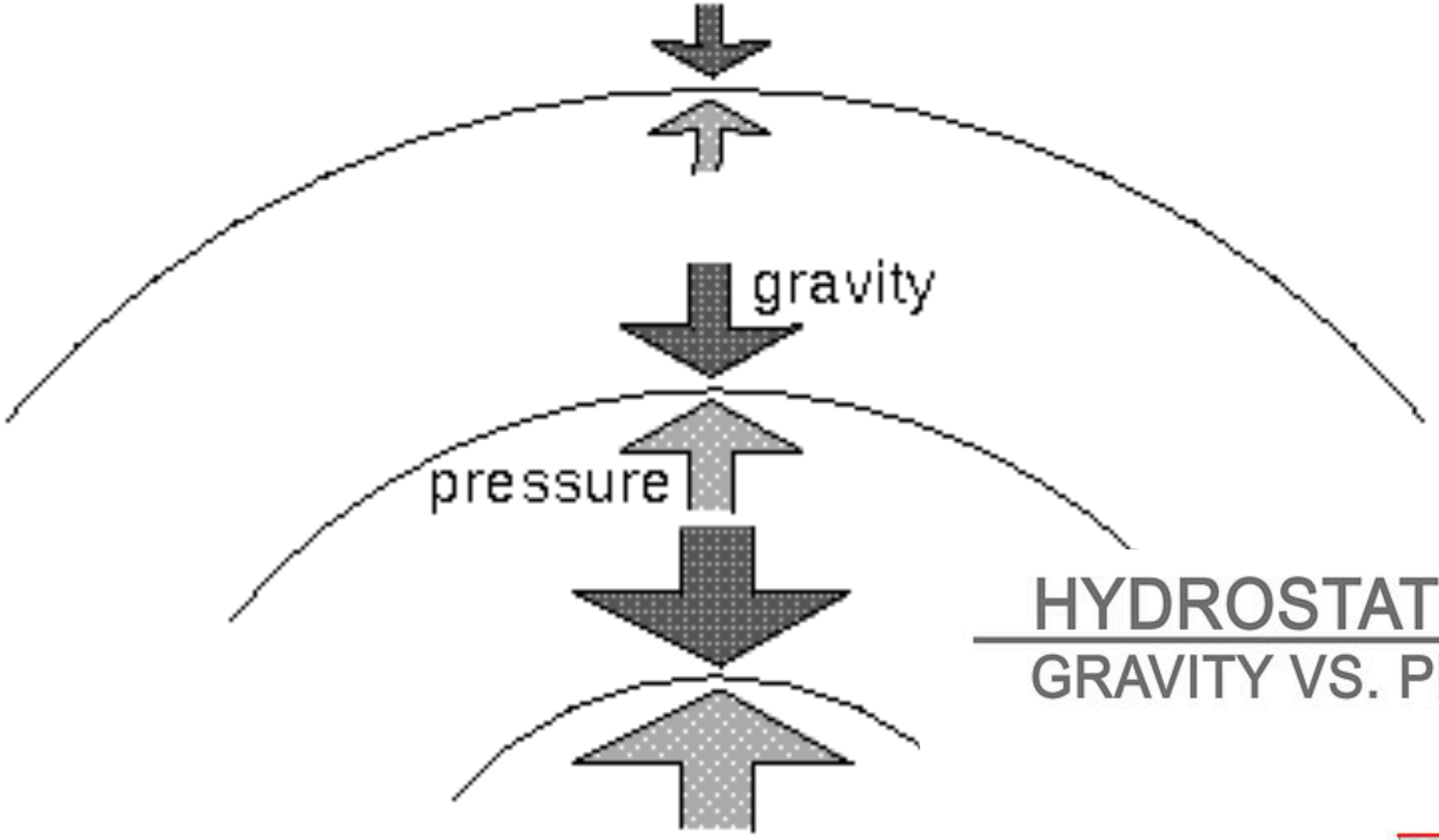
C) Bathysphere

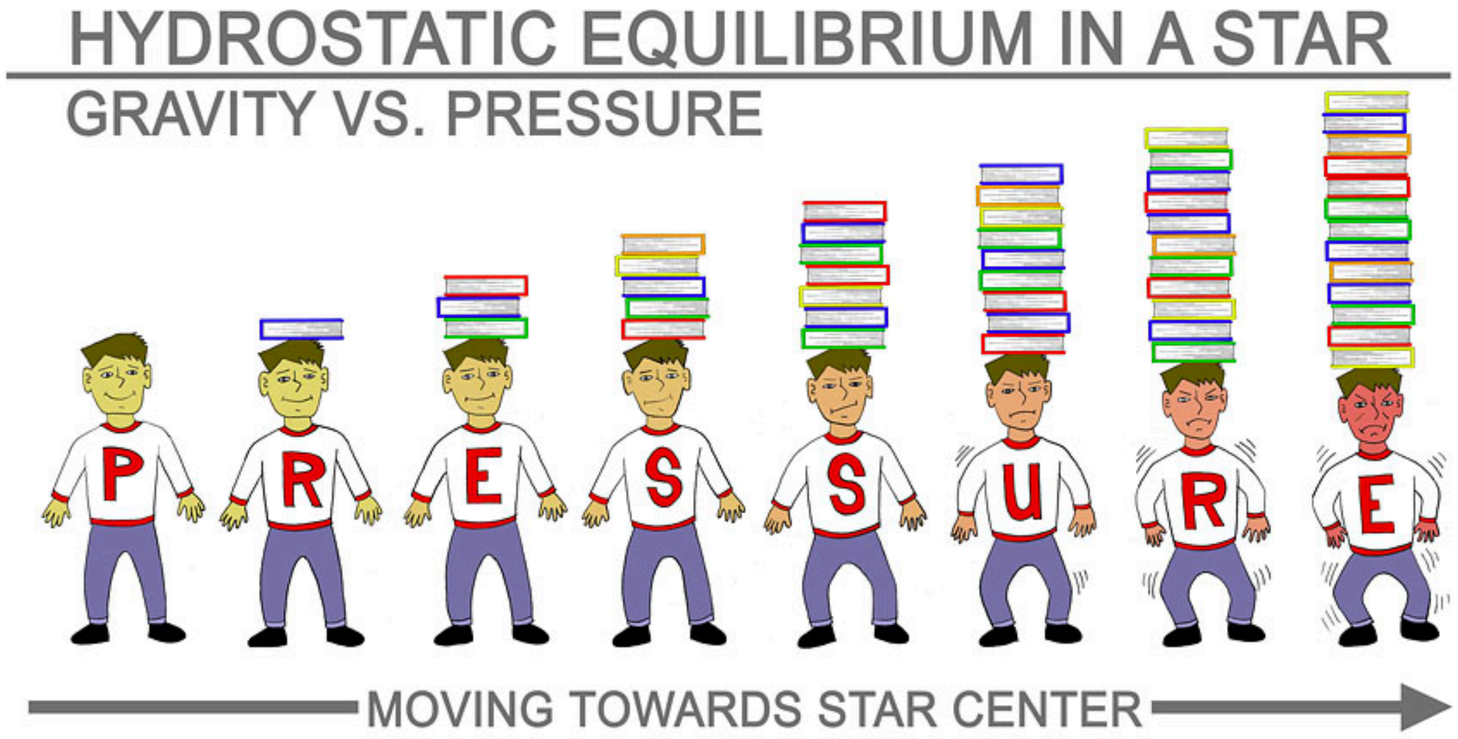
D) Loch Ness Llama



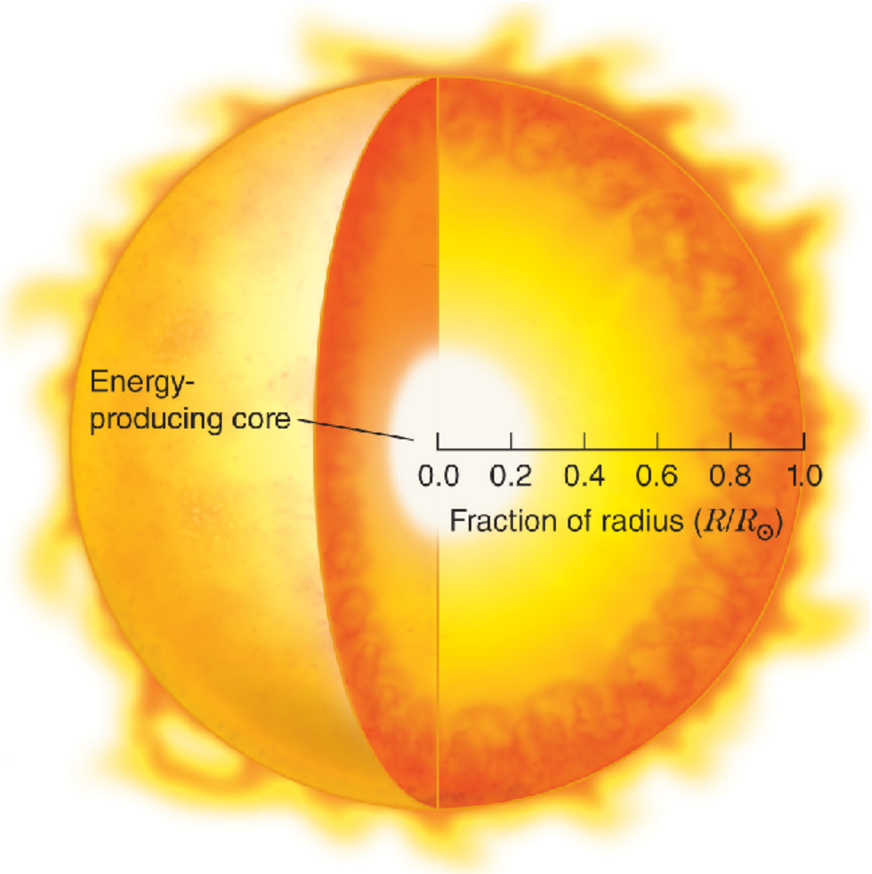


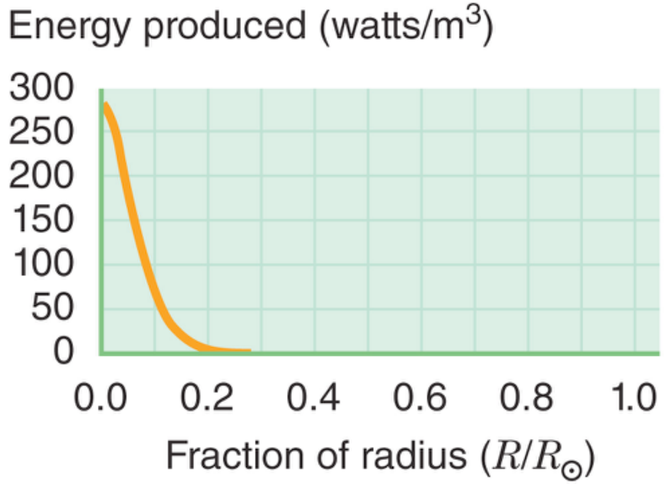
Hydrostatic Equilibrium

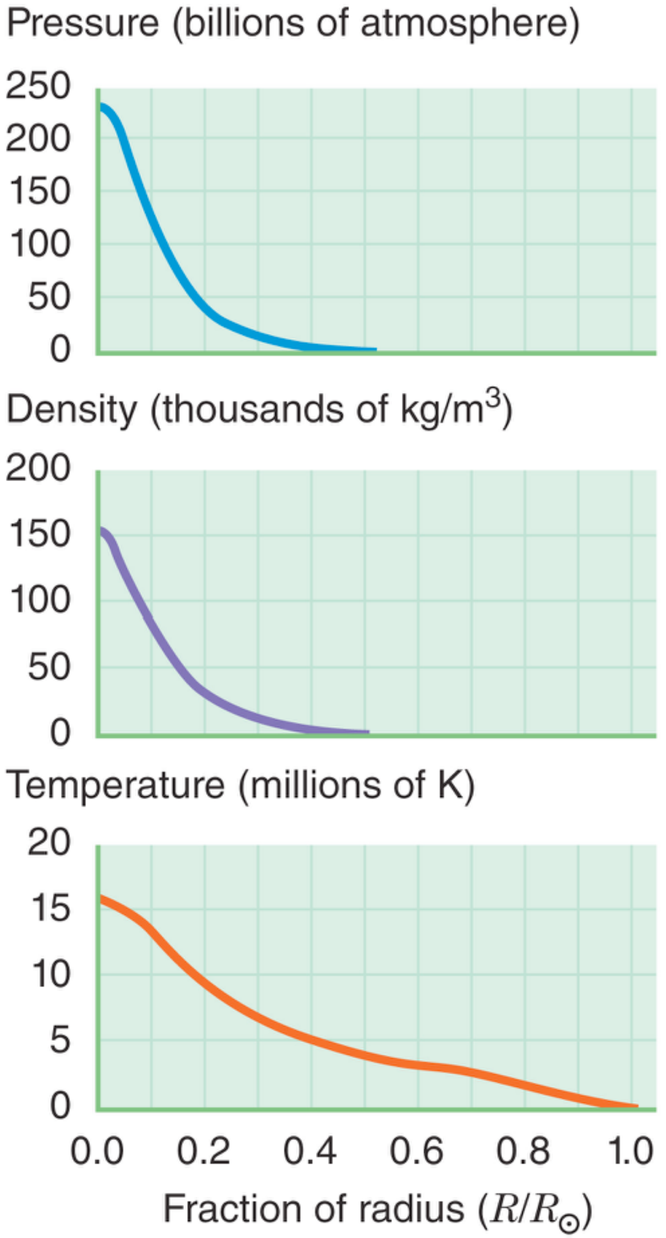

gravity
pressure


HYDROSTATIC EQUILIBRIUM IN A STAR
GRAVITY VS. PRESSURE
PRESSURE
MOVING TOWARDS STAR CENTER

Pressure, Temperature, Density, Energy Produced all change with radius







The Sun's Luminosity Comes From:

A) Chemical Burning (loss of electron energy)

B) Nuclear Fusion

C) Gravitational Collapse

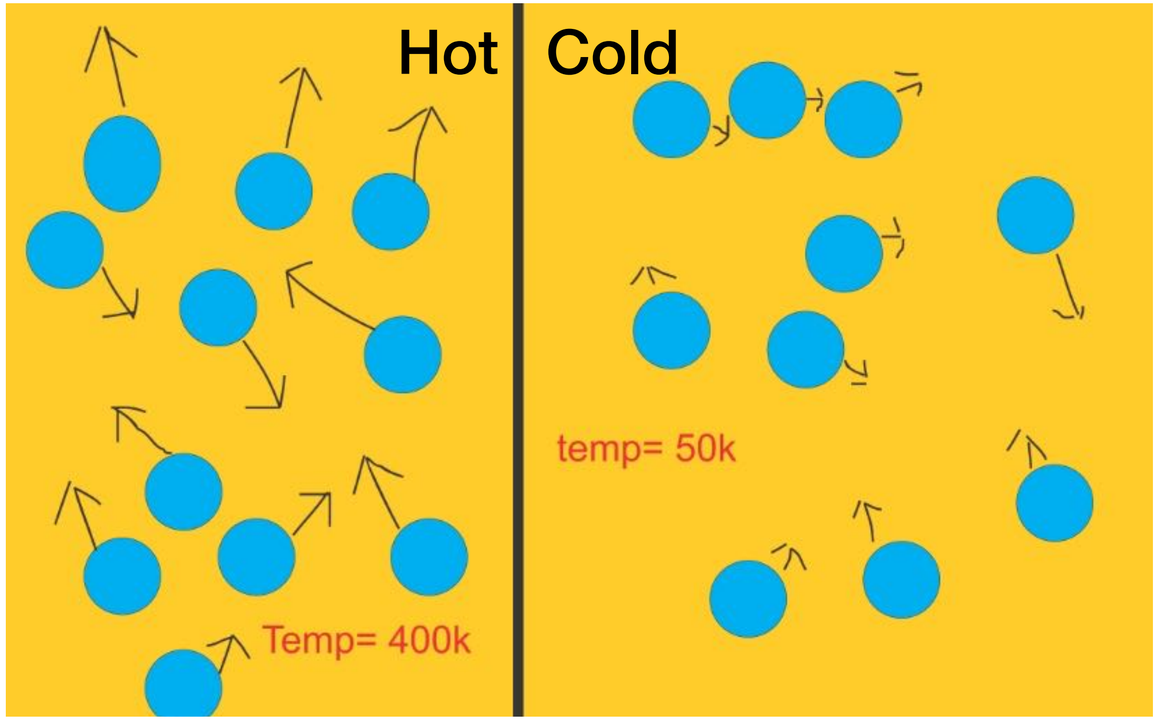
Fusion happens at the center of the sun because:

A) High Temperature

B) High Density

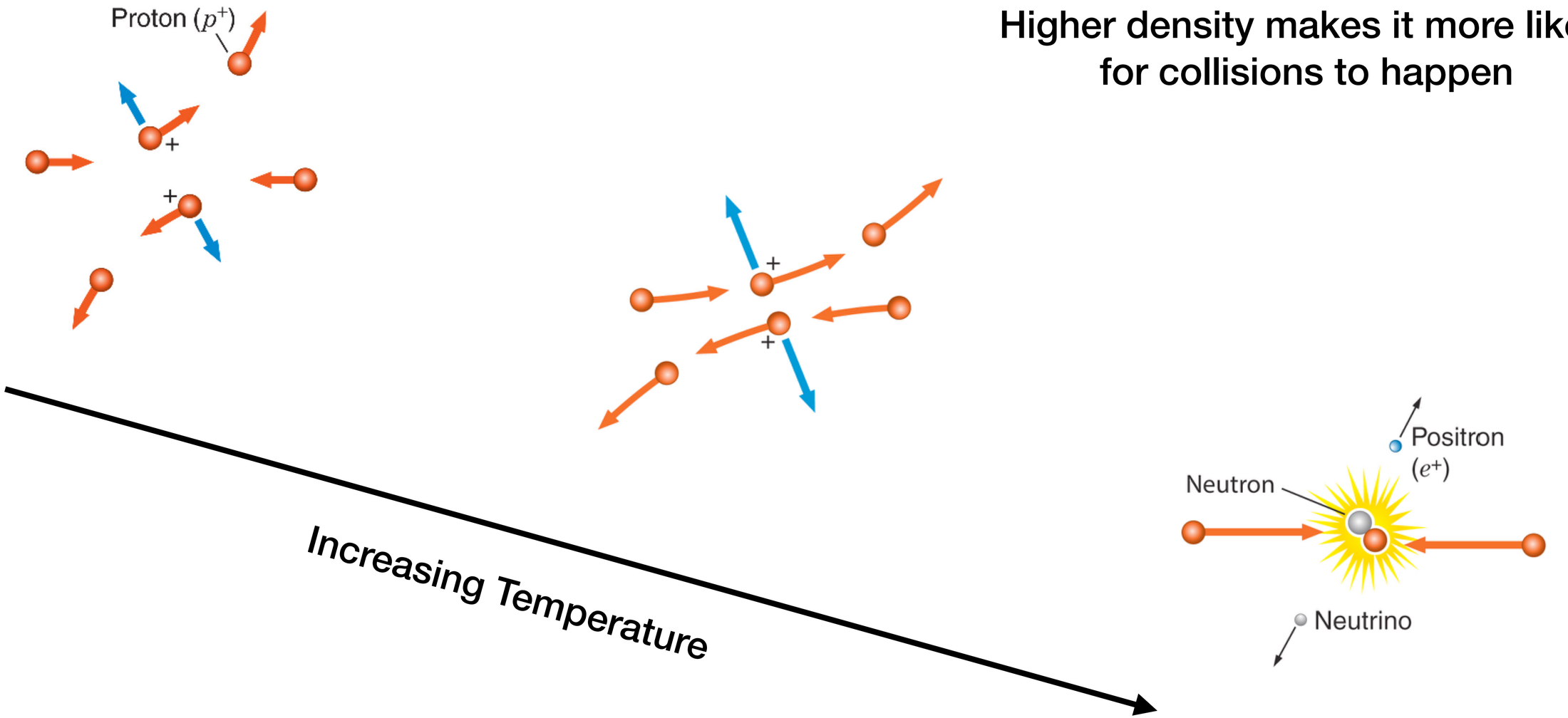
C) High Density & Temperature

Higher Temperature —> Faster Movement



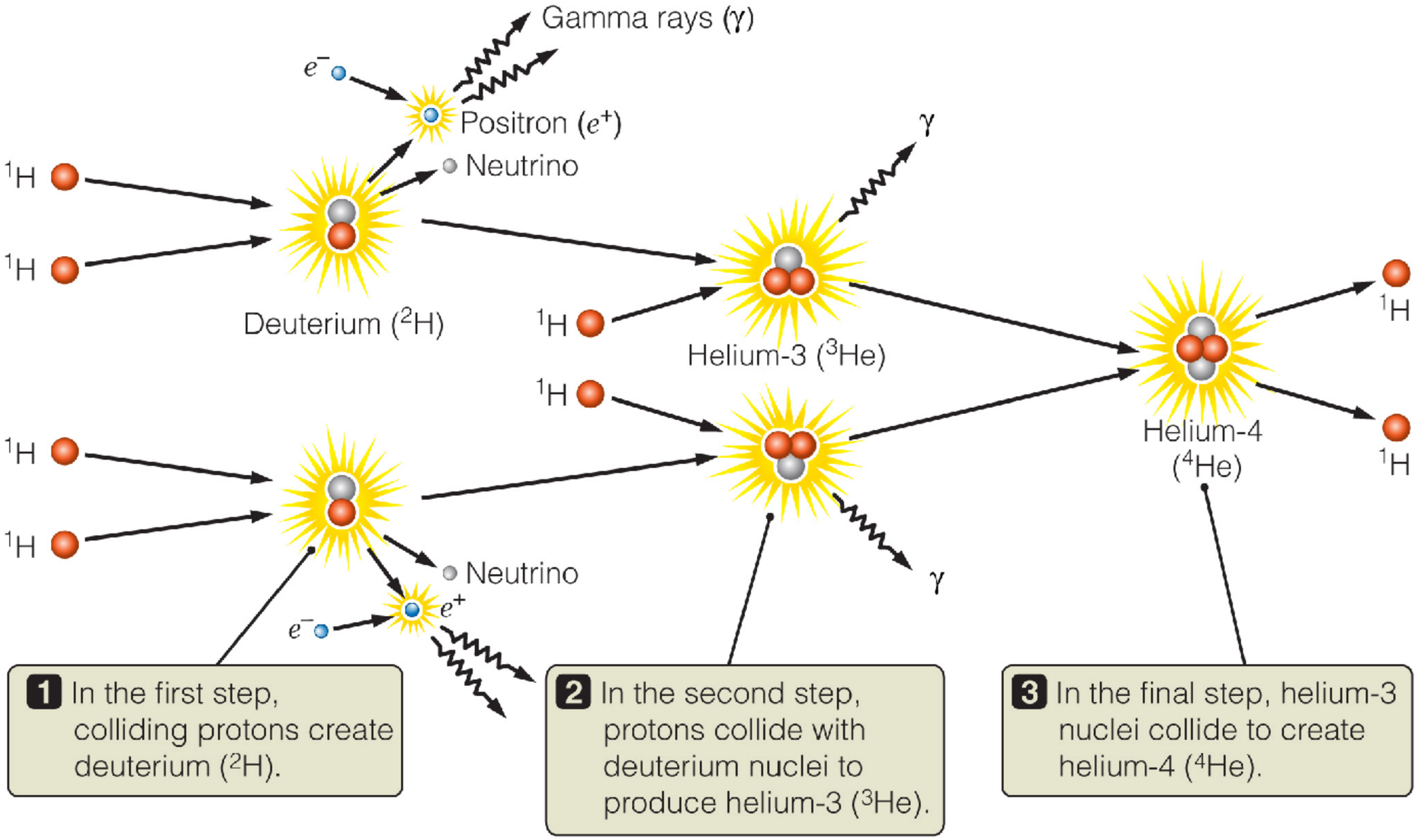
High Density —> More likely to run into things

Higher temperature makes collisions possible

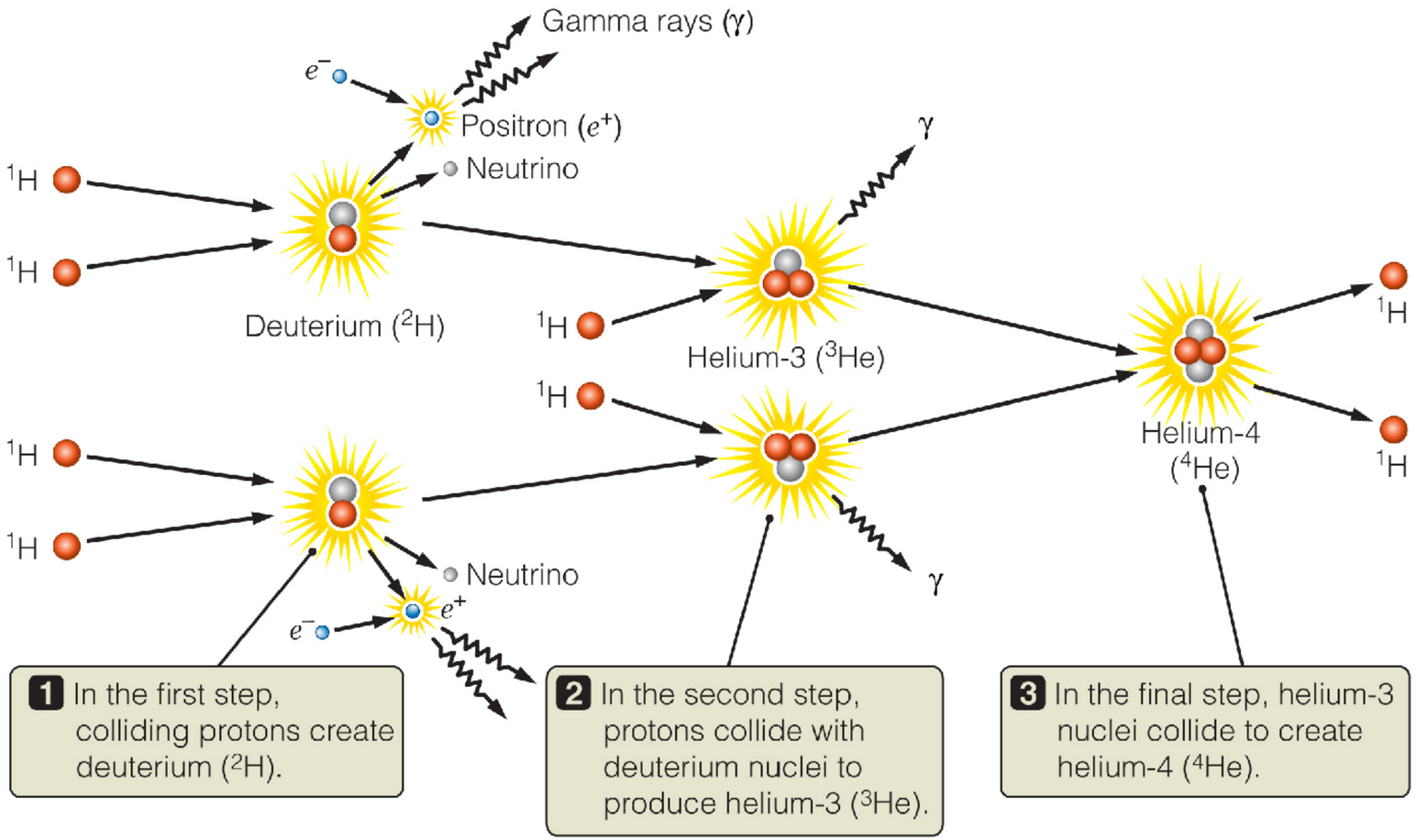


Higher density makes it more likely for collisions to happen

Hydrogen burning via the p-p chain



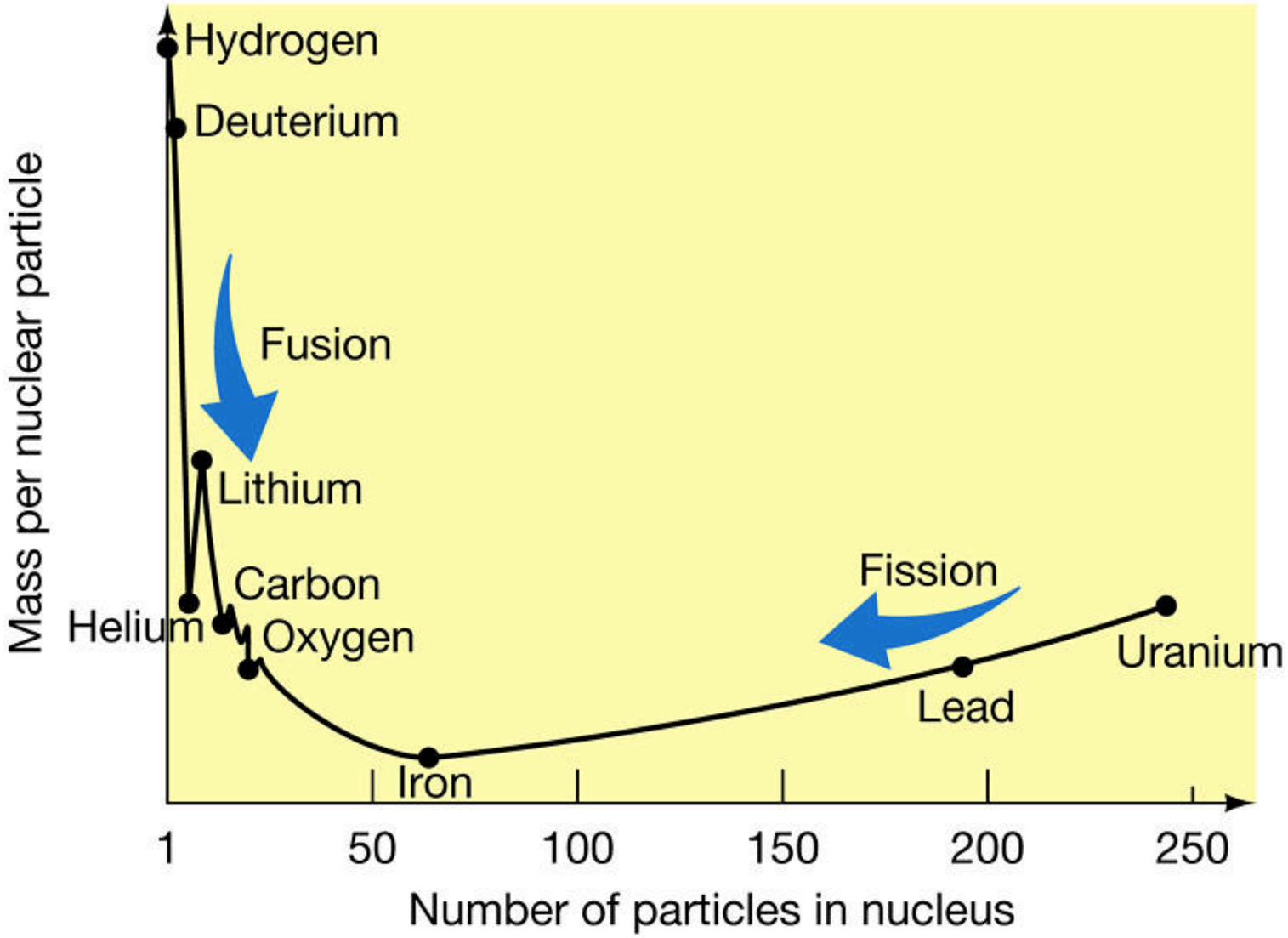
Energy is conserved (and $E=mc^2$), so…



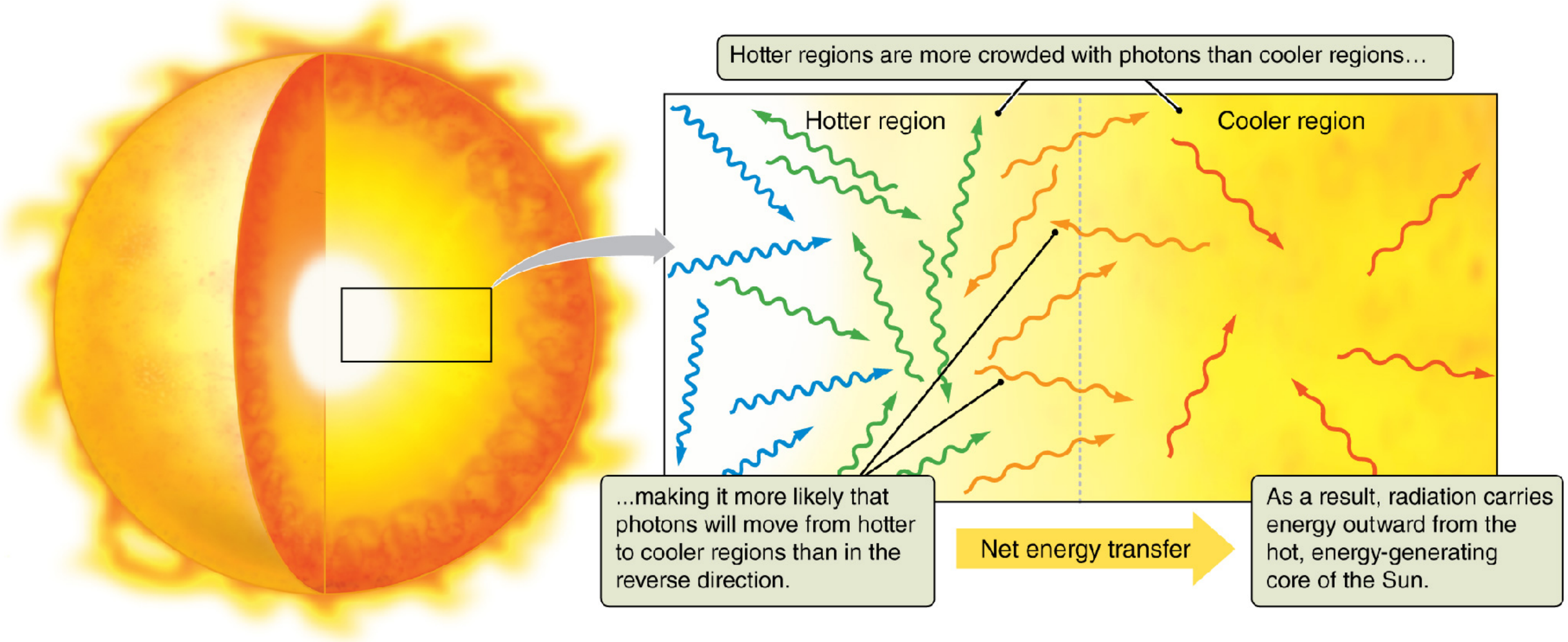
A) then 4 Hydrogen atoms must weigh more than one Helium atom

B) then 4 Hydrogen atoms must weigh less than one Helium atom

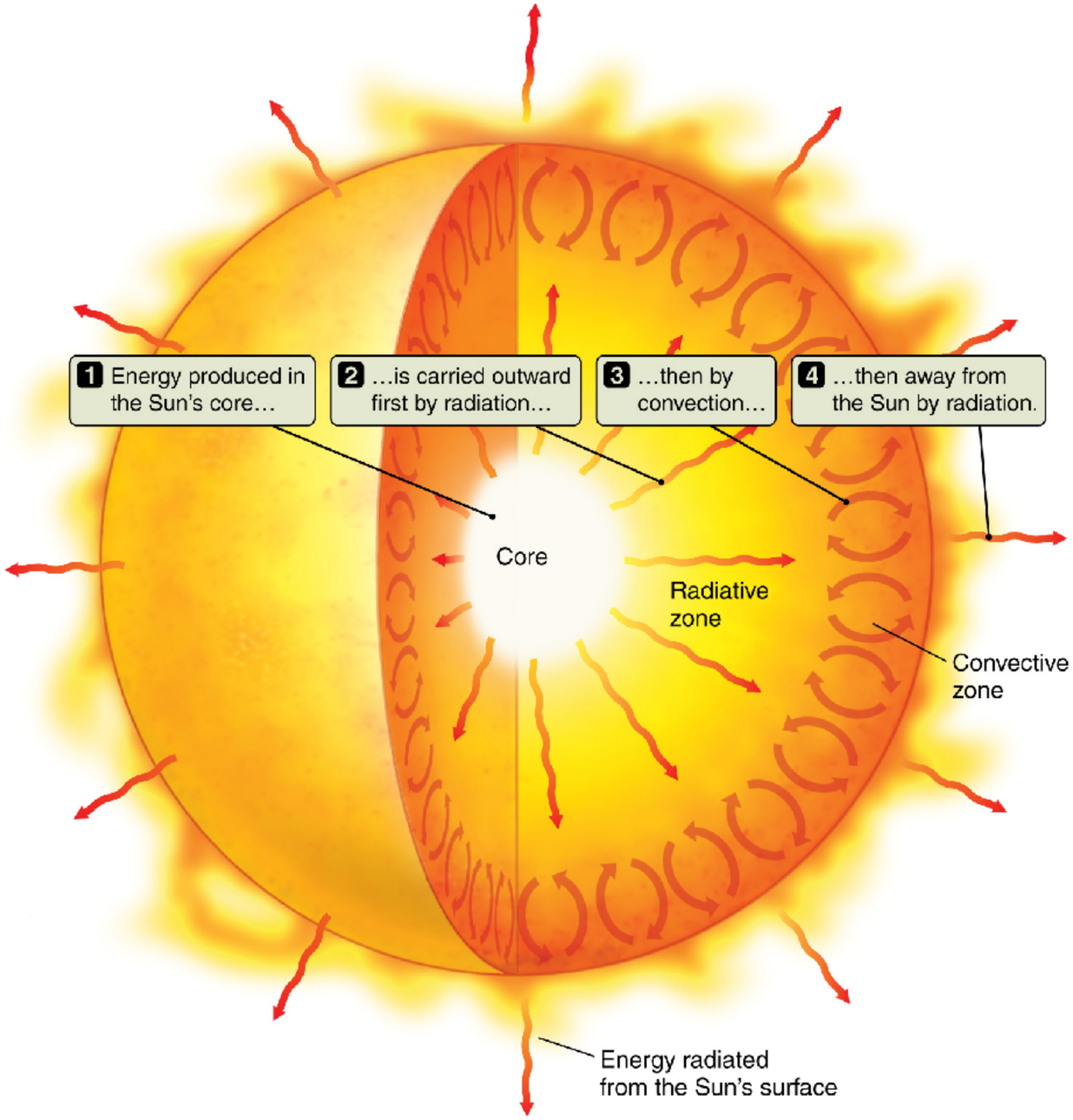
Energy from Mass



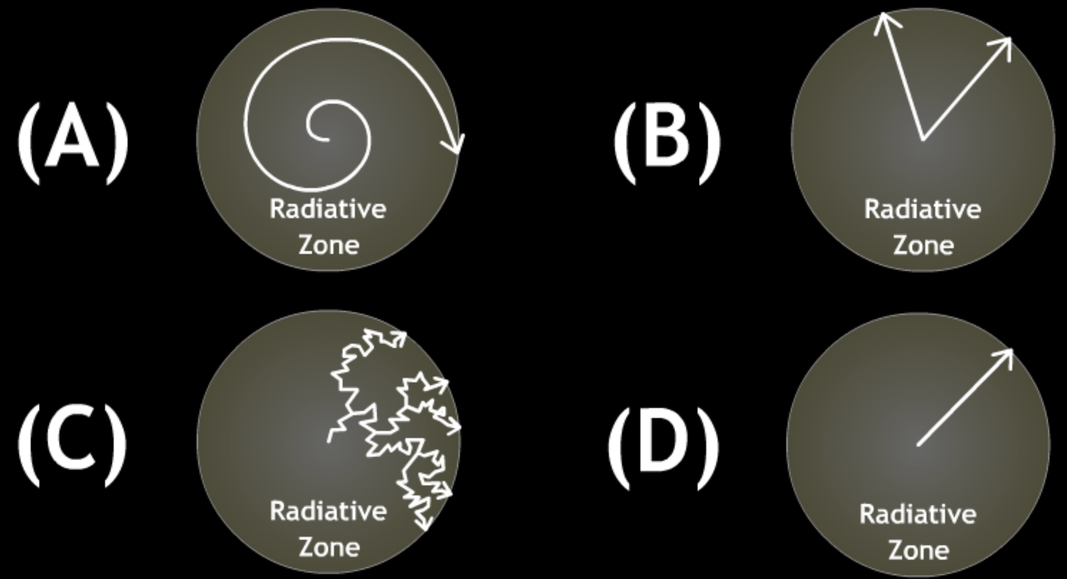
Photons are created in the core and move outward to the surface



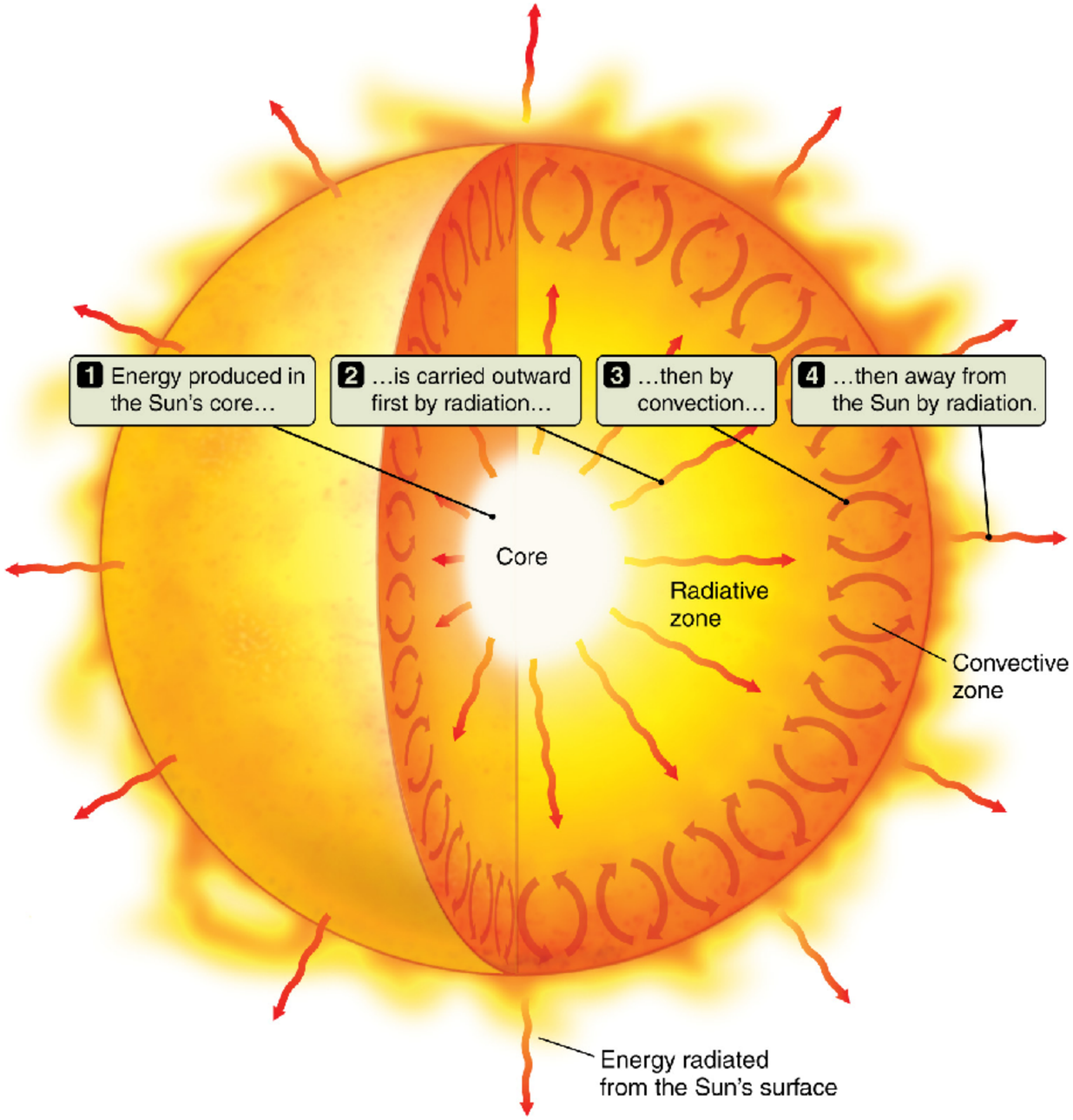
How light escapes the Sun

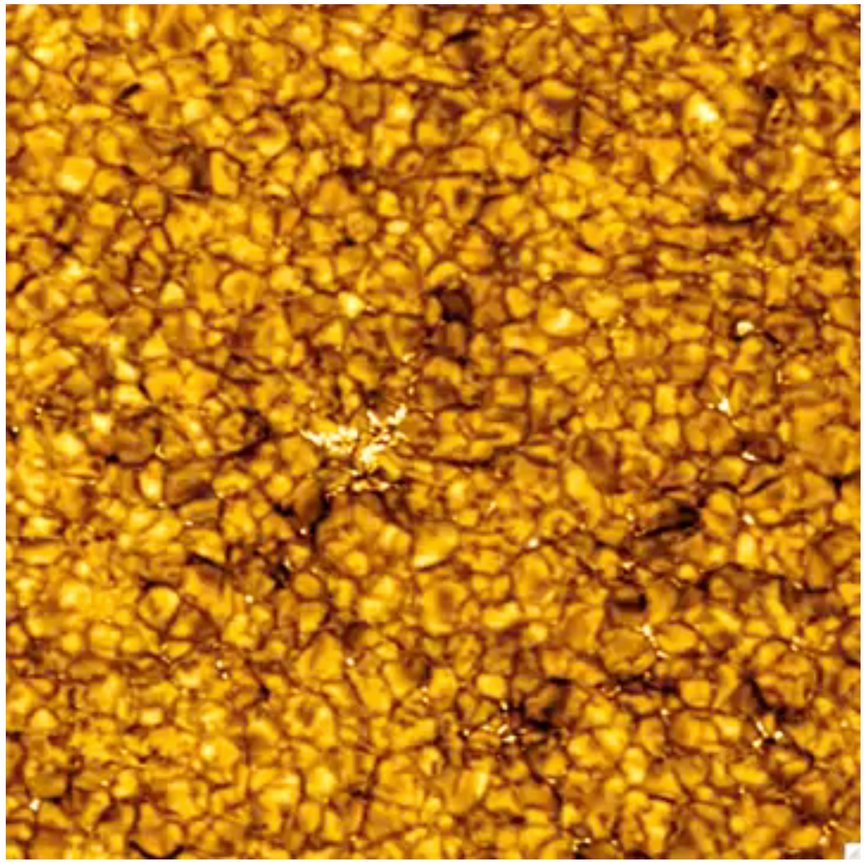


A high-energy photon is produced by a nuclear reaction at the center of the Sun. Which diagram best represents how that photon's energy escapes from the Sun's radiative zone?



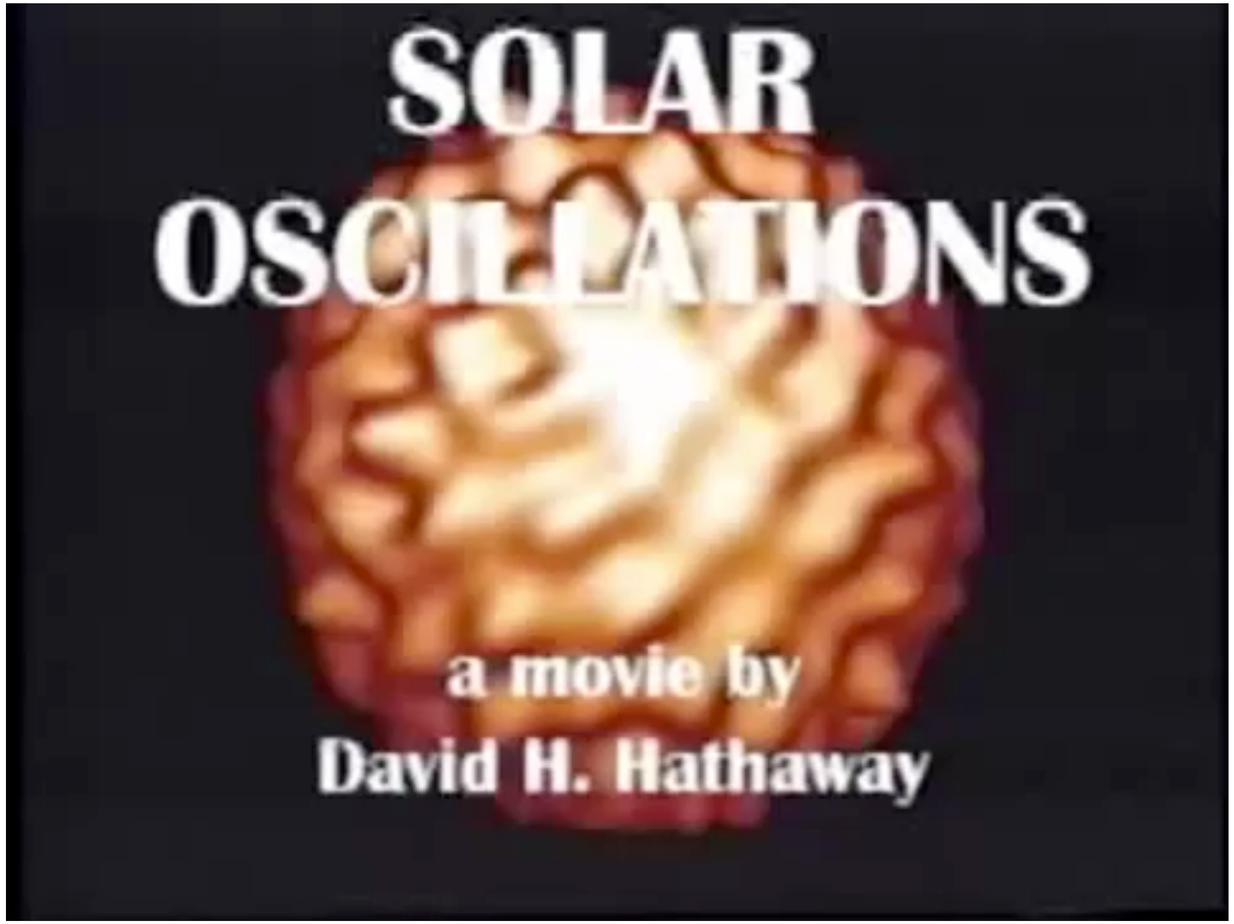
How light escapes the Sun

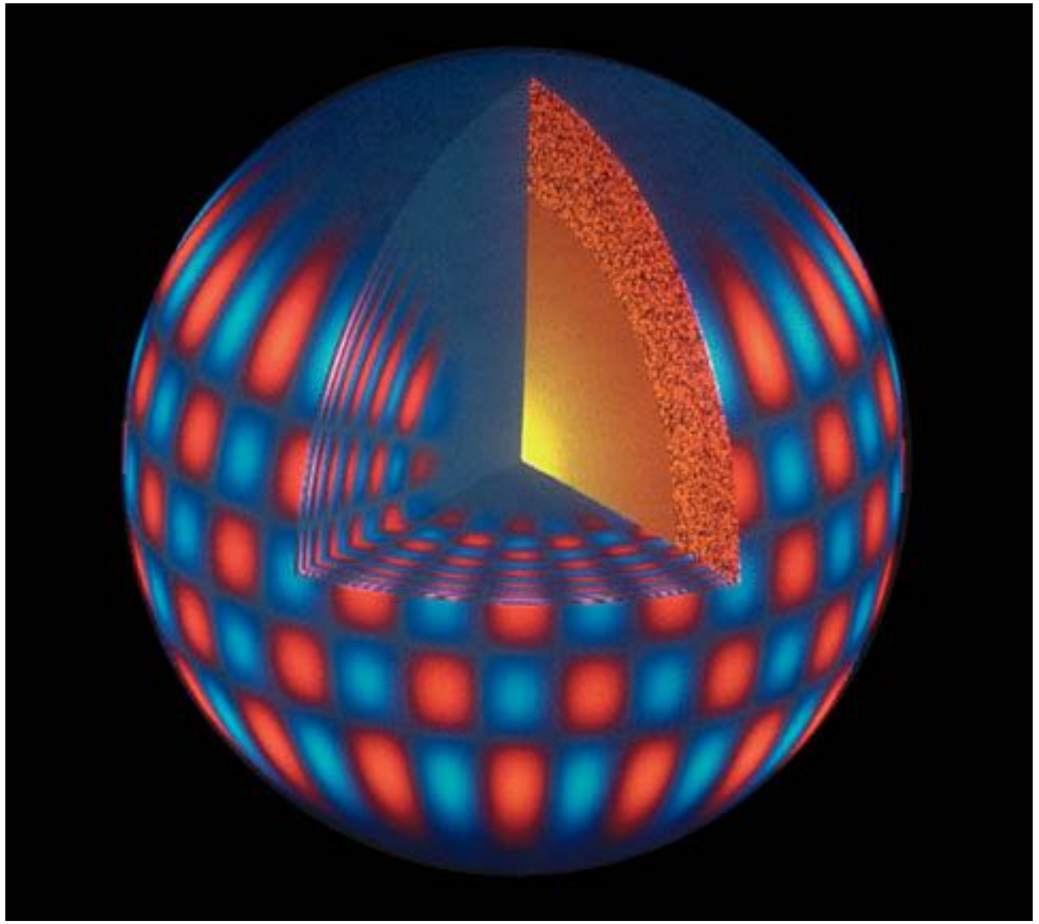




https://www.youtube.com/watch?v=W_Scoj4HqCQ

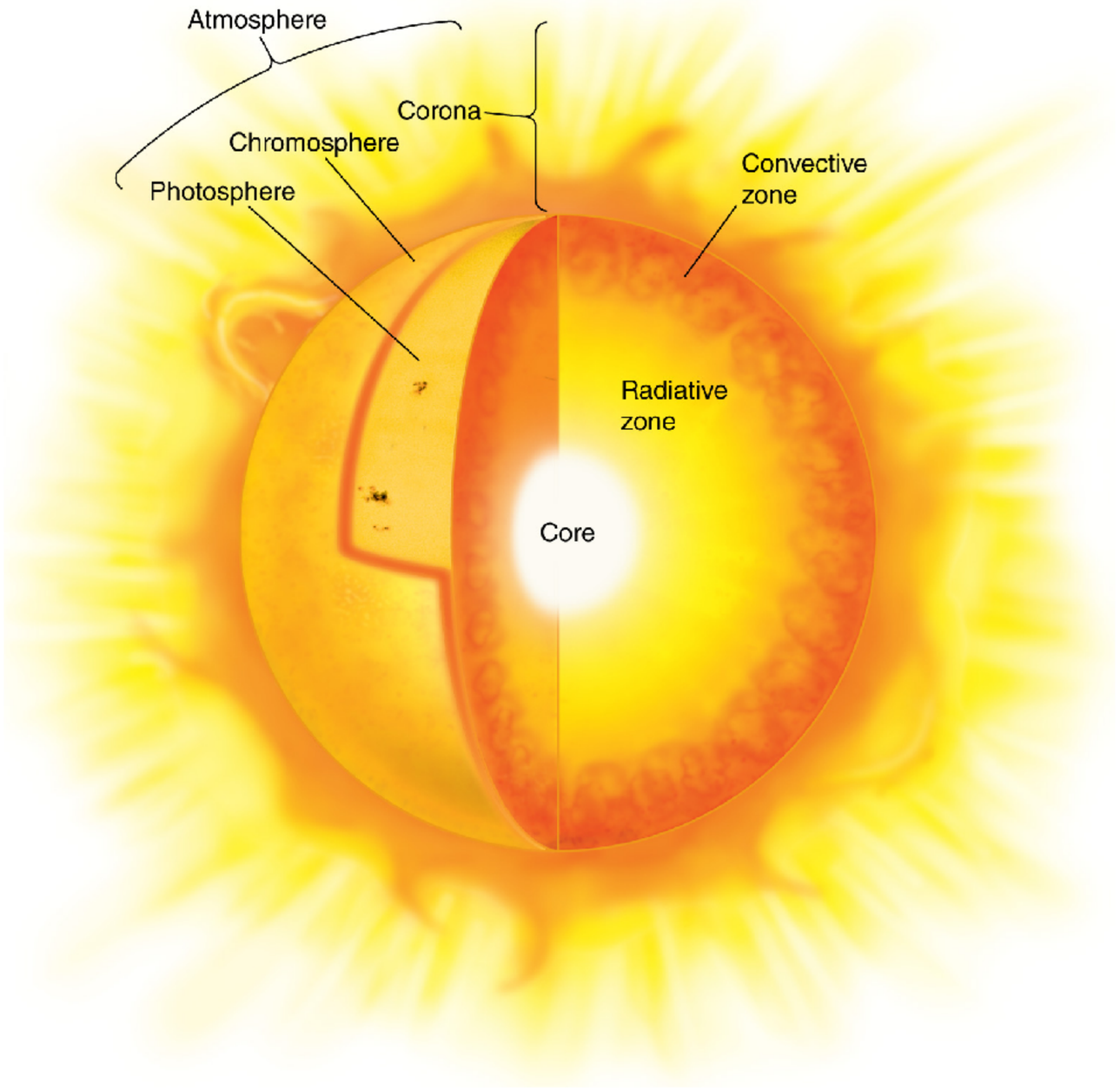
We learn about the Sun's interior from "sunquakes": helioseismology



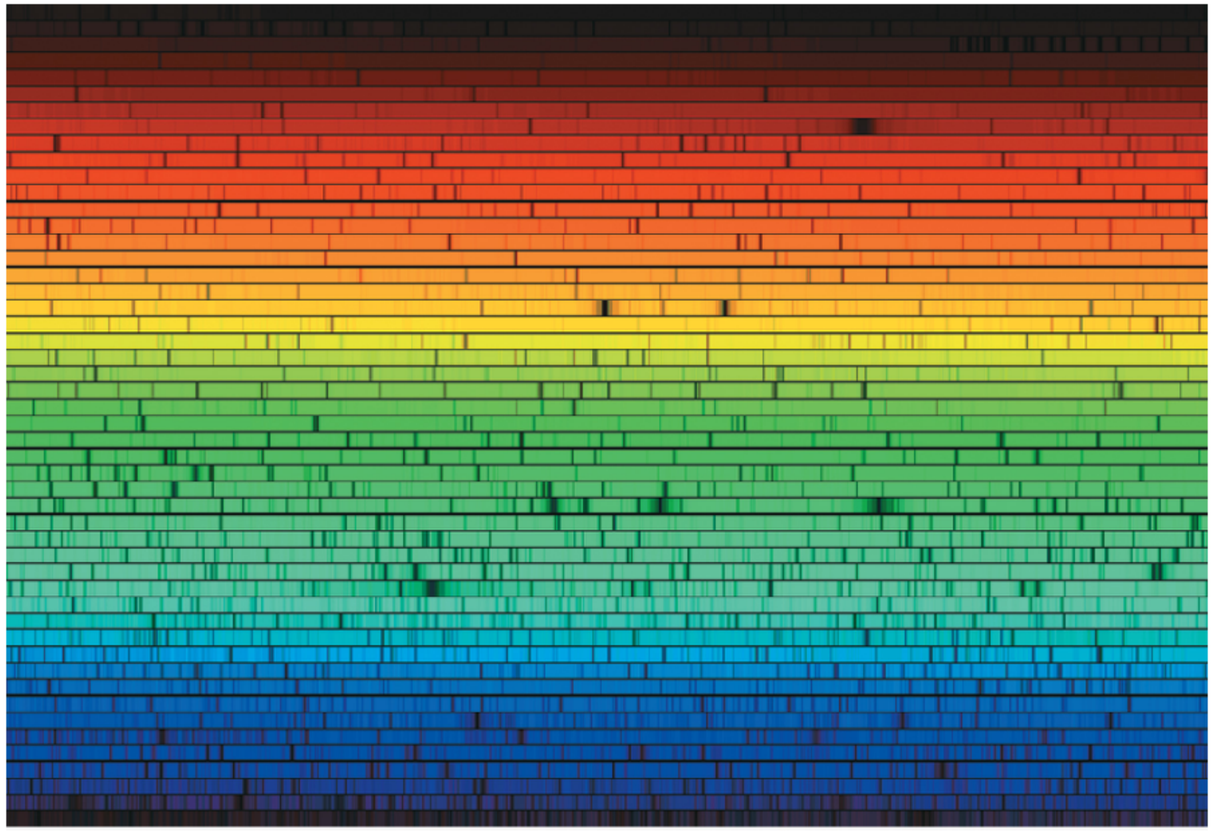


http://www.youtube.com/watch?v=YxUsr4vp3yM

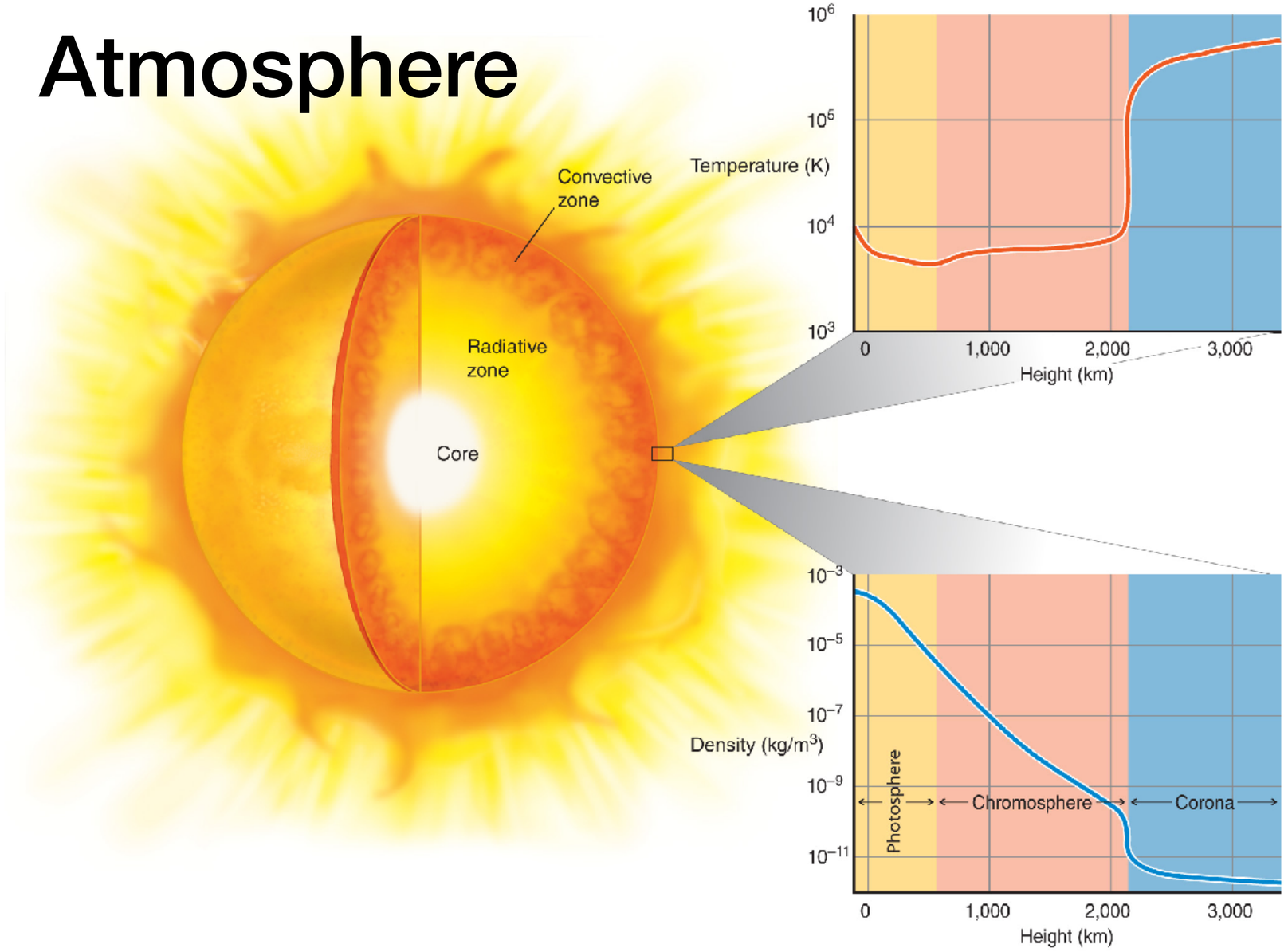
Zones of the Sun



High Resolution Solar Spectrum



Sun's Atmosphere



Limb Darkening

The Sun is "limb darkened." It is dimmer near its edge because near its edge we see the Sun at a steep angle and so do not see deeply into its atmosphere.