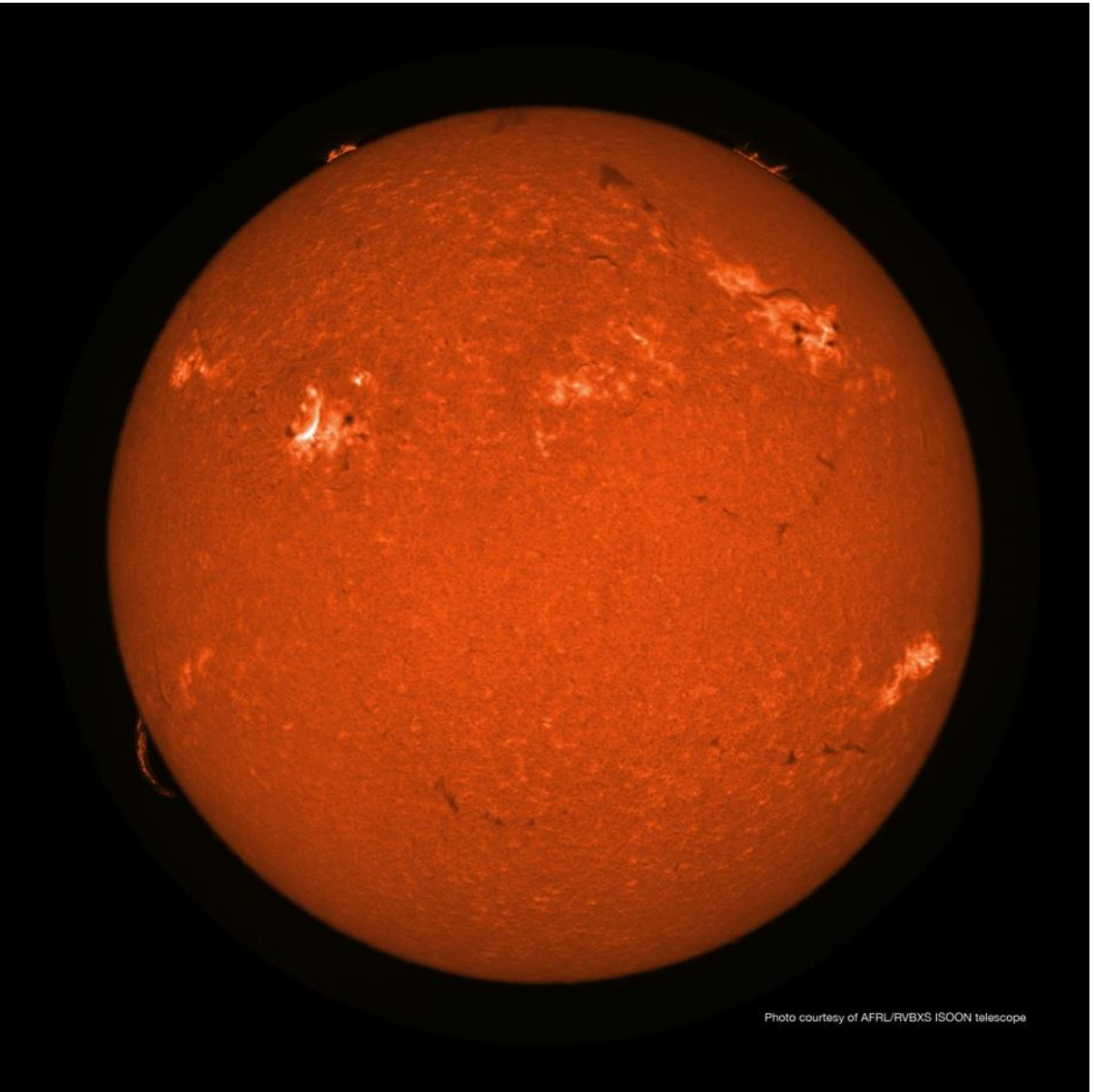
The Sun and Other Stars

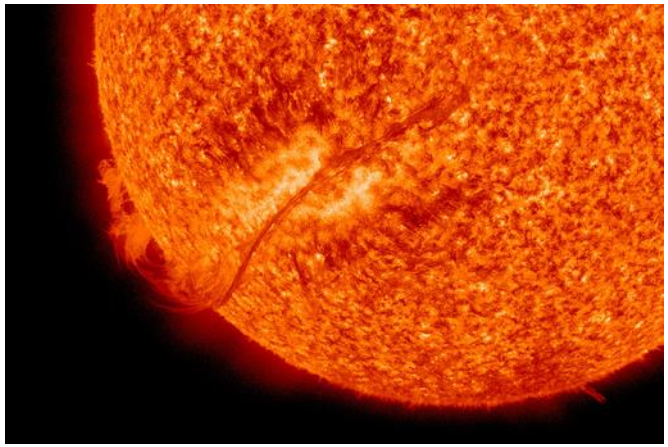
SDO/HMI Quick-Look Continuum: 20121114_000000

The Sun Today

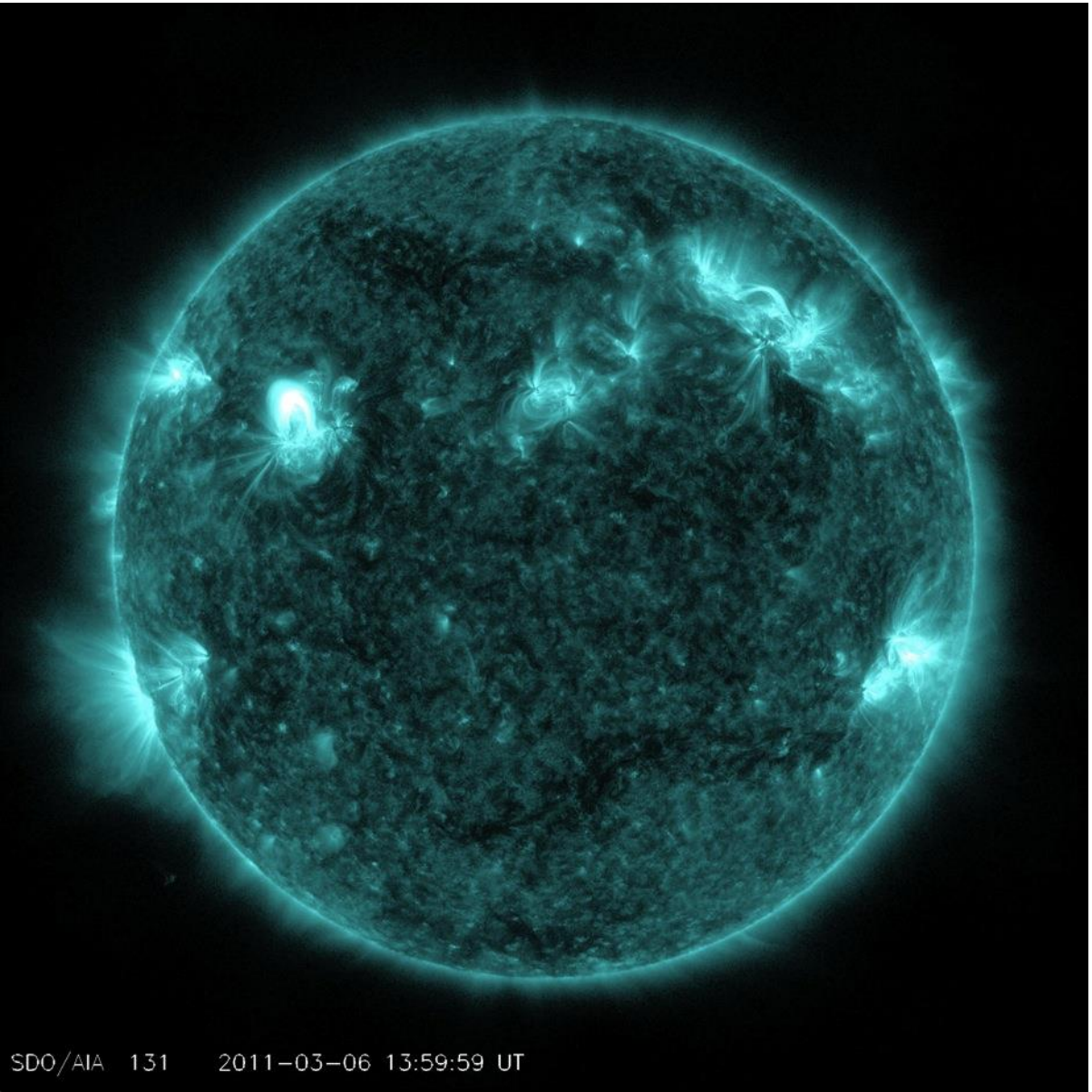
The Sun in Deep Red Light



In this specific color of red light we can see more details of the Sun's magnetic activity.

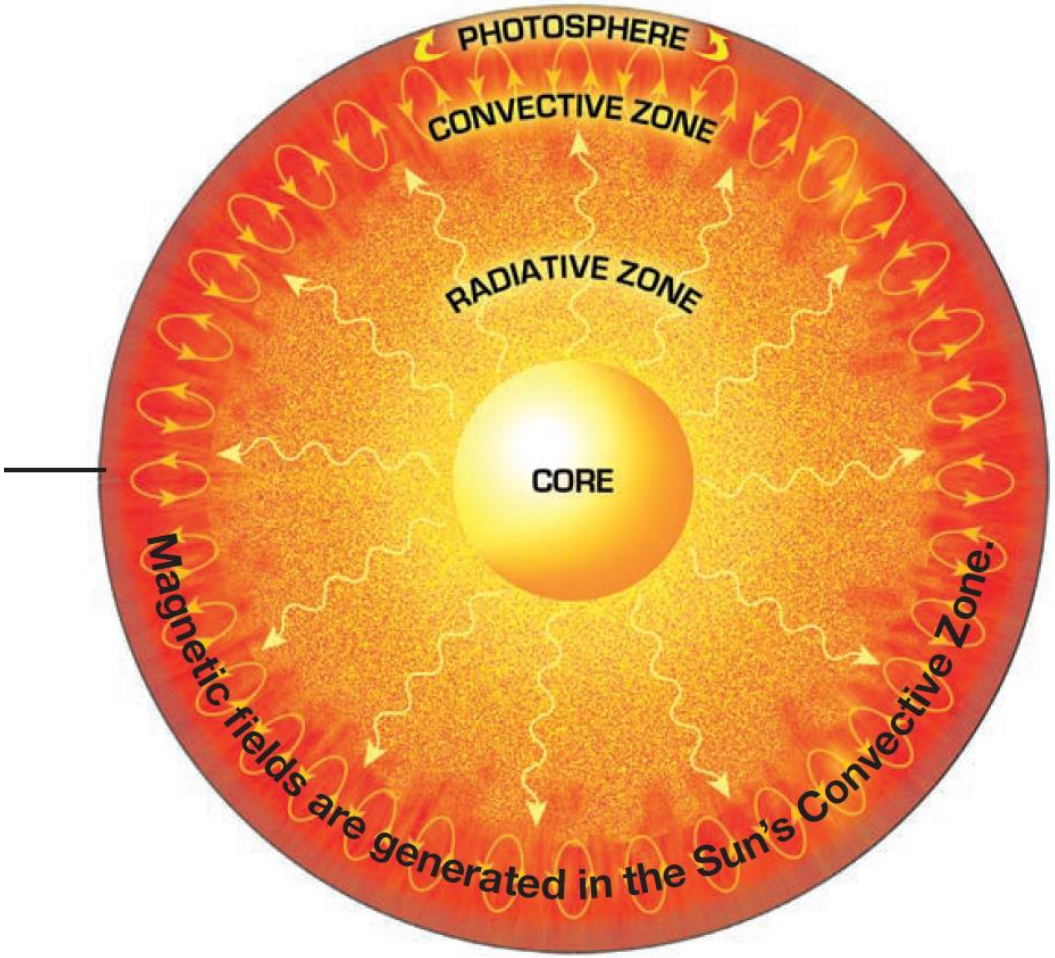


The Sun in Ultraviolet



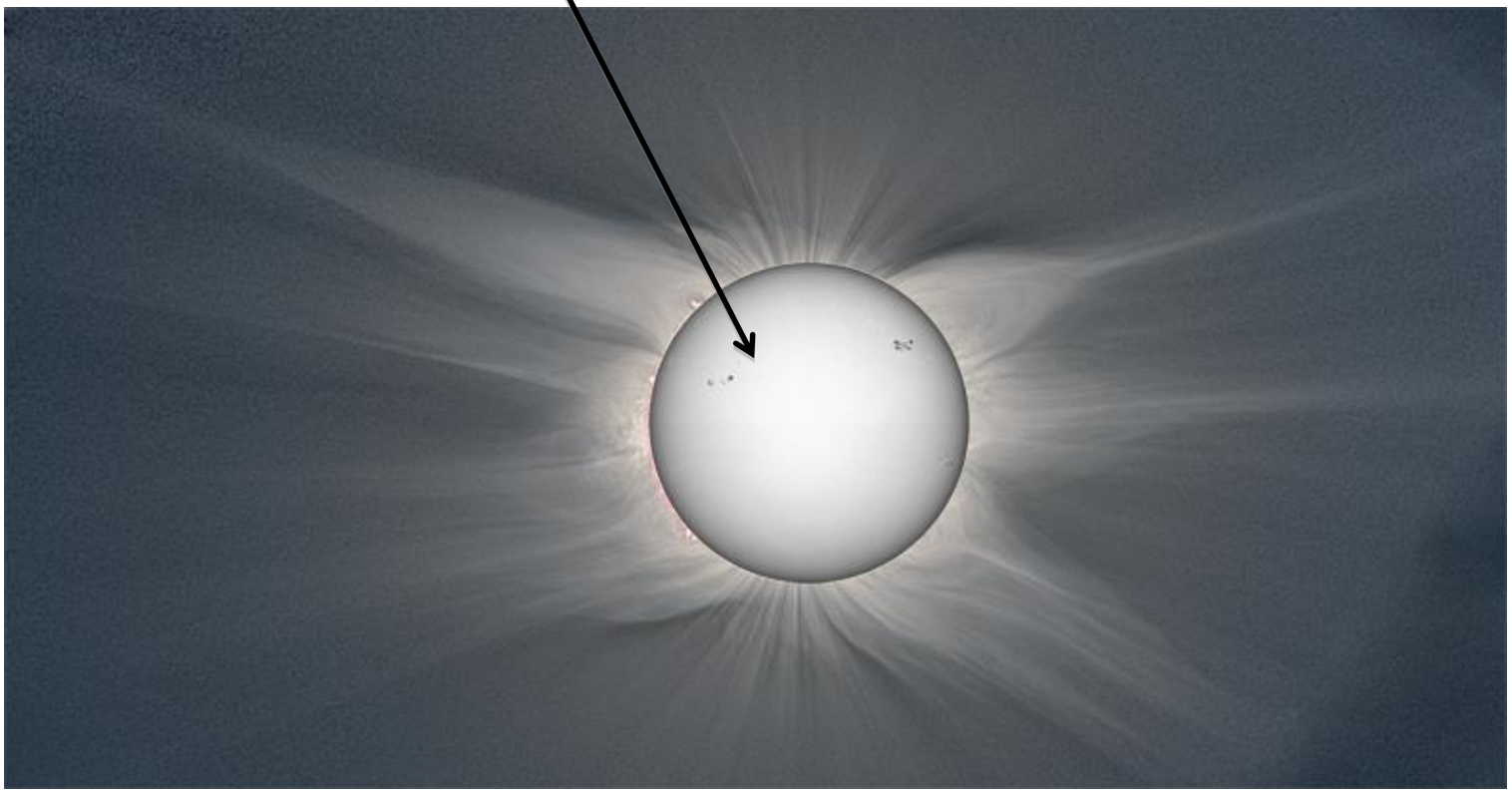
From space, we can observe the Sun in ultraviolet (UV) light and see hot gas trapped in magnetic fields on the Sun.

The Interior of the Sun



Exterior of the Sun

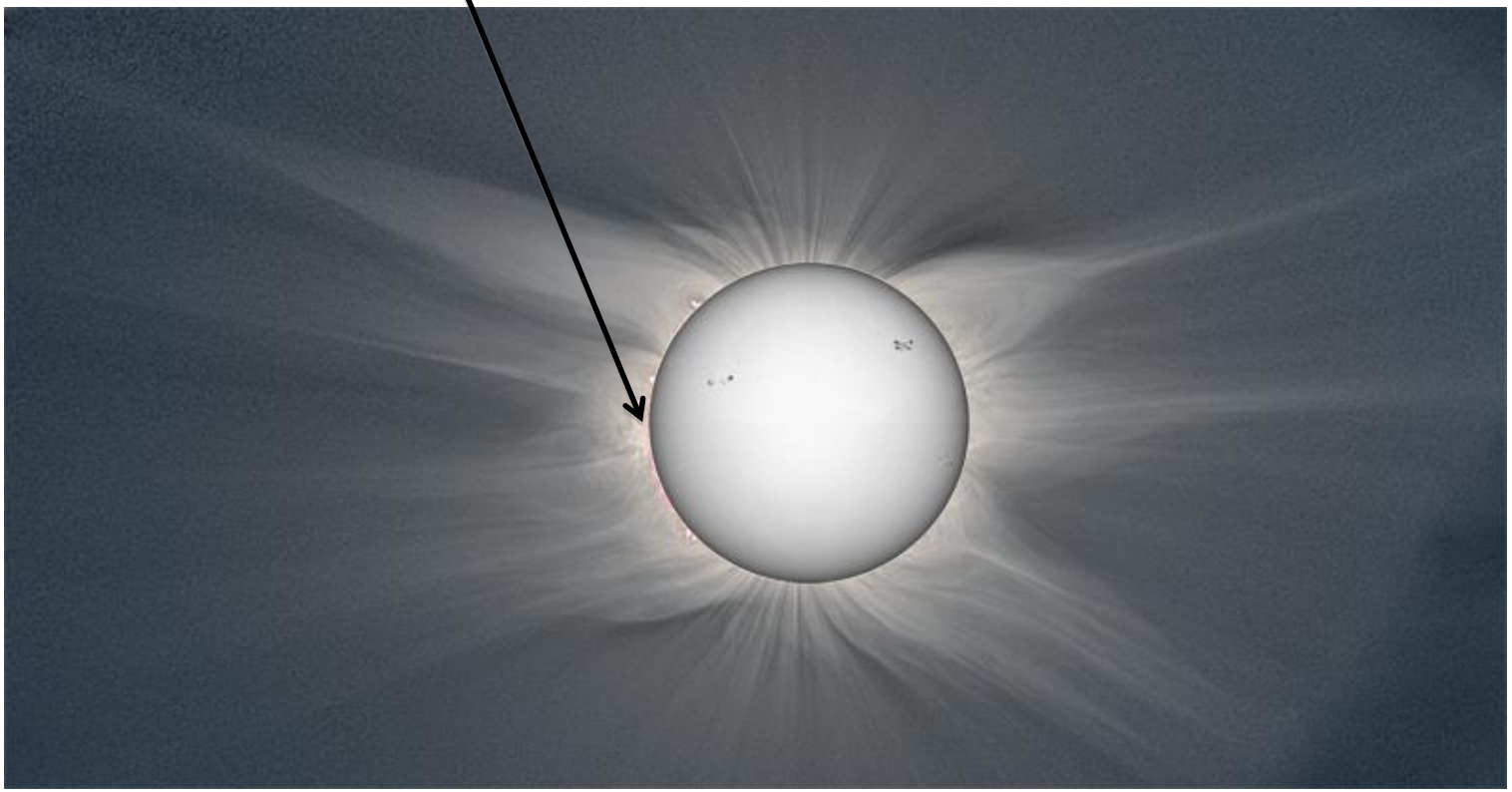
Photosphere: Sun's visible "surface"



Exterior of the Sun

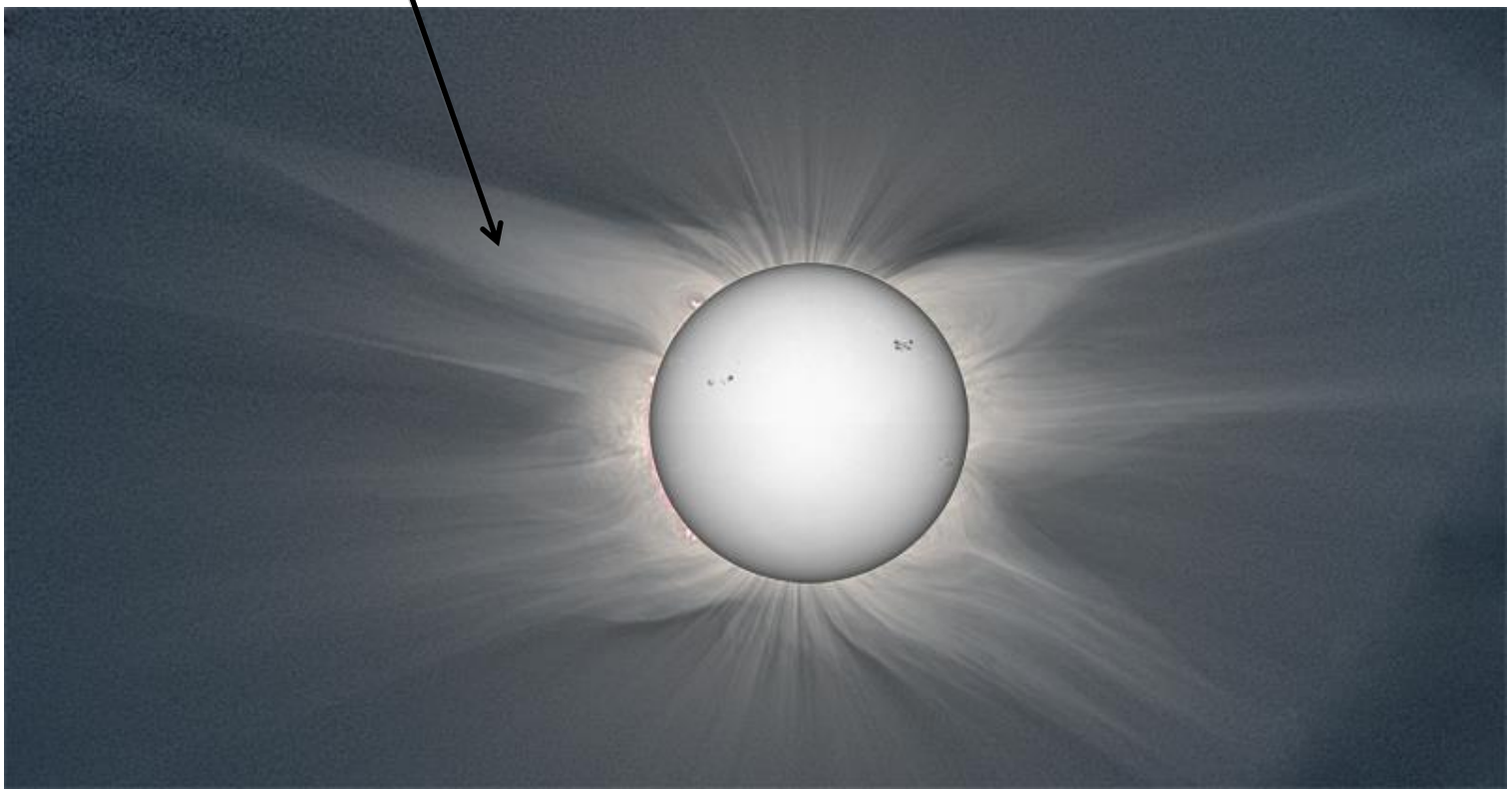
Photosphere: Sun's visible "surface"

Chromosphere: Just above the Photosphere



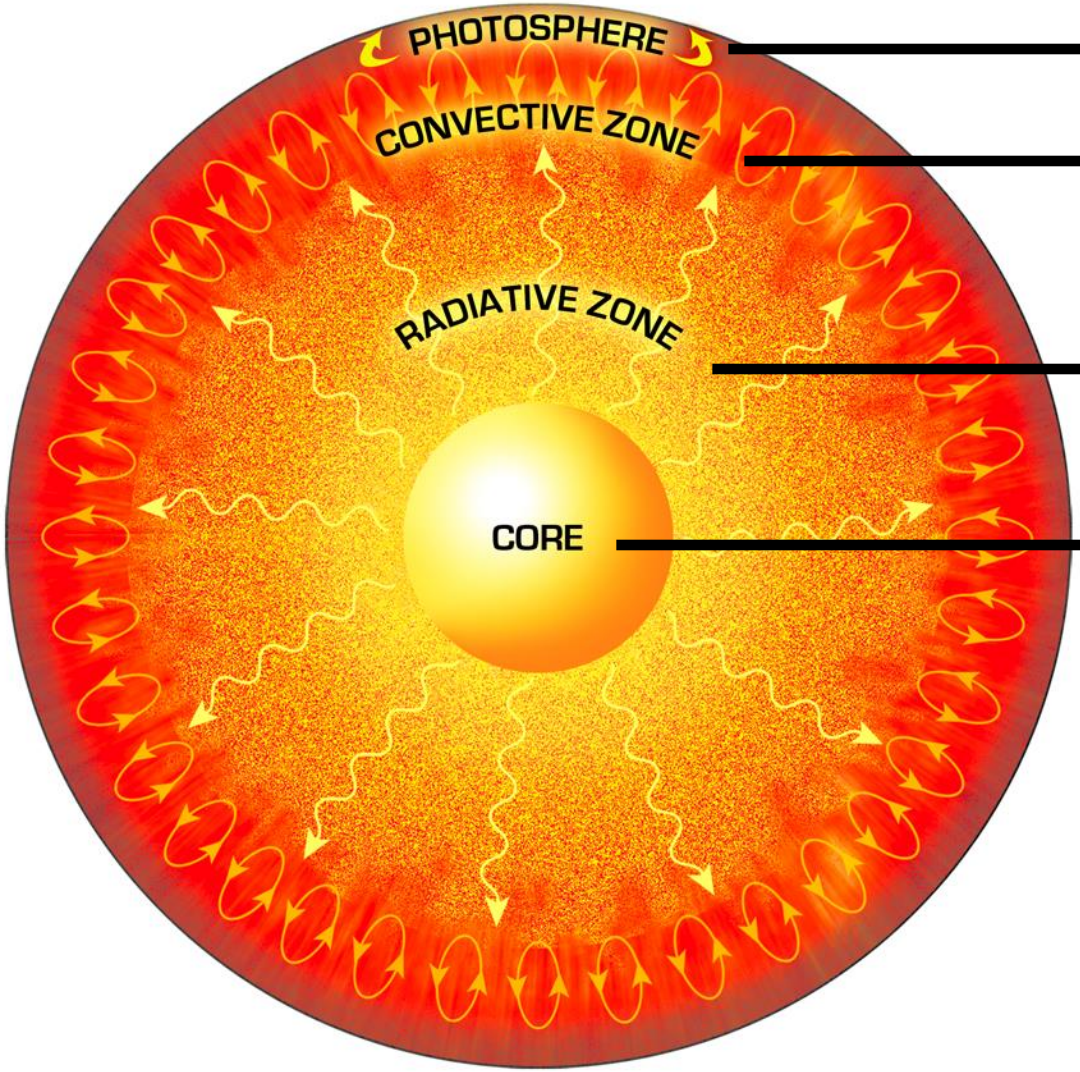
Exterior of the Sun

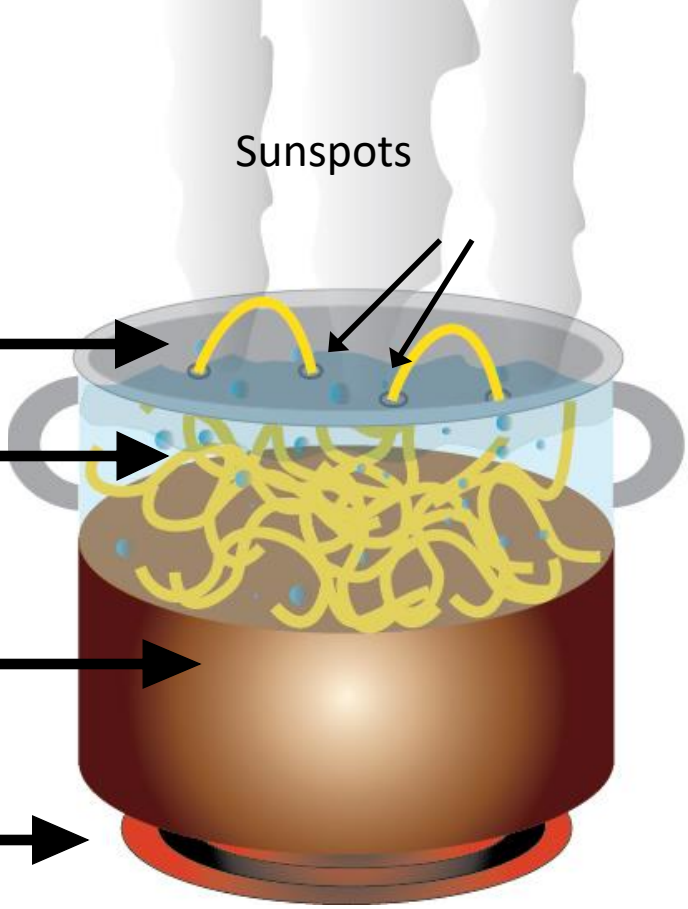
Photosphere: Sun's visible "surface"
Chromosphere: Just above the Photosphere
Corona: The Sun's outer atmosphere

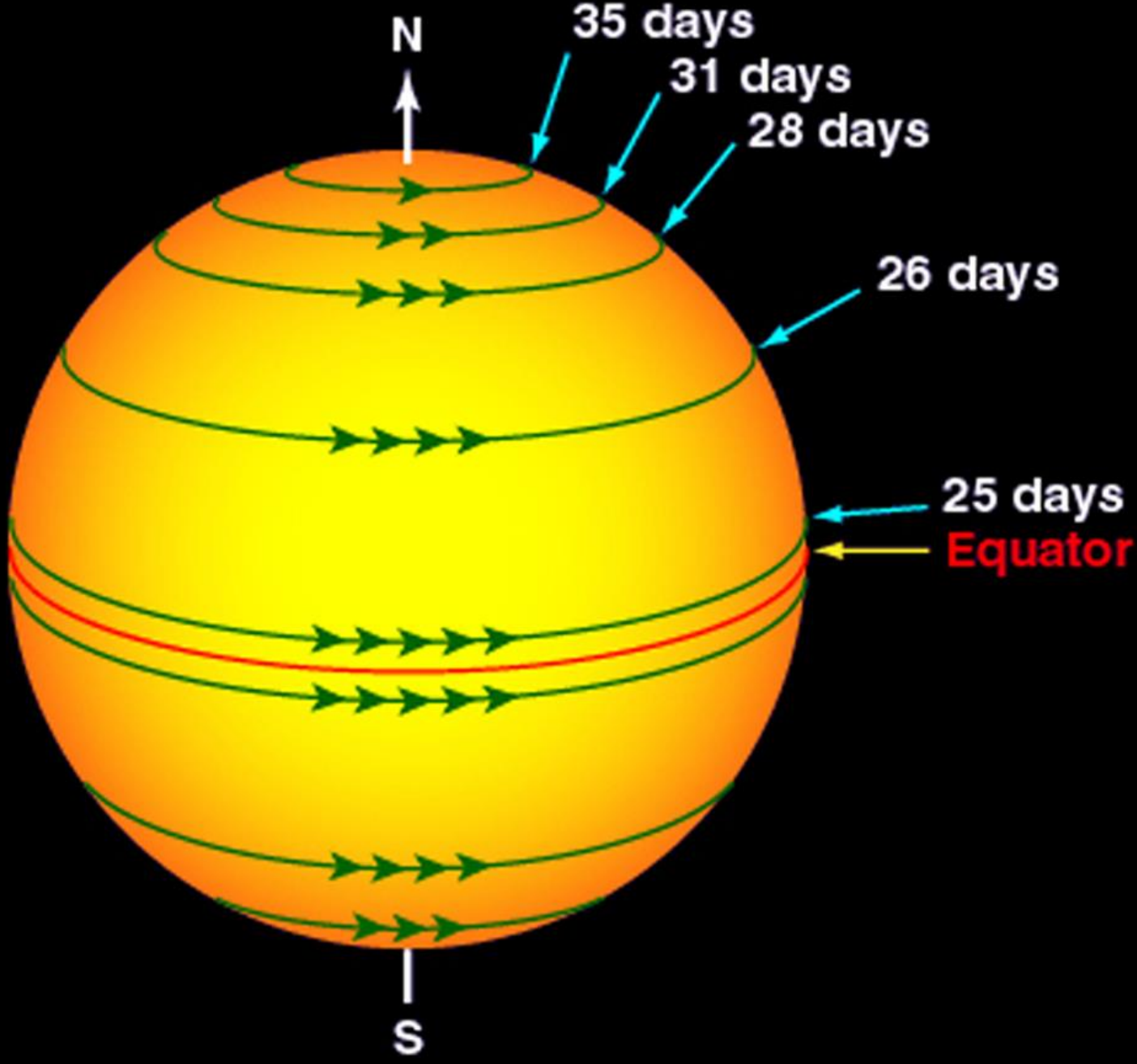


The Corona extends far out into the Solar System, in fact we *live* in it!

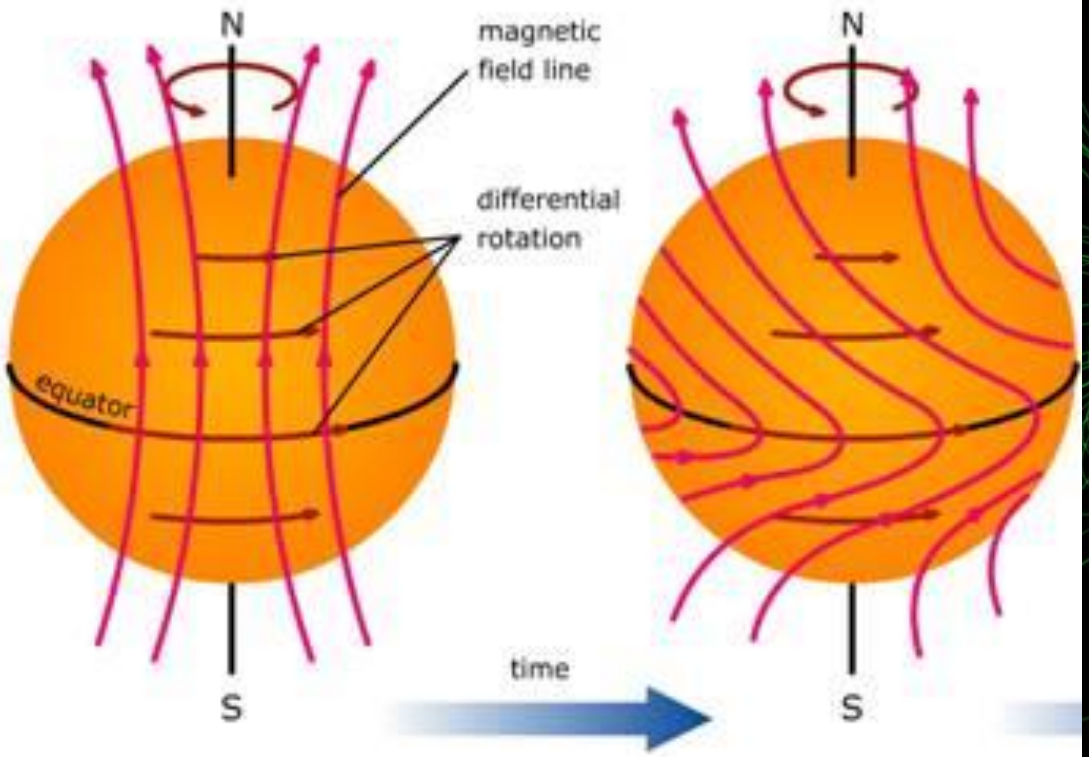
Inside the Sun

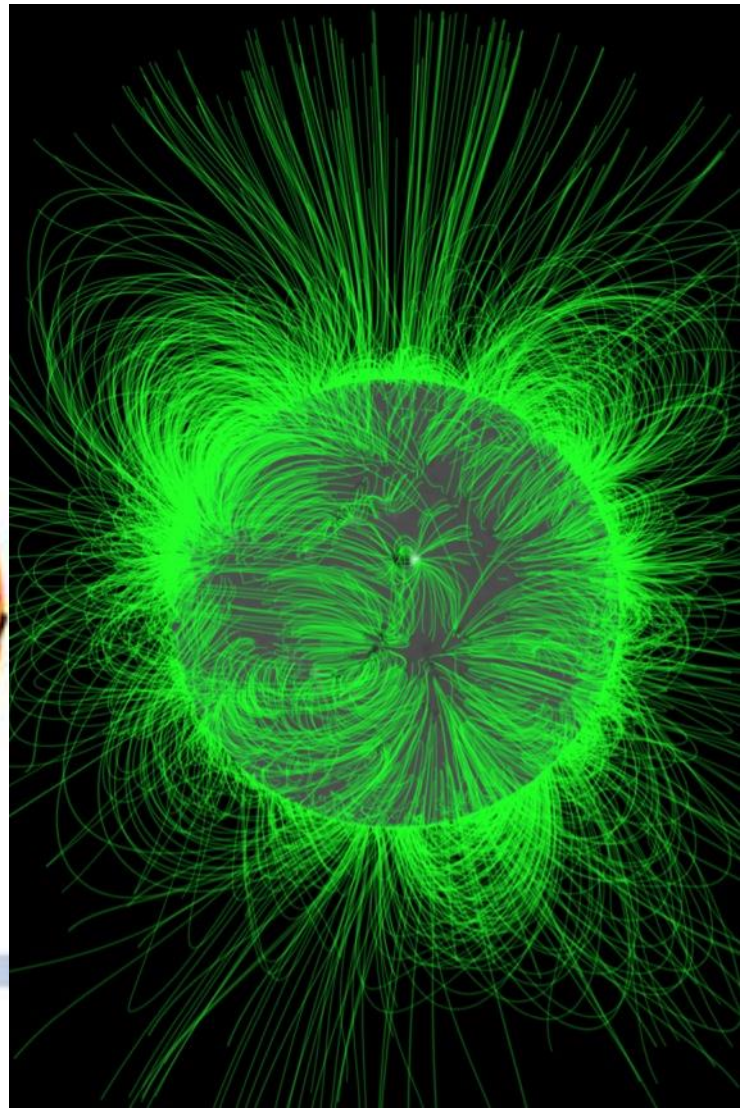




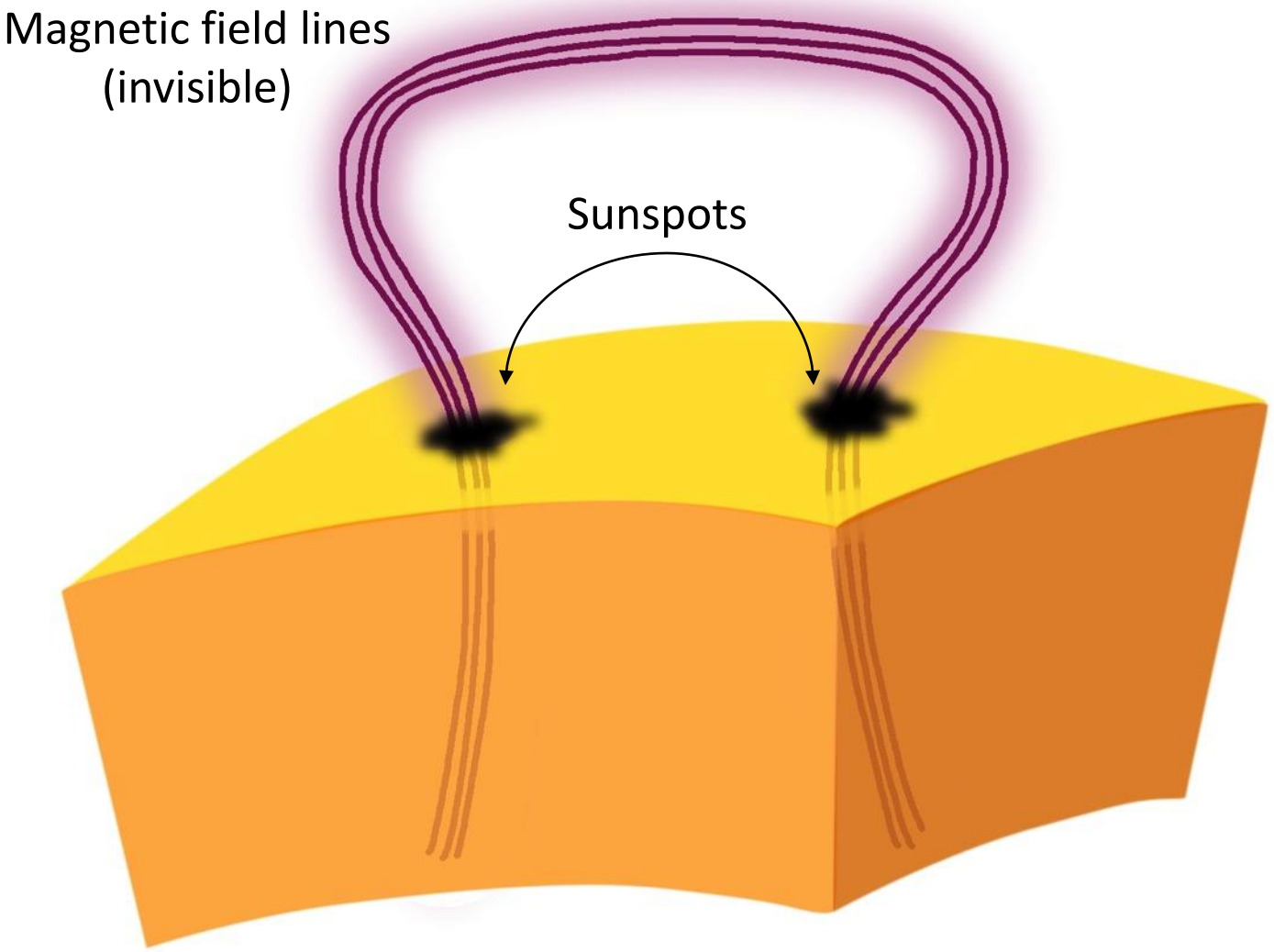

N
35 days
31 days
28 days
26 days
25 days
Equator
S

The Sun's Magnetic Field





What Makes Up Sunspots?

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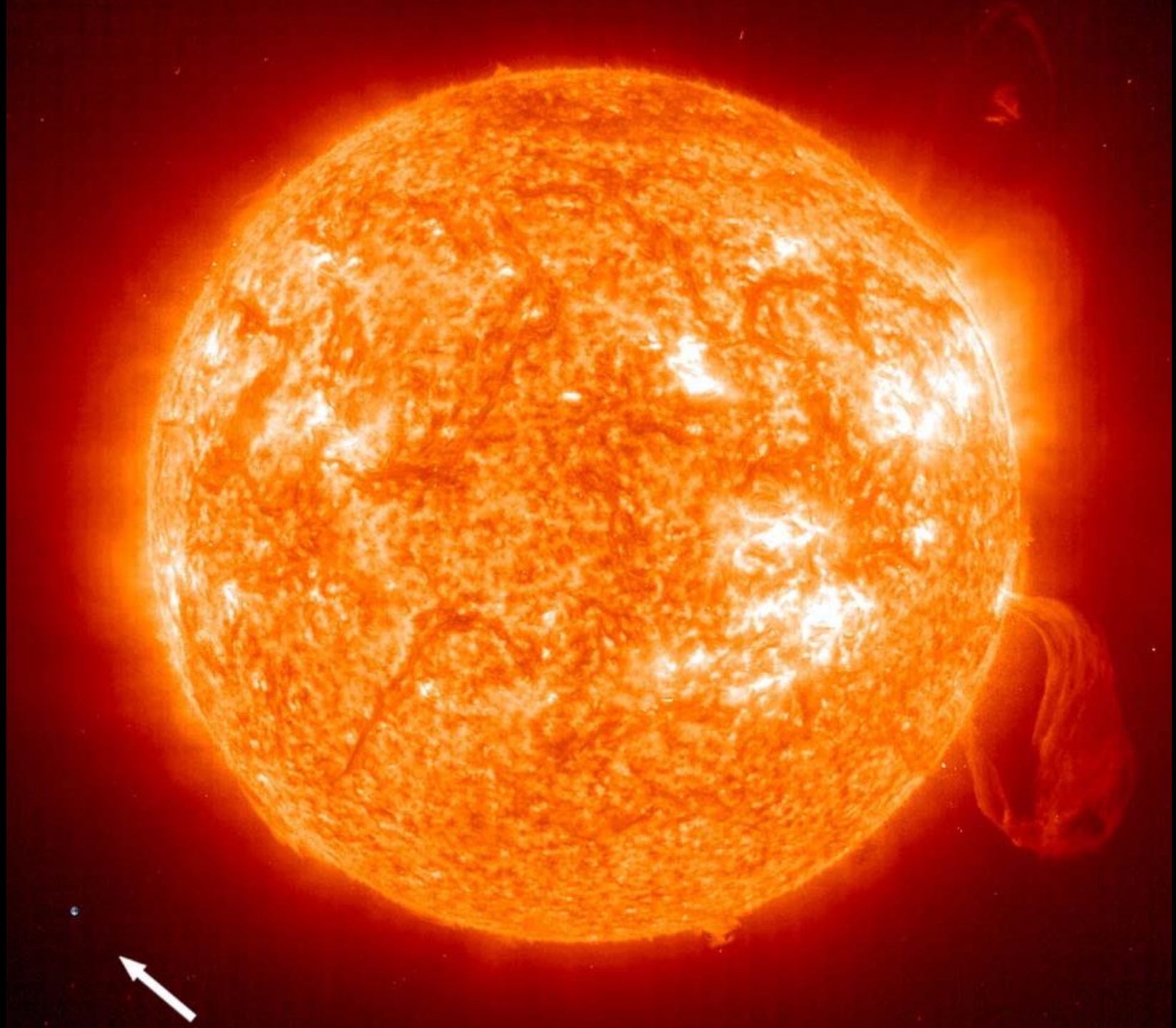
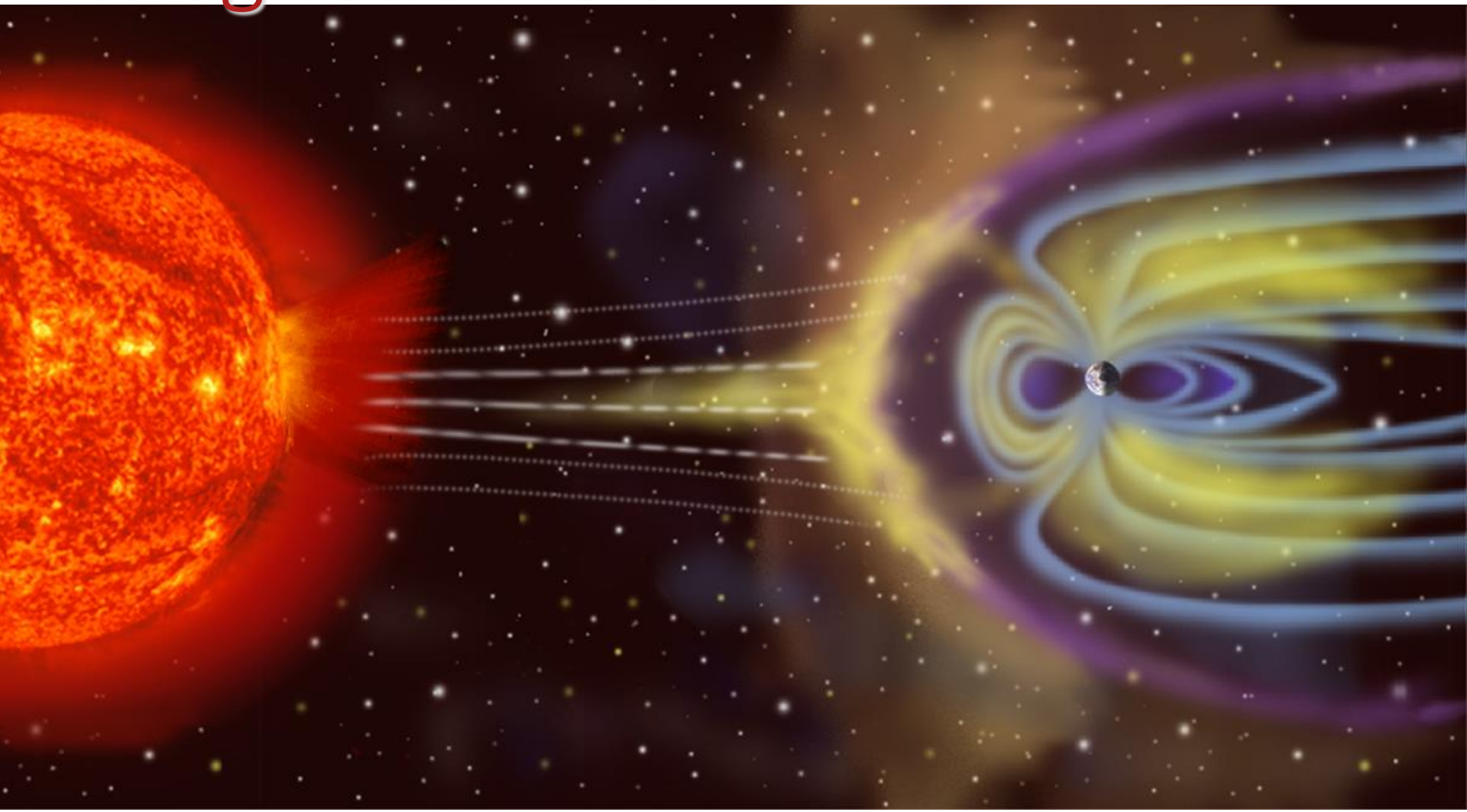
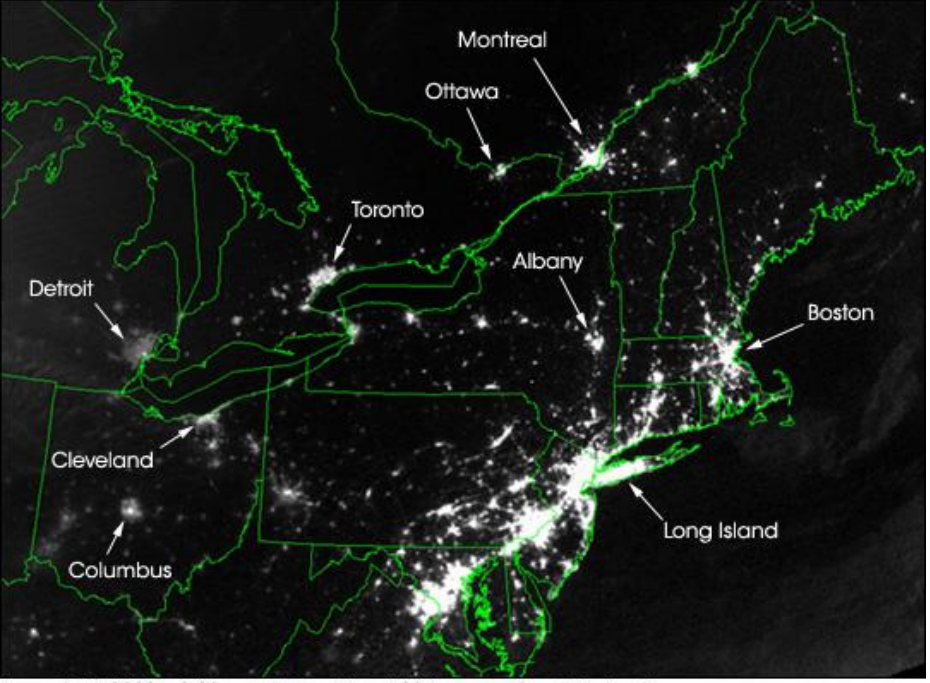
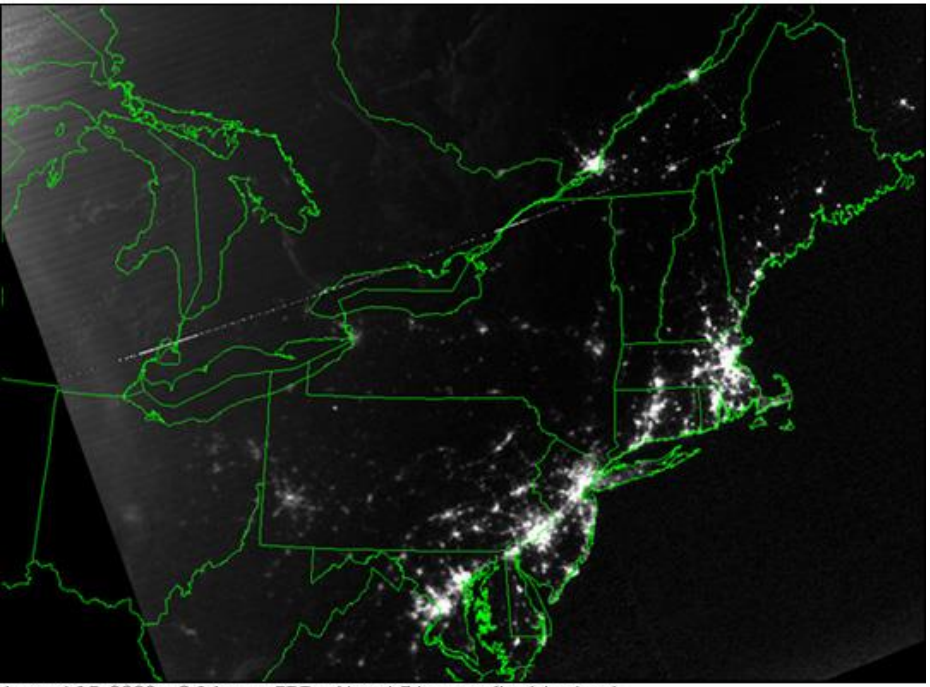


Earth is Protected by it's Magnetic Field



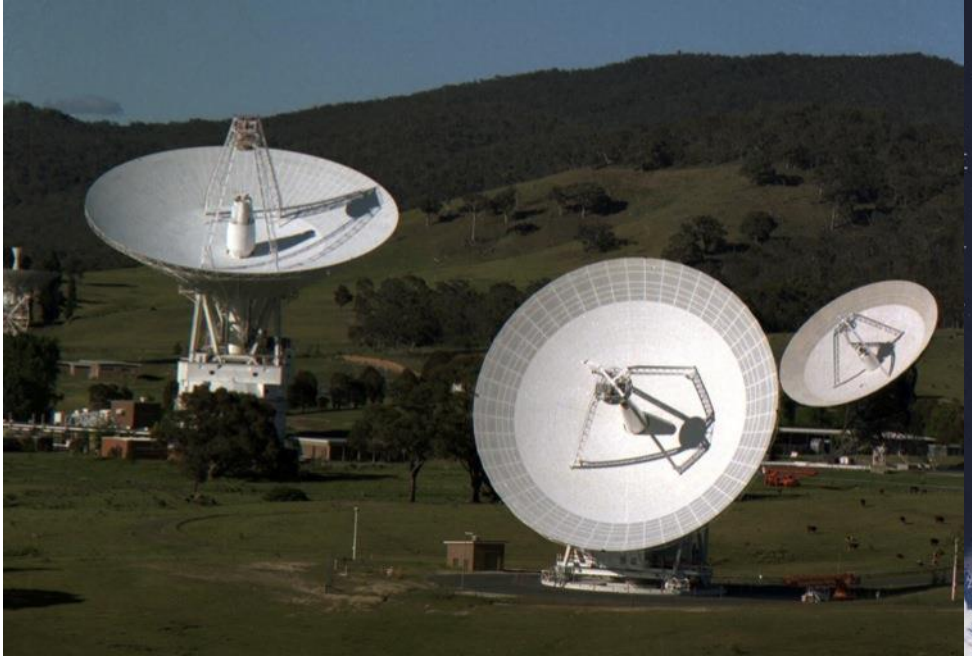


August 14, 2003 • 9:29 p.m. EDT • About 20 hours before blackout


August 15, 2003 • 9:14 p.m. EDT • About 7 hours after blackout

Solar Storms

can cause massive power outages



Solar Storms **can disrupt communications between the ground, satellites, and transportation**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How Many Stars?

- How Many stars Can you see?

  About 2000

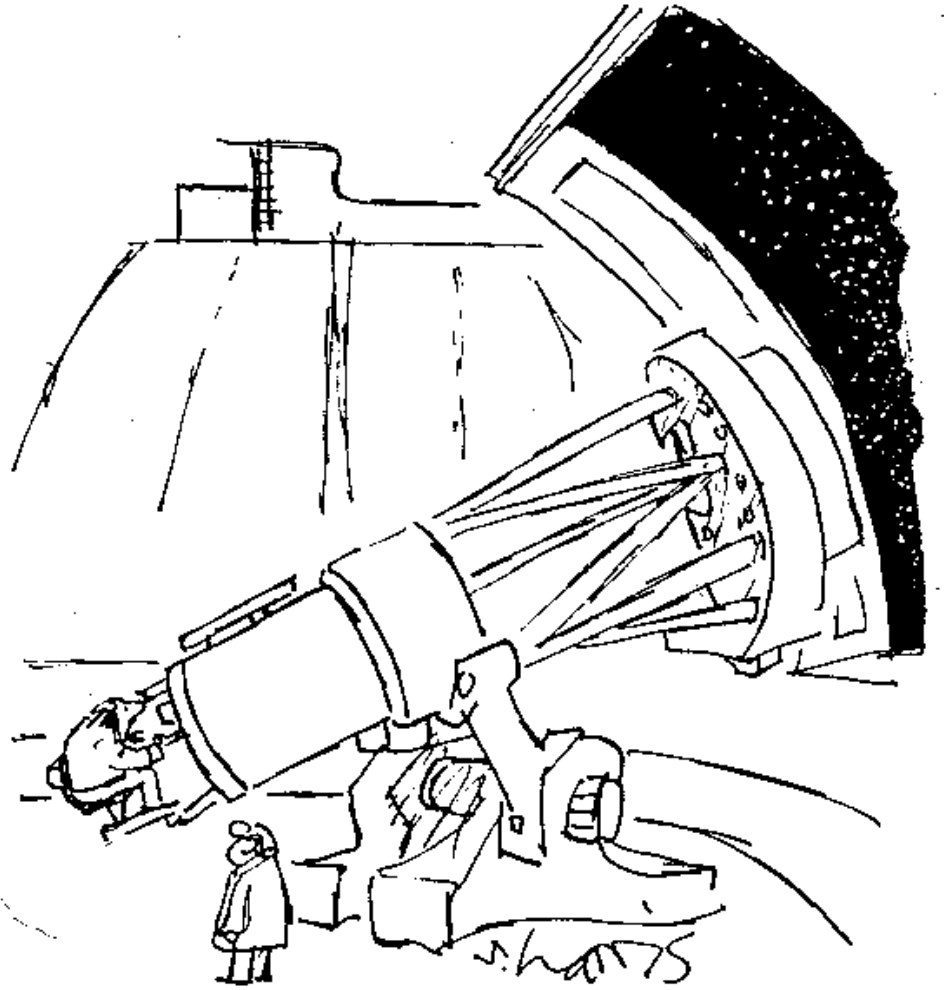
- How many Stars are there in the universe?

  10,000,000,000,000,000,000,000 (10 sextillion)

  to

  1,000,000,000,000,000,000,000,000 (1 septillion)

- That is between 10,000 to 1,000,000 stars for every grain of sand on earth.

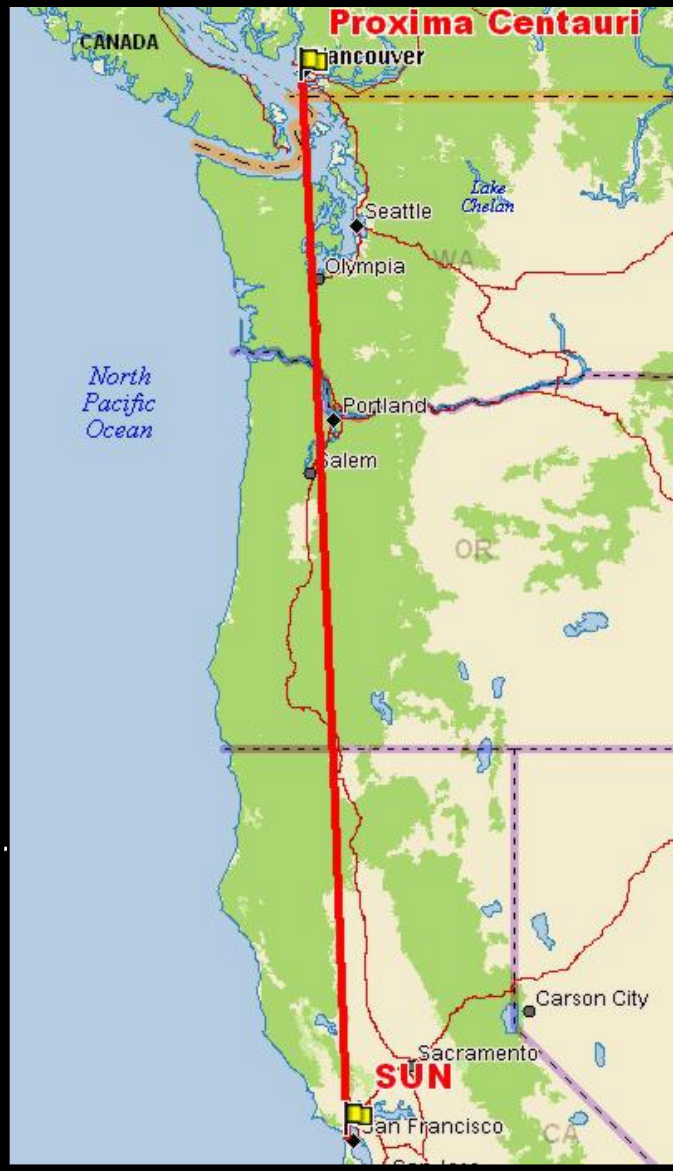


"Let's see, now ... picking up where we left off ... one billion, sixty-two million, thirty thousand, four hundred and thirteen ... one billion, sixty-two million, thirty thousand, four hundred and fourteen ..."

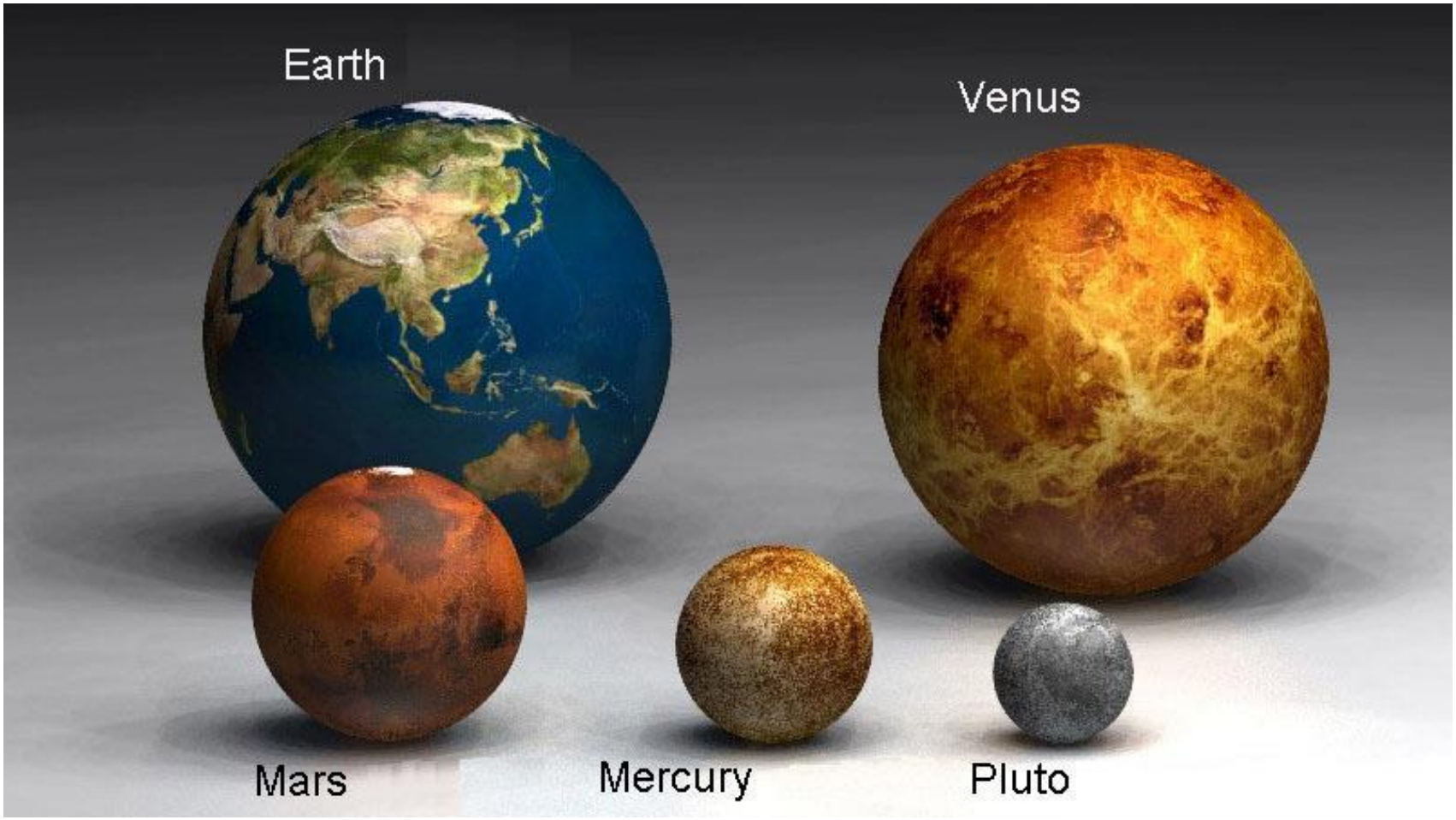
THE DISTANCE BETWEEN STARS

Shrinking the sun to the size of a golf ball.

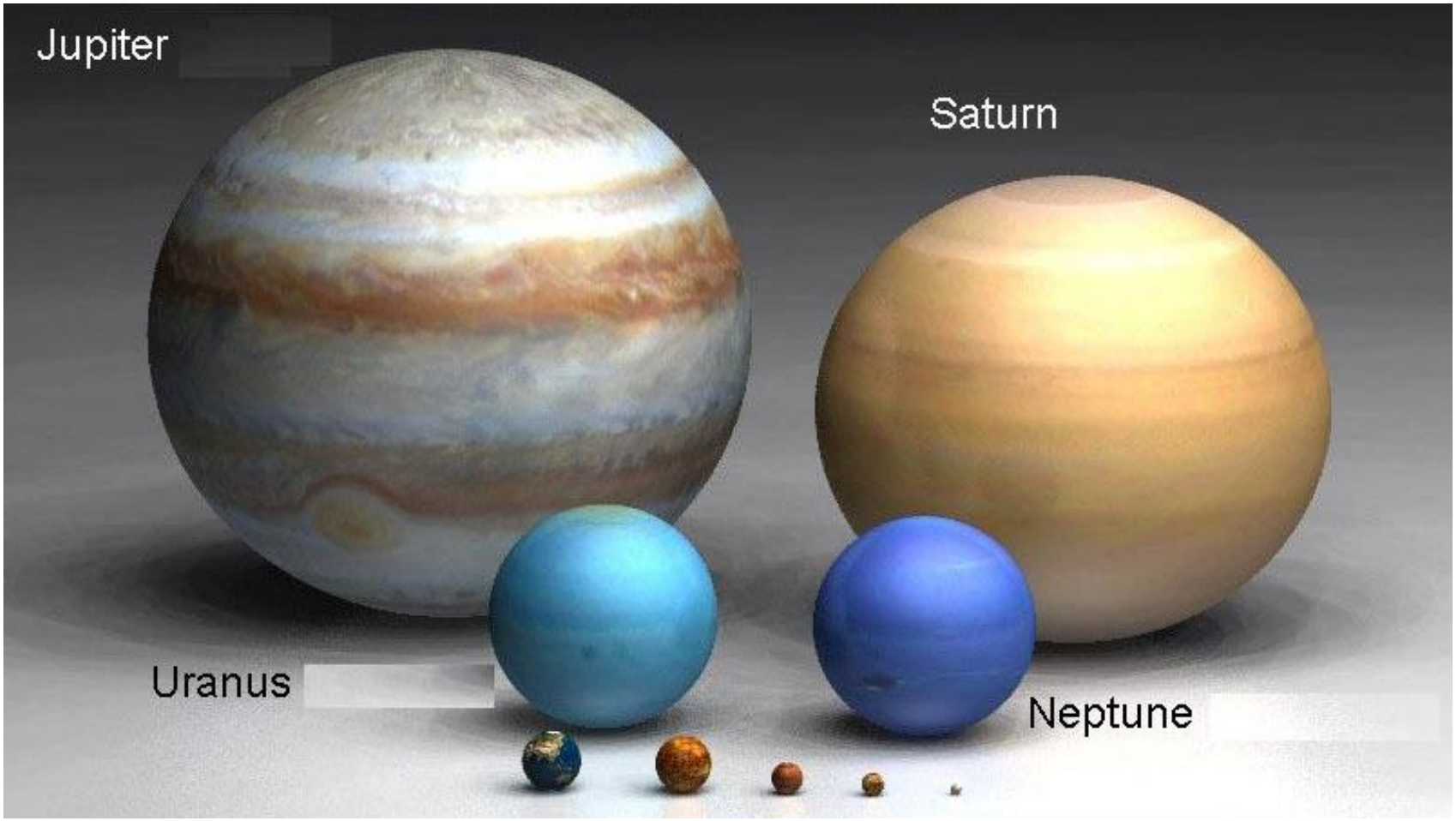
The distance to the nearest star (Proxima Centauri) would be
miles.



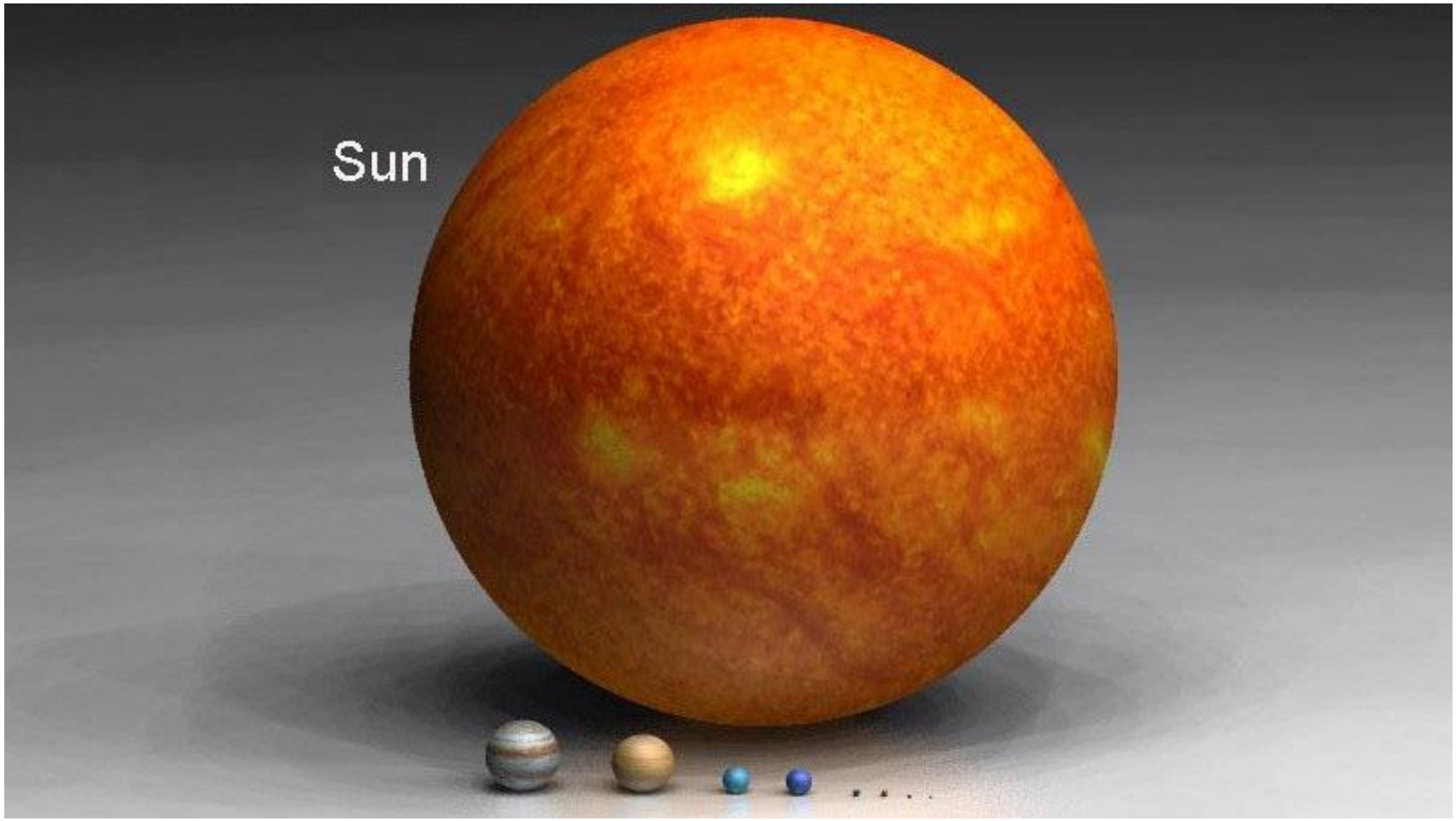
The Size of the Planets



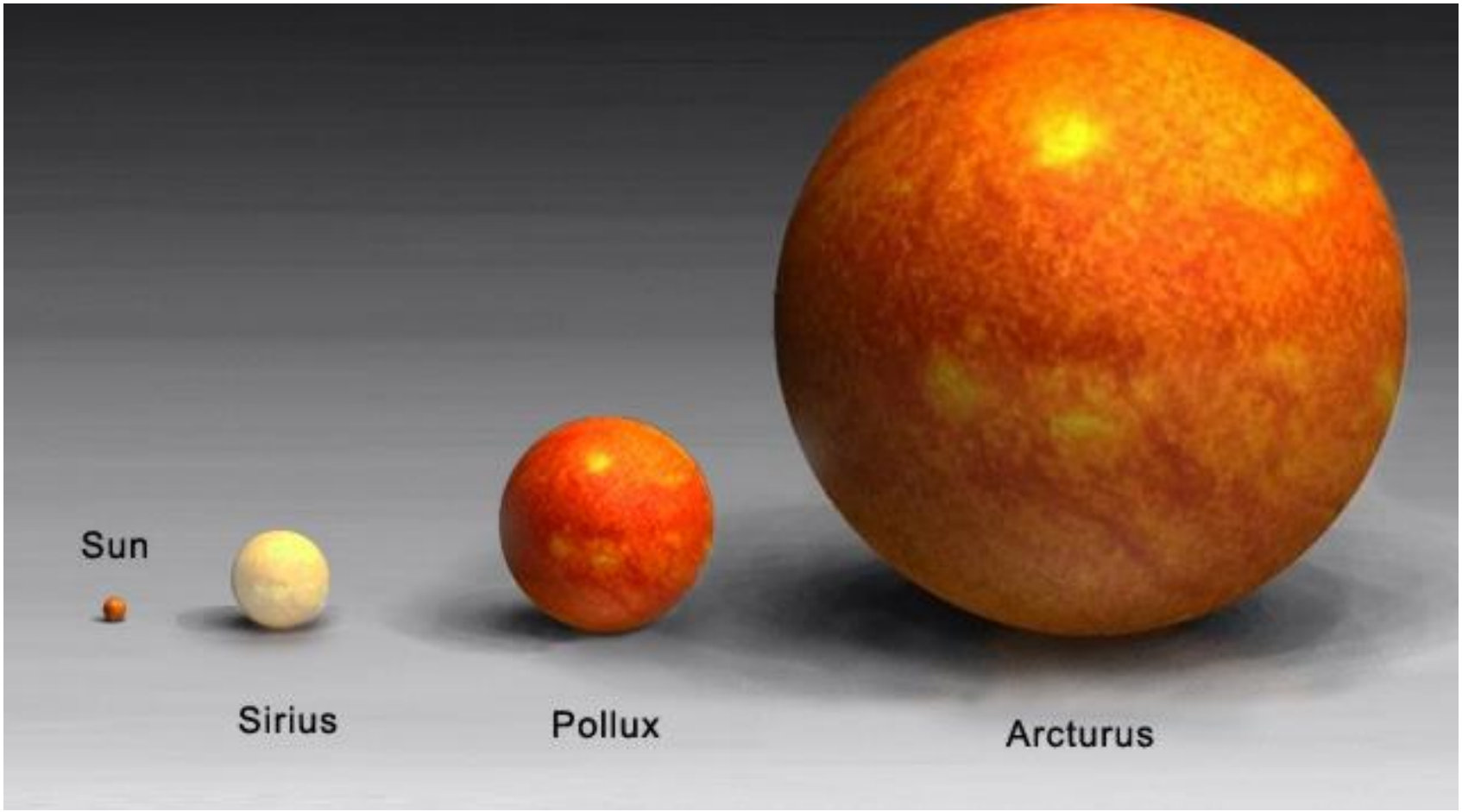
The Size of the Planets



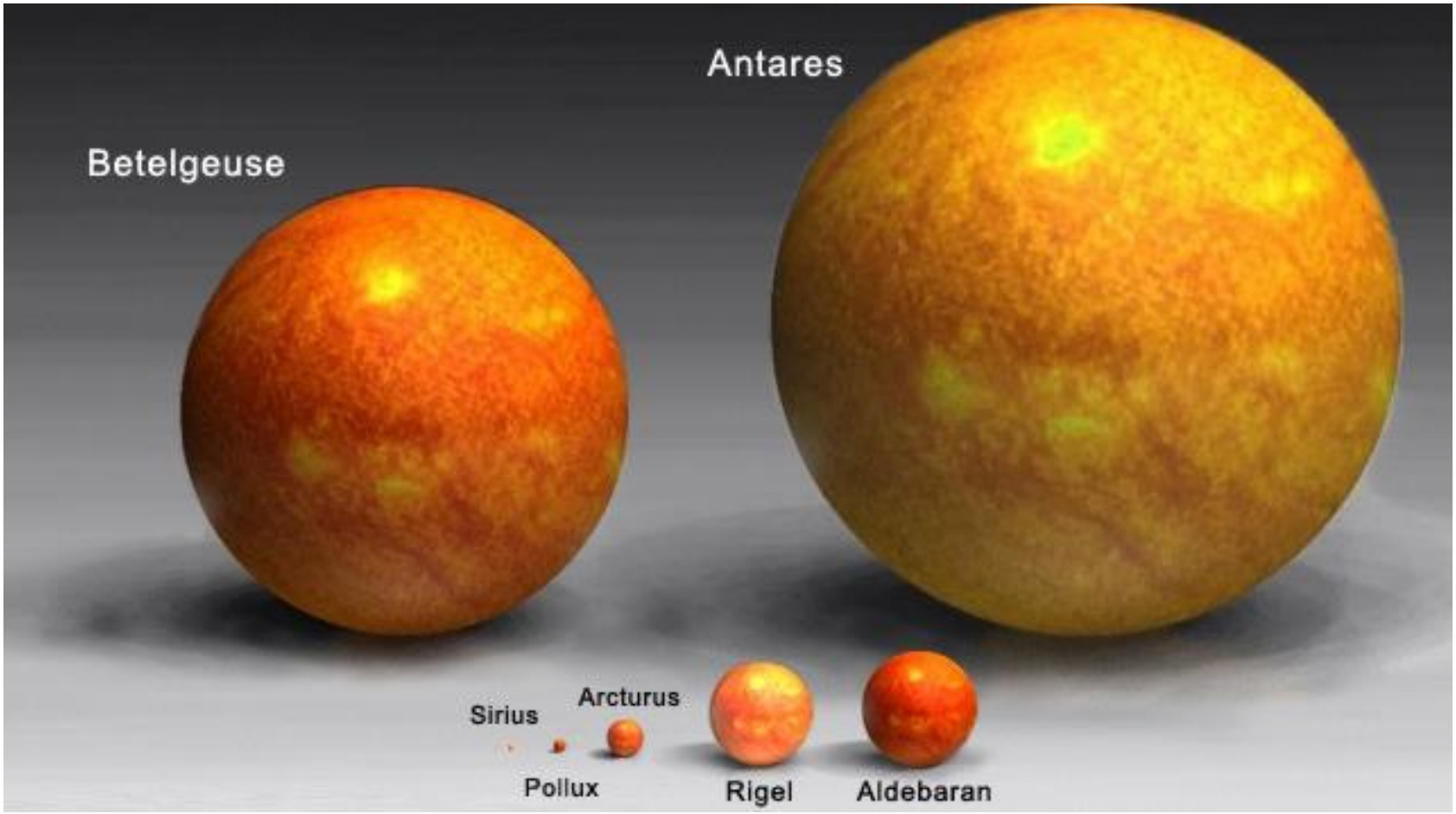
The Size of the Sun



The Size of the Sun

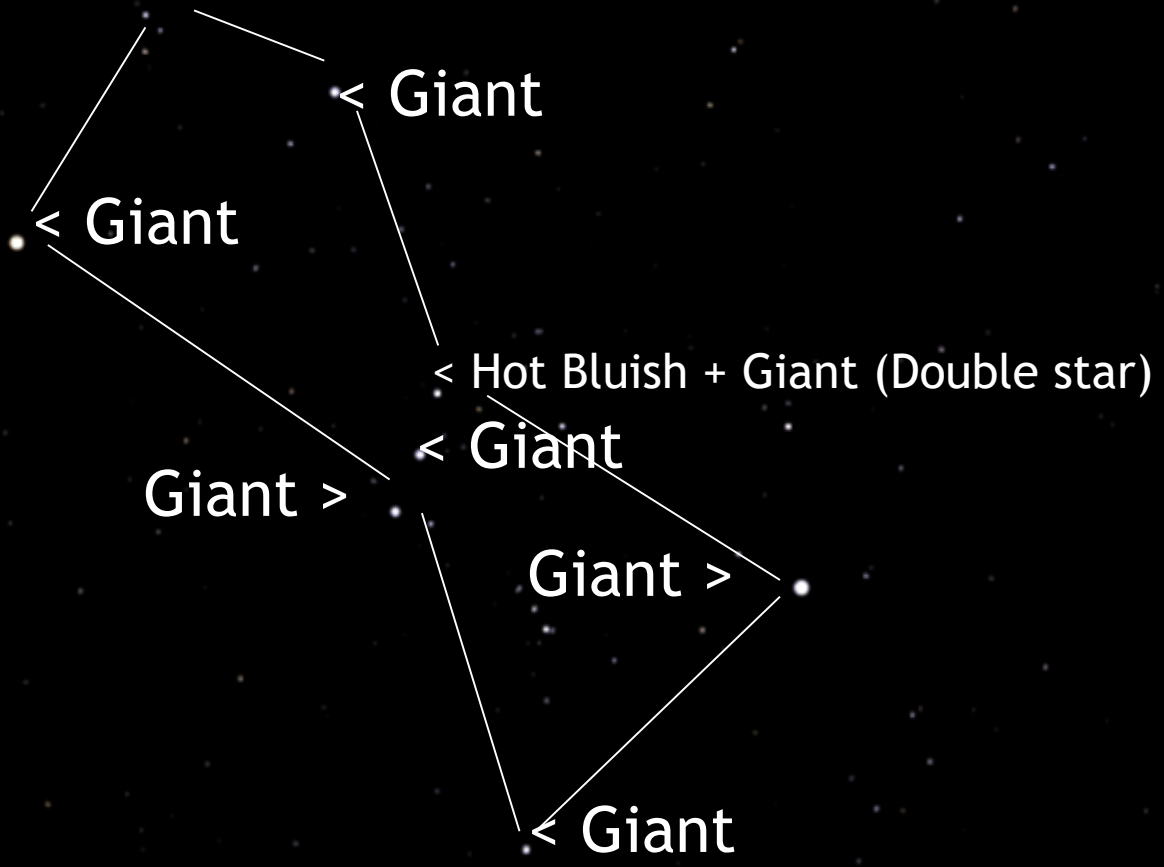


The Size of the Sun



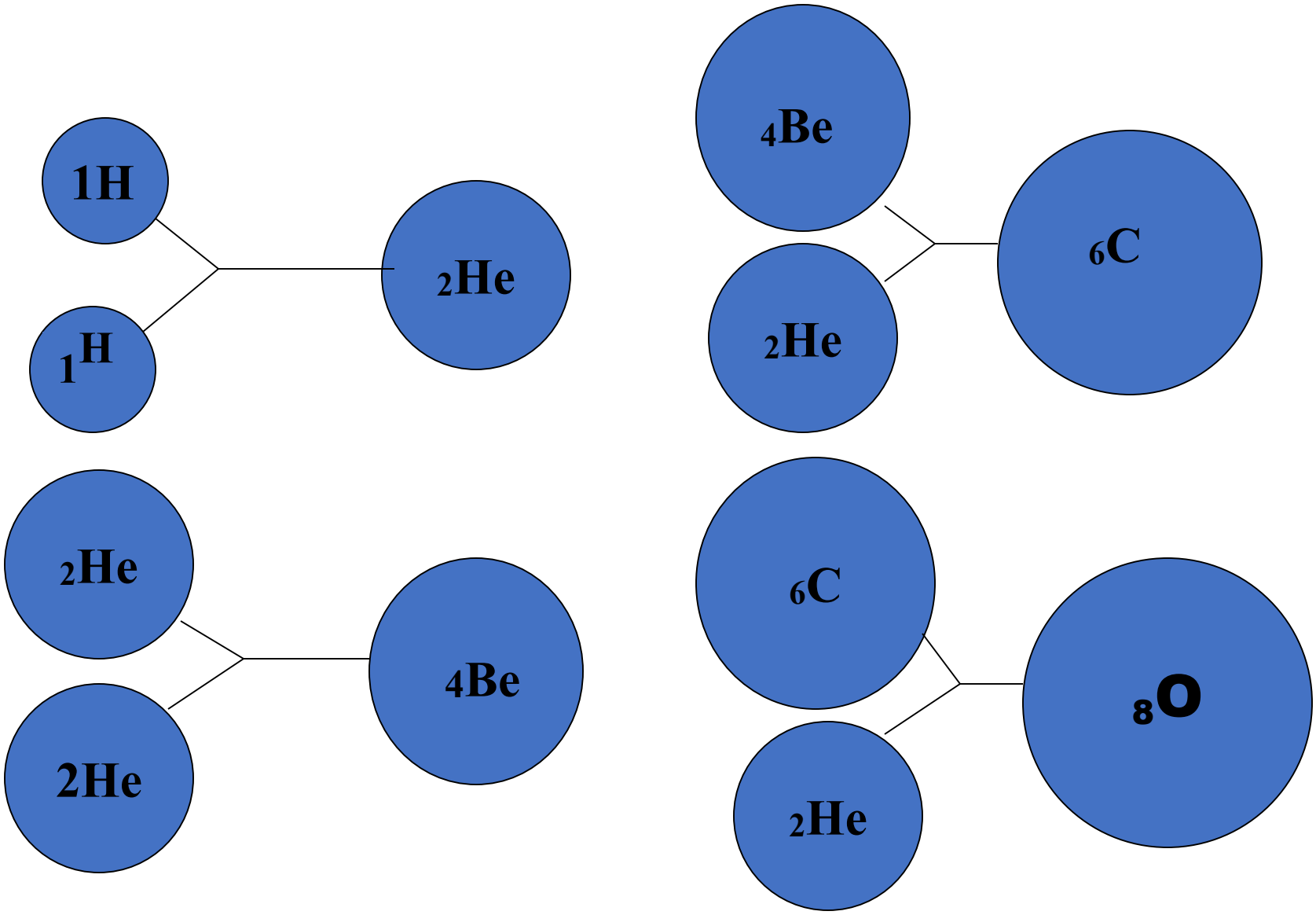
Orion

Orion

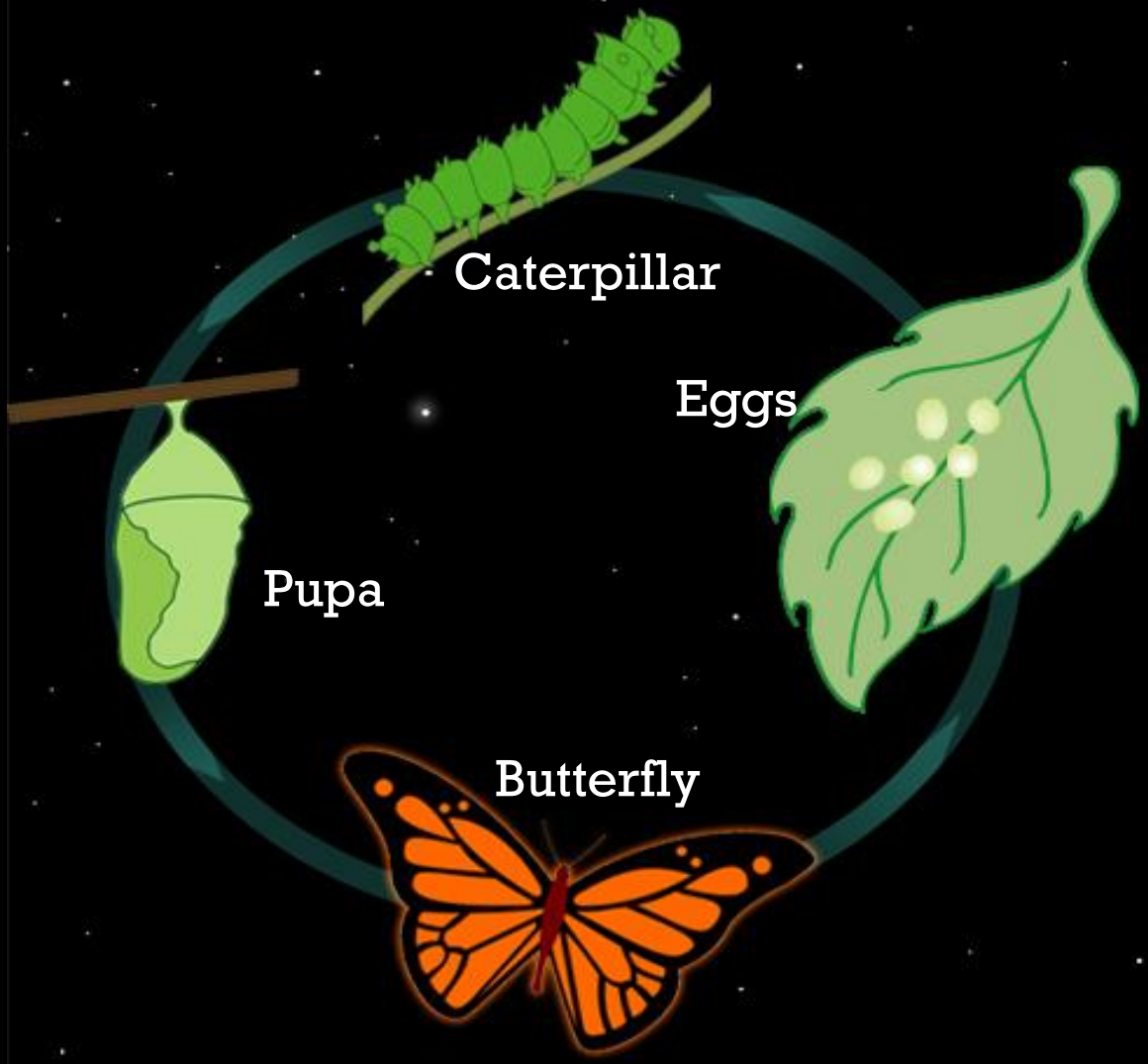

< Giant
< Giant
< Hot Bluish + Giant (Double star)
< Giant
Giant >
Giant >
< Giant


This Explosion burns about ½ a pound of Hydrogen
The Sun burns 600 Million Tons of Hydrogen per second.

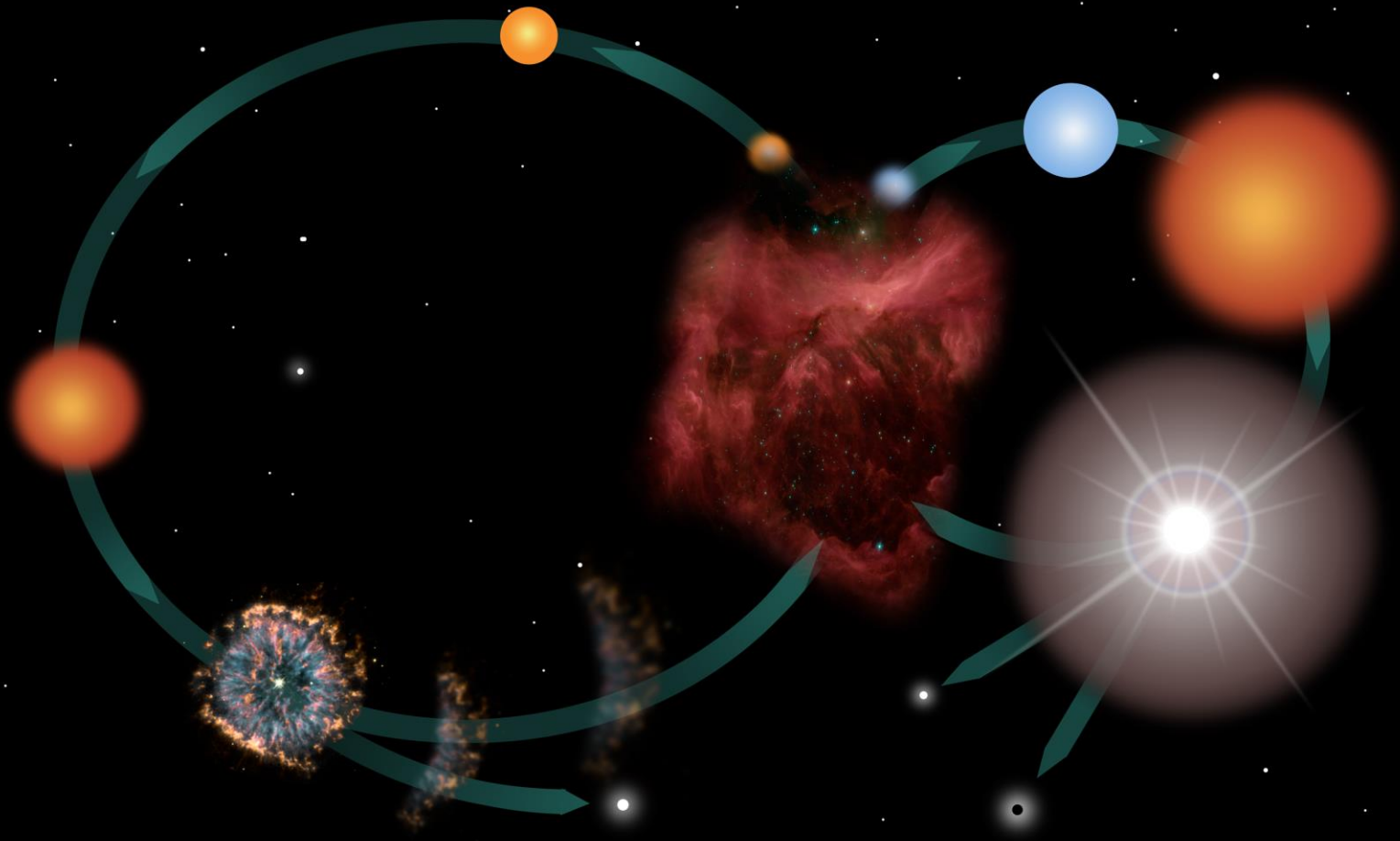
Fusion Reactions



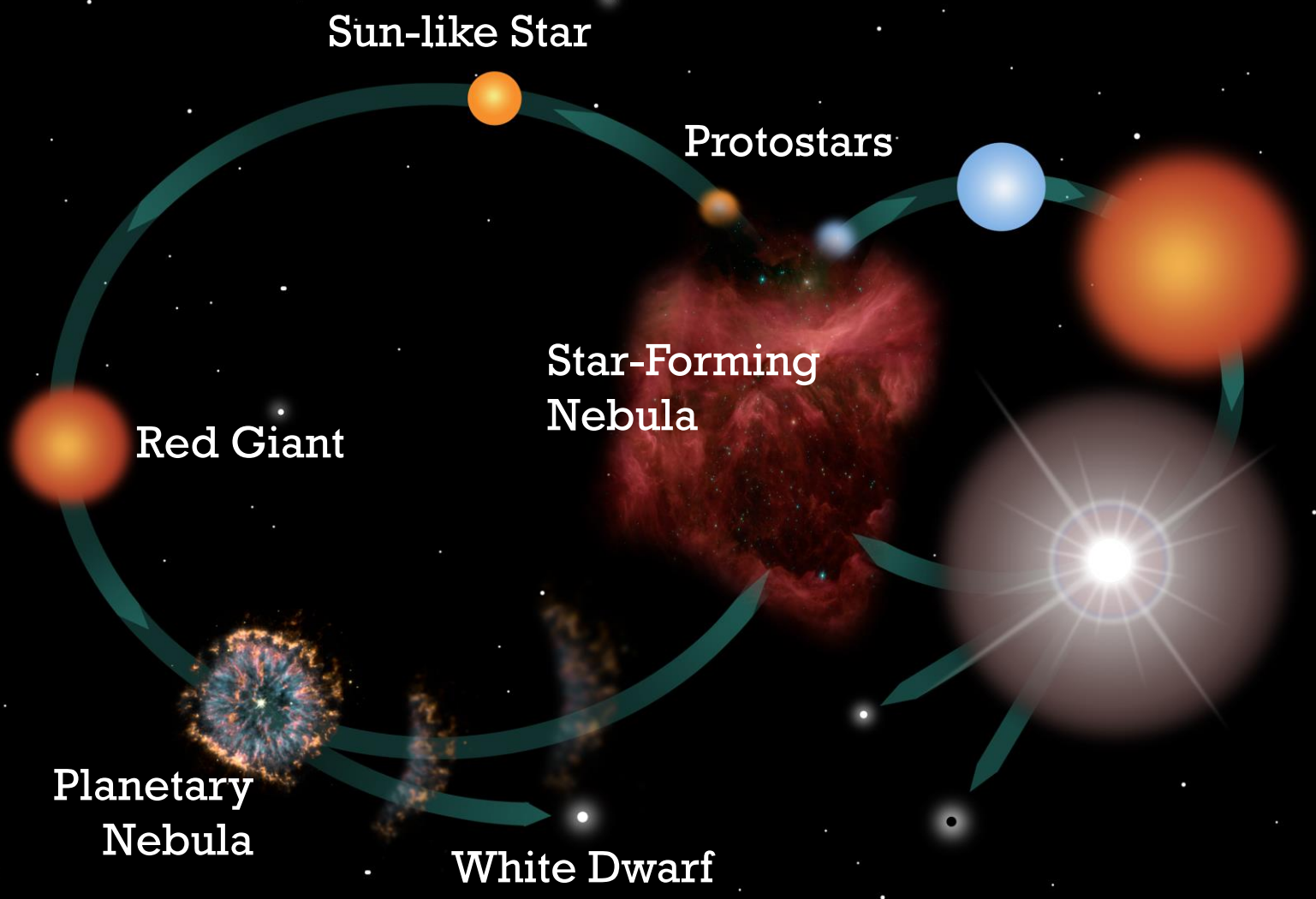
LIFE OF A BUTTERFLY



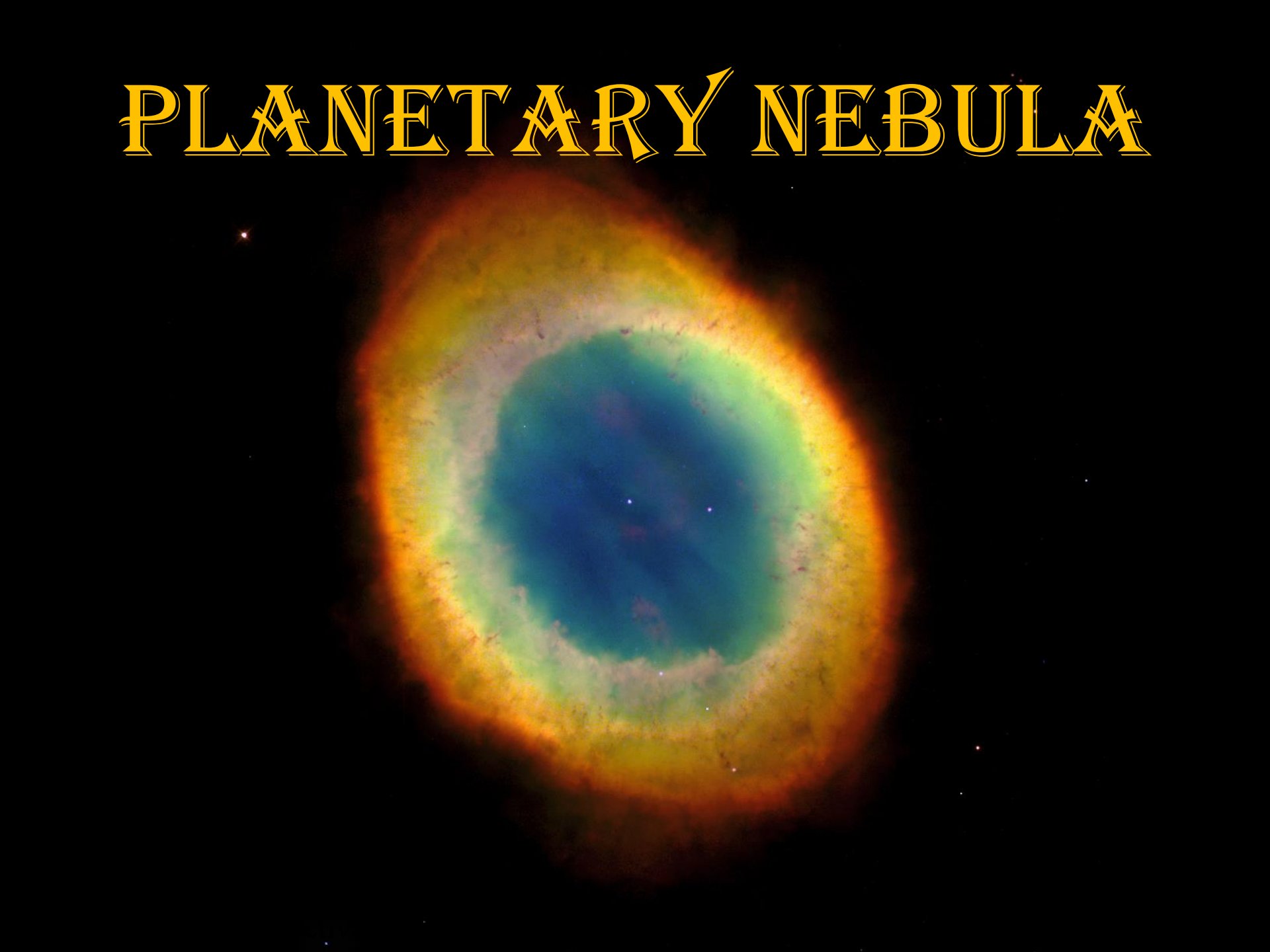
LIFE OF A STAR



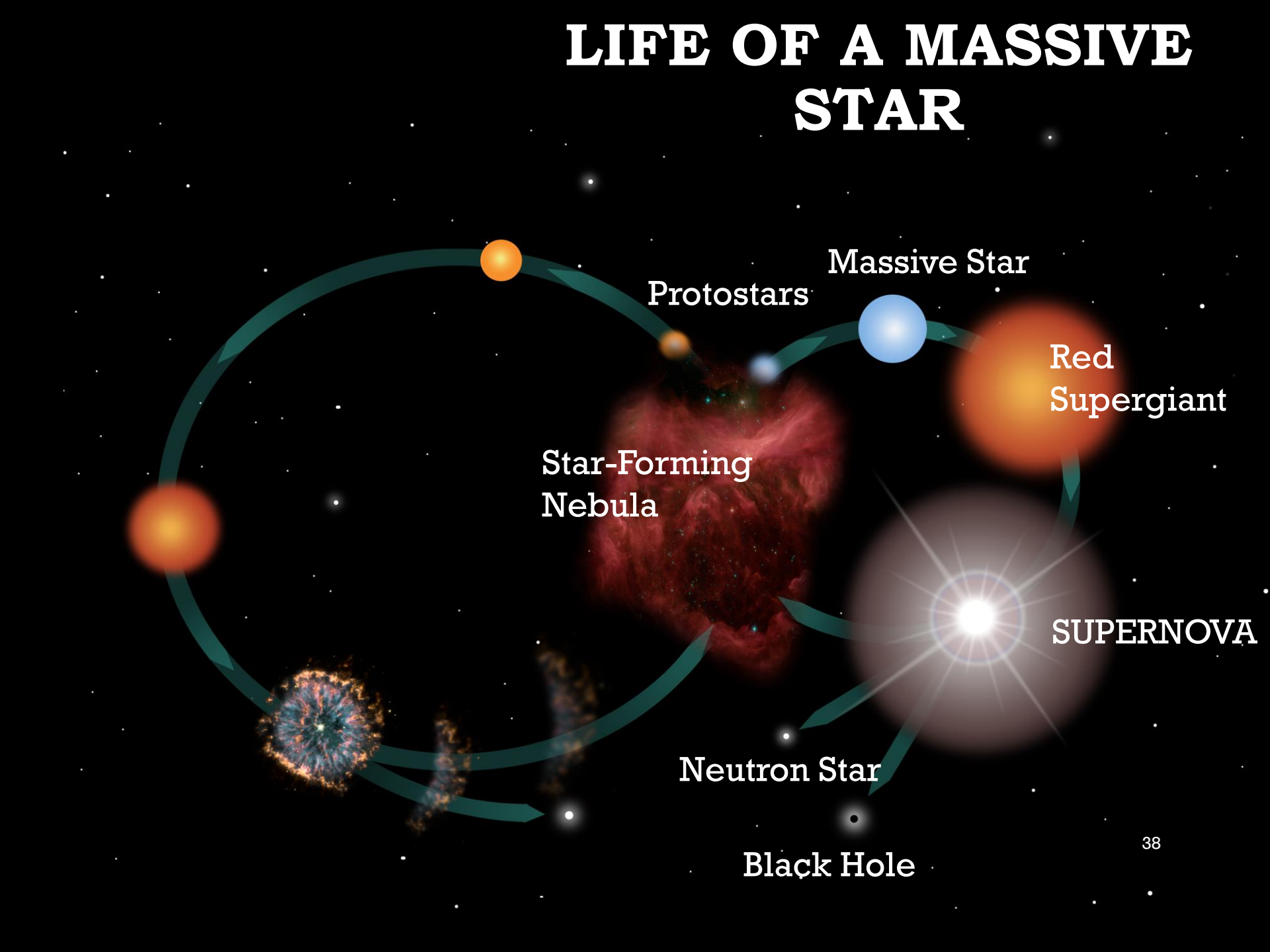
LIFE OF A SUN-LIKE STAR



PLANETARY NEBULA



LIFE OF A MASSIVE STAR



SUPERNOVA!

Click on image to activate movie

SUPERNOVA: Explosion of a Massive Star

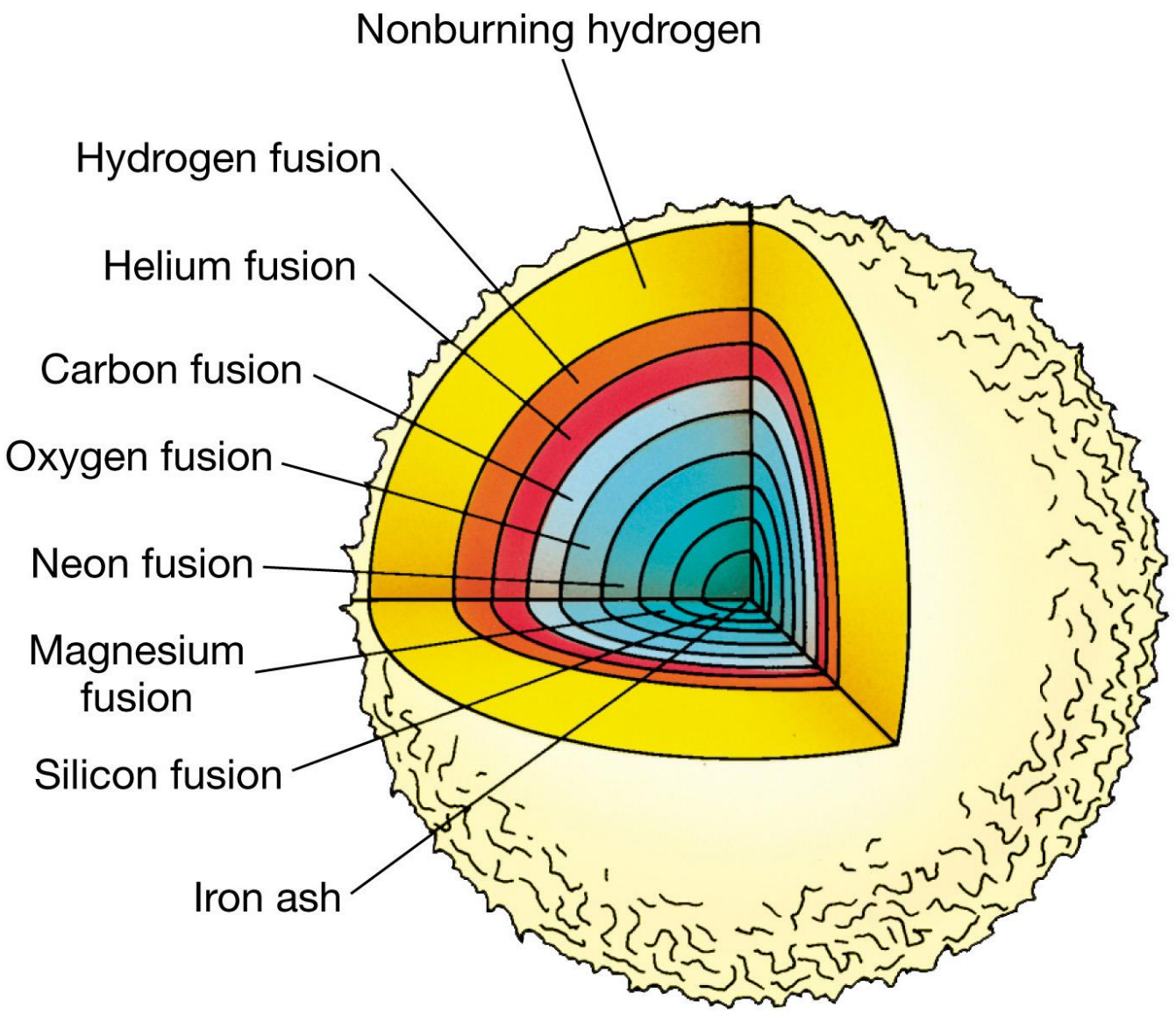
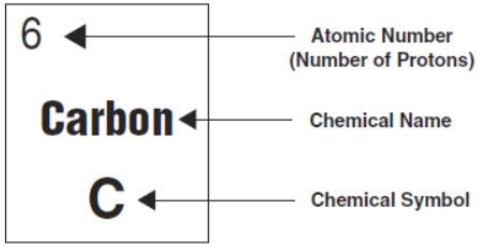

Nonburning hydrogen
Hydrogen fusion
Helium fusion
Carbon fusion
Oxygen fusion
Neon fusion
Magnesium fusion
Silicon fusion
Iron ash

Table of Elements



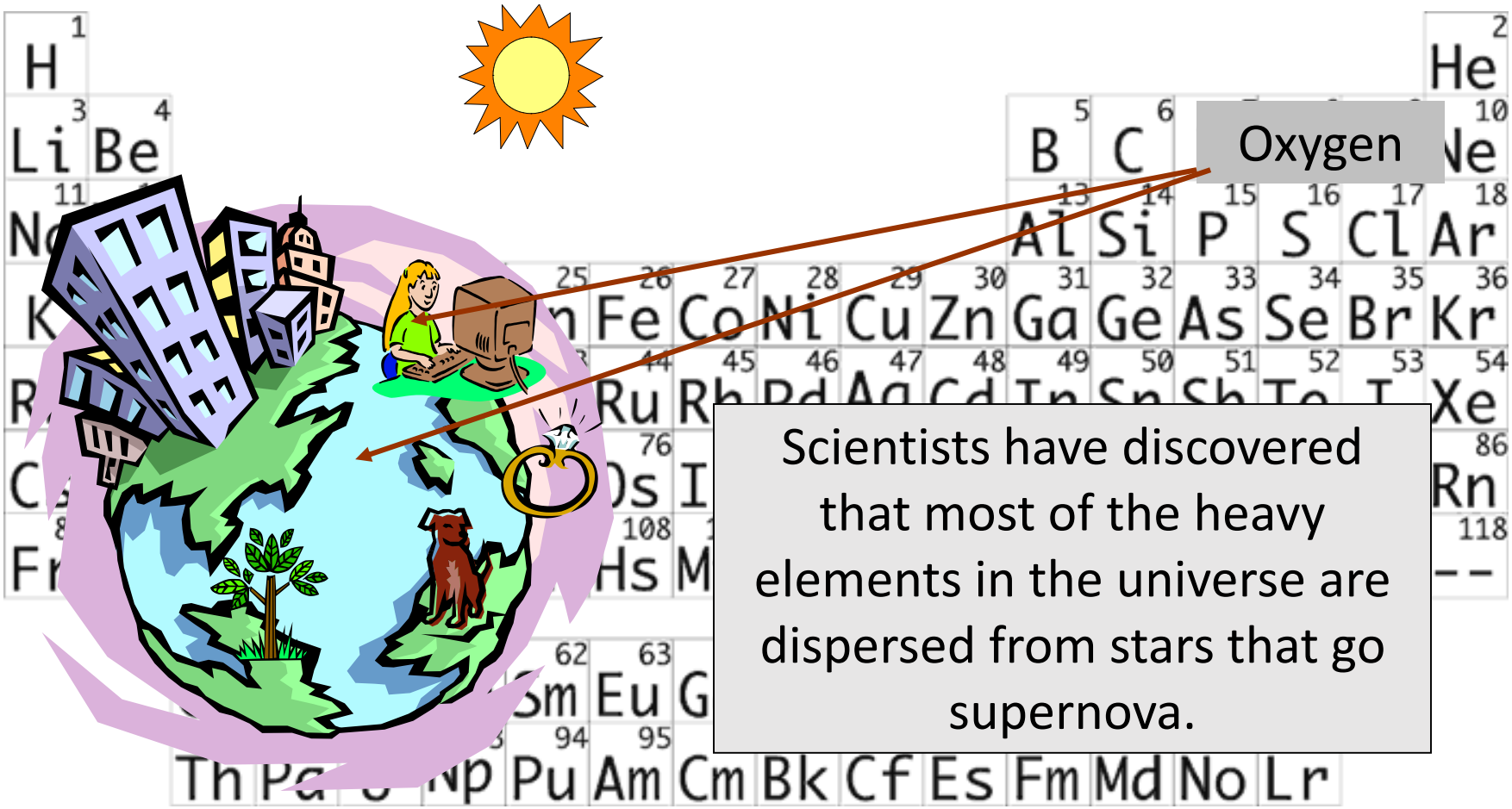
1 Hydrogen H																	2 Helium He
3 Lithium Li	4 Beryllium Be											5 Boron B	6 Carbon C	7 Nitrogen N	8 Oxygen O	9 Fluorine F	10 Neon Ne
11 Sodium Na	12 Magnesium Mg											13 Aluminum Al	14 Silicon Si	15 Phosphorus P	16 Sulfur S	17 Chlorine Cl	18 Argon Ar
19 Potassium K	20 Calcium Ca	21 Scandium Sc	22 Titanium Ti	23 Vanadium V	24 Chromium Cr	25 Manganese Mn	26 Iron Fe	27 Cobalt Co	28 Nickel Ni	29 Copper Cu	30 Zinc Zn	31 Gallium Ga	32 Germanium Ge	33 Arsenic As	34 Selenium Se	35 Bromine Br	36 Krypton Kr
37 Rubidium Rb	38 Strontium Sr	39 Yttrium Y	40 Zirconium Zr	41 Niobium Nb	42 Molybdenum Mo	43 Technetium Tc	44 Ruthenium Ru	45 Rhodium Rh	46 Palladium Pd	47 Silver Ag	48 Cadmium Cd	49 Indium In	50 Tin Sn	51 Antimony Sb	52 Tellurium Te	53 Iodine I	54 Xenon Xe
55 Cesium Cs	56 Barium Ba	57-71 *	72 Hafnium Hf	73 Tantalum Ta	74 Tungsten W	75 Rhenium Re	76 Osmium Os	77 Iridium Ir	78 Platinum Pt	79 Gold Au	80 Mercury Hg	81 Thallium Tl	82 Lead Pb	83 Bismuth Bi	84 Polonium Po	85 Astatine At	86 Radon Rn
87 Francium Fr	88 Radium Ra	89-103 **	104 Rutherfordium Rf	105 Dubnium Db	106 Seaborgium Sg	107 Bohrium Bh	108 Hassium Hs	109 Meitnerium Mt	110 Darmstadtium Ds	111 Roentgenium Rg	112 Ununbium Uub	113 Ununtrium Uut	114 Ununquadium Uuq	115 Ununpentium Uup	116 Ununhexium Uuh	117 Ununseptium Uus	118 Ununoctium Uuo

*	57 Lanthanum La	58 Cerium Ce	59 Praseodymium Pr	60 Neodymium Nd	61 Promethium Pm	62 Samarium Sm	63 Europium Eu	64 Gadolinium Gd	65 Terbium Tb	66 Dysprosium Dy	67 Holmium Ho	68 Erbium Er	69 Thulium Tm	70 Ytterbium Yb	71 Lutetium Lu
**	89 Actinium Ac	90 Thorium Th	91 Protactinium Pa	92 Uranium U	93 Neptunium Np	94 Plutonium Pu	95 Americium Am	96 Curium Cm	97 Berkelium Bk	98 Californium Cf	99 Einsteinium Es	100 Fermium Fm	101 Mendelevium Md	102 Nobelium No	103 Lawrencium Lr

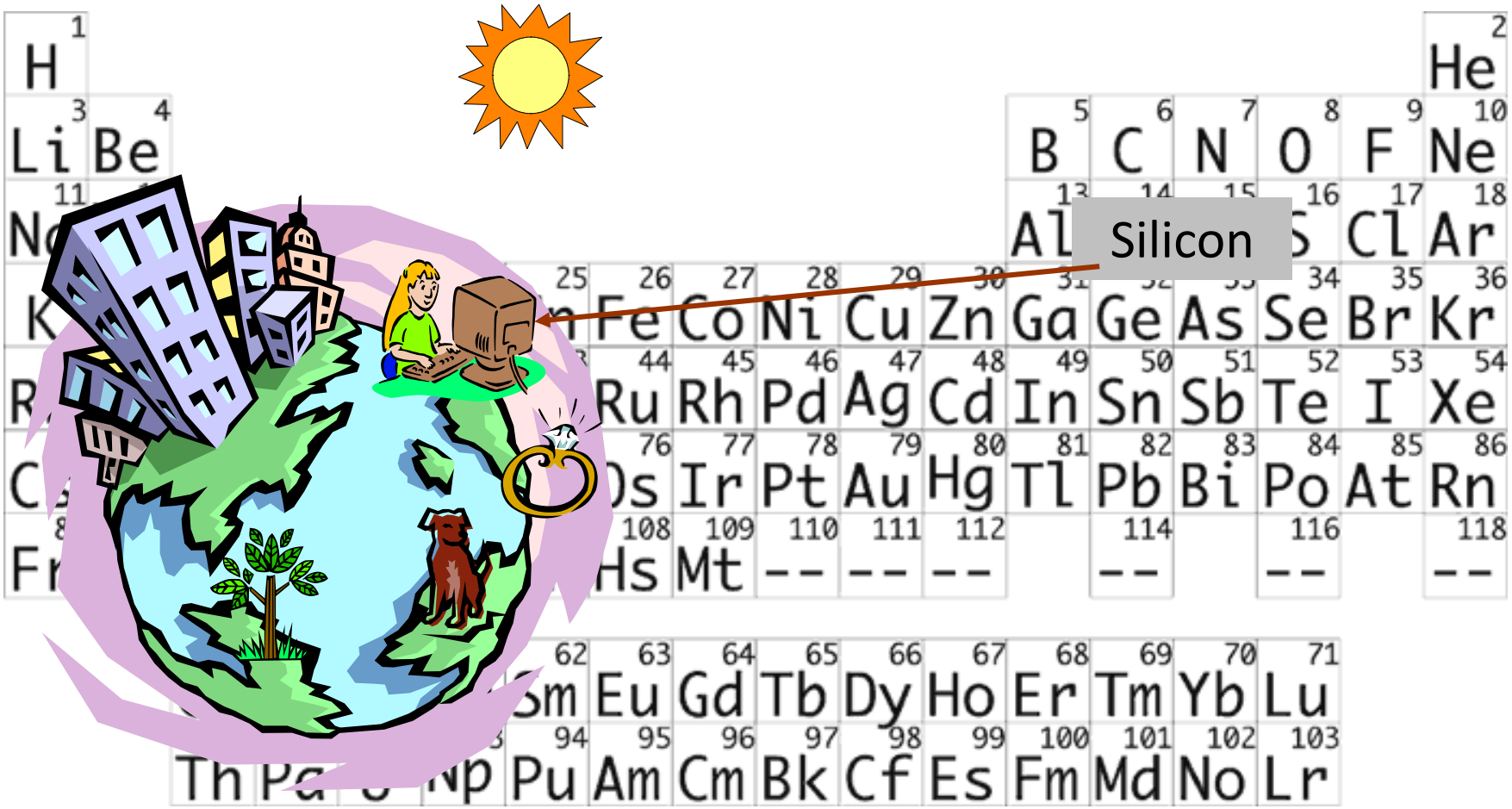
Creation of Elements

- When the universe was formed there was only Hydrogen.
- Every element from Helium to Iron was made inside a star.
- All elements heavier than Iron were created in a Supernova explosion.

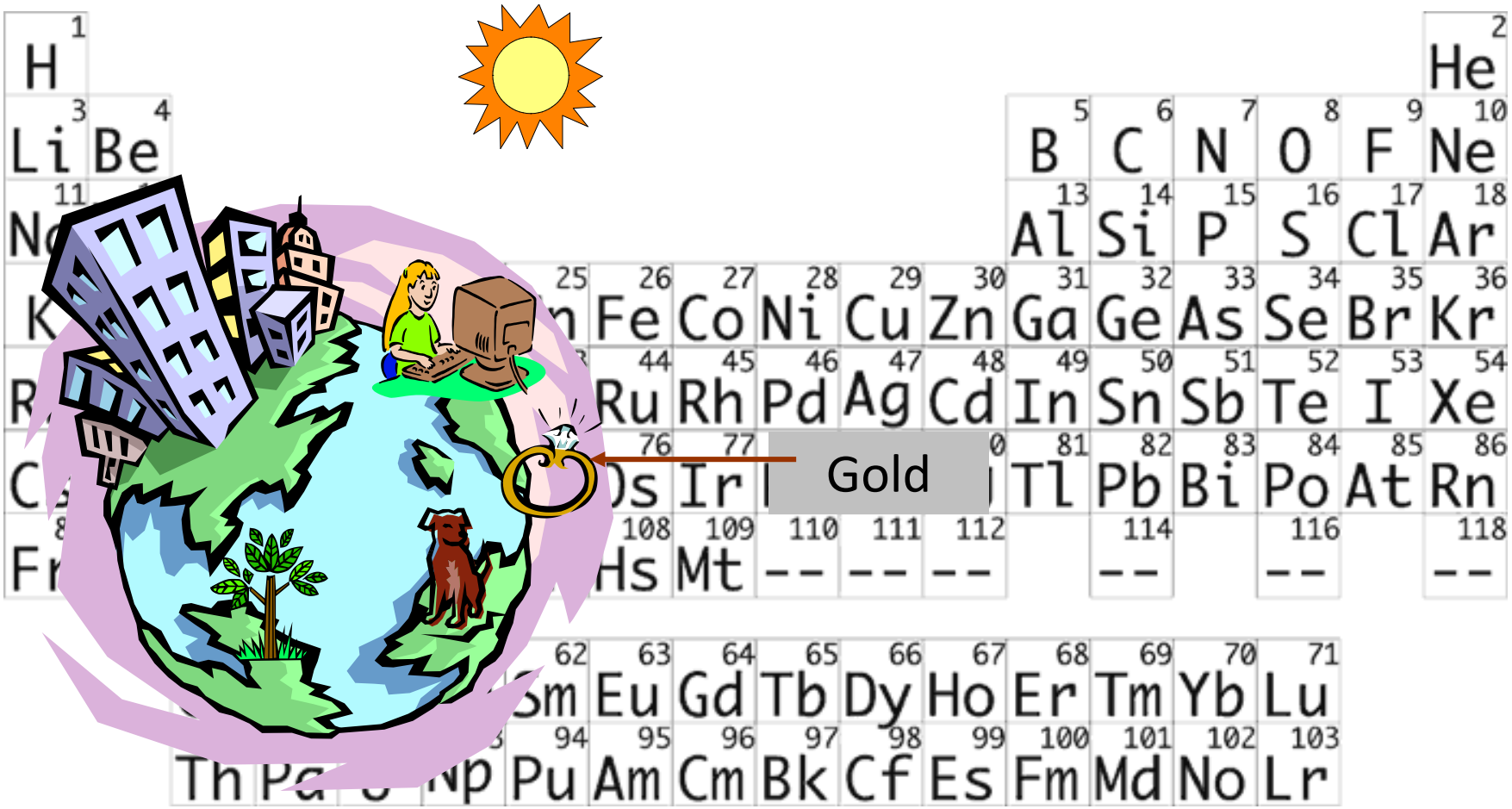
Life from Exploding Stars!



Life from Exploding Stars!



Life from Exploding Stars!



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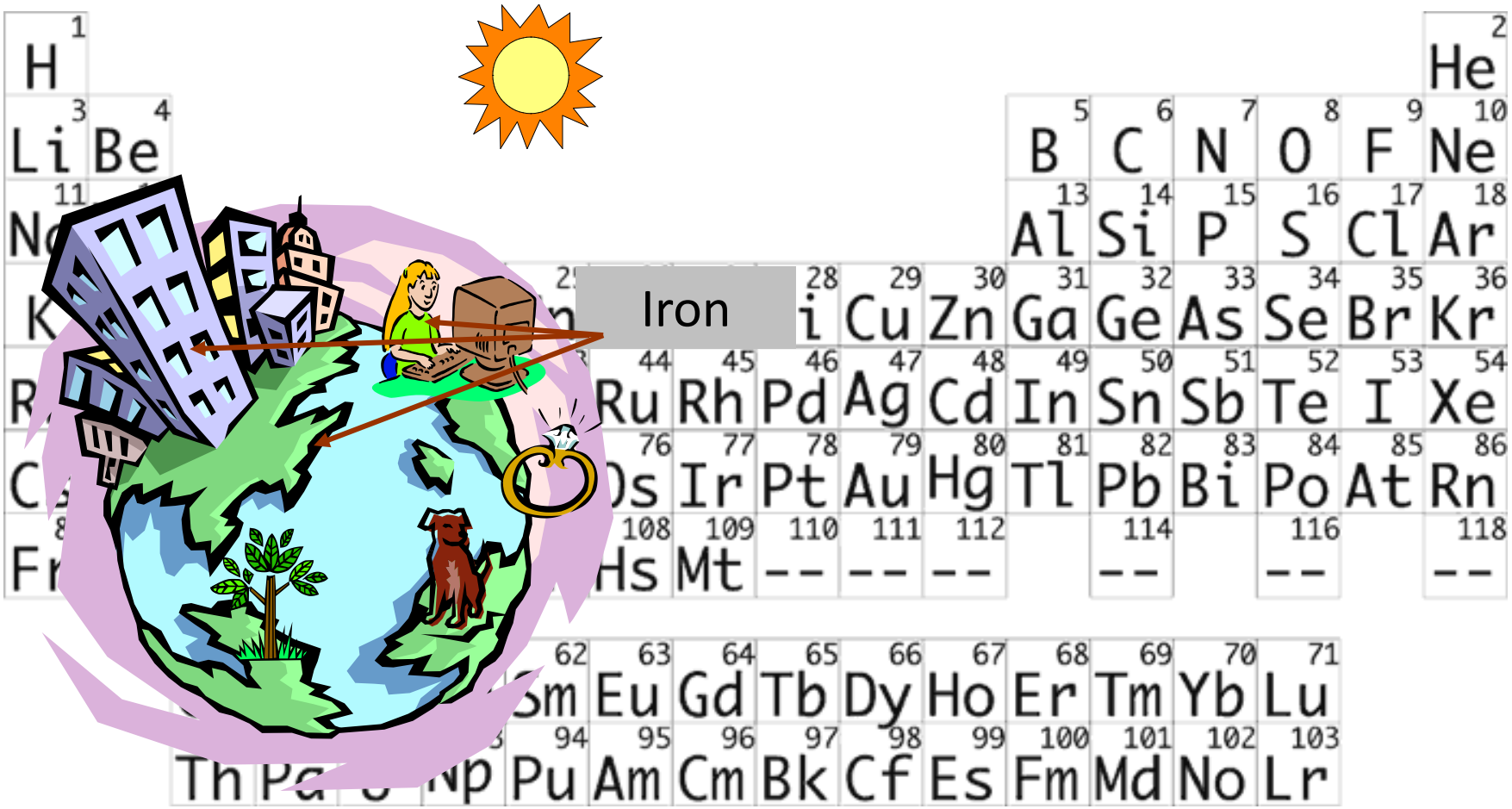
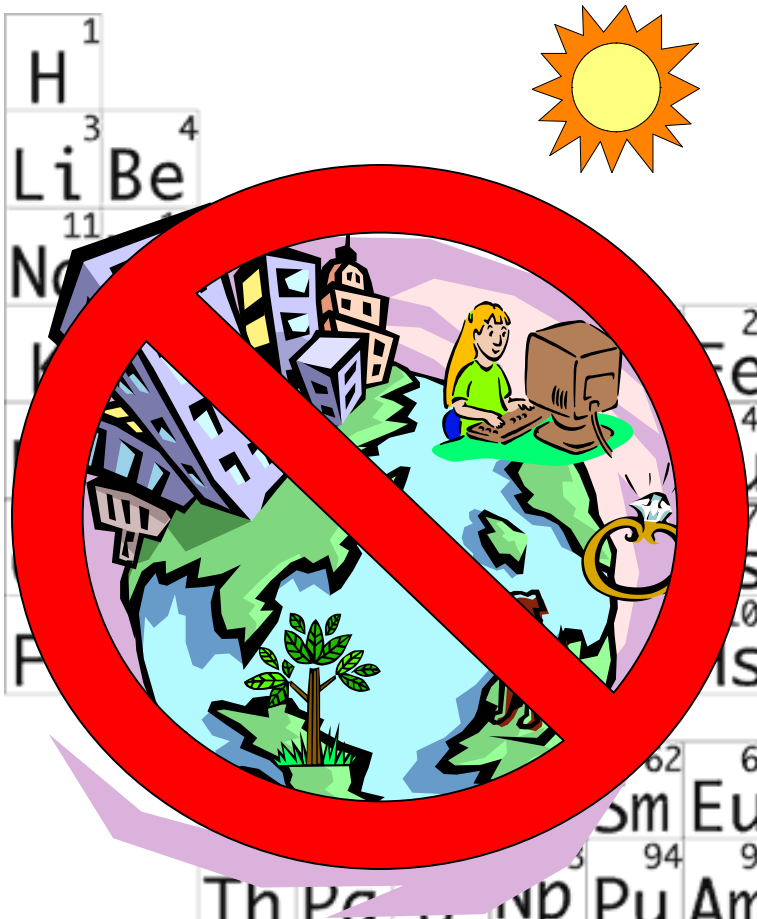
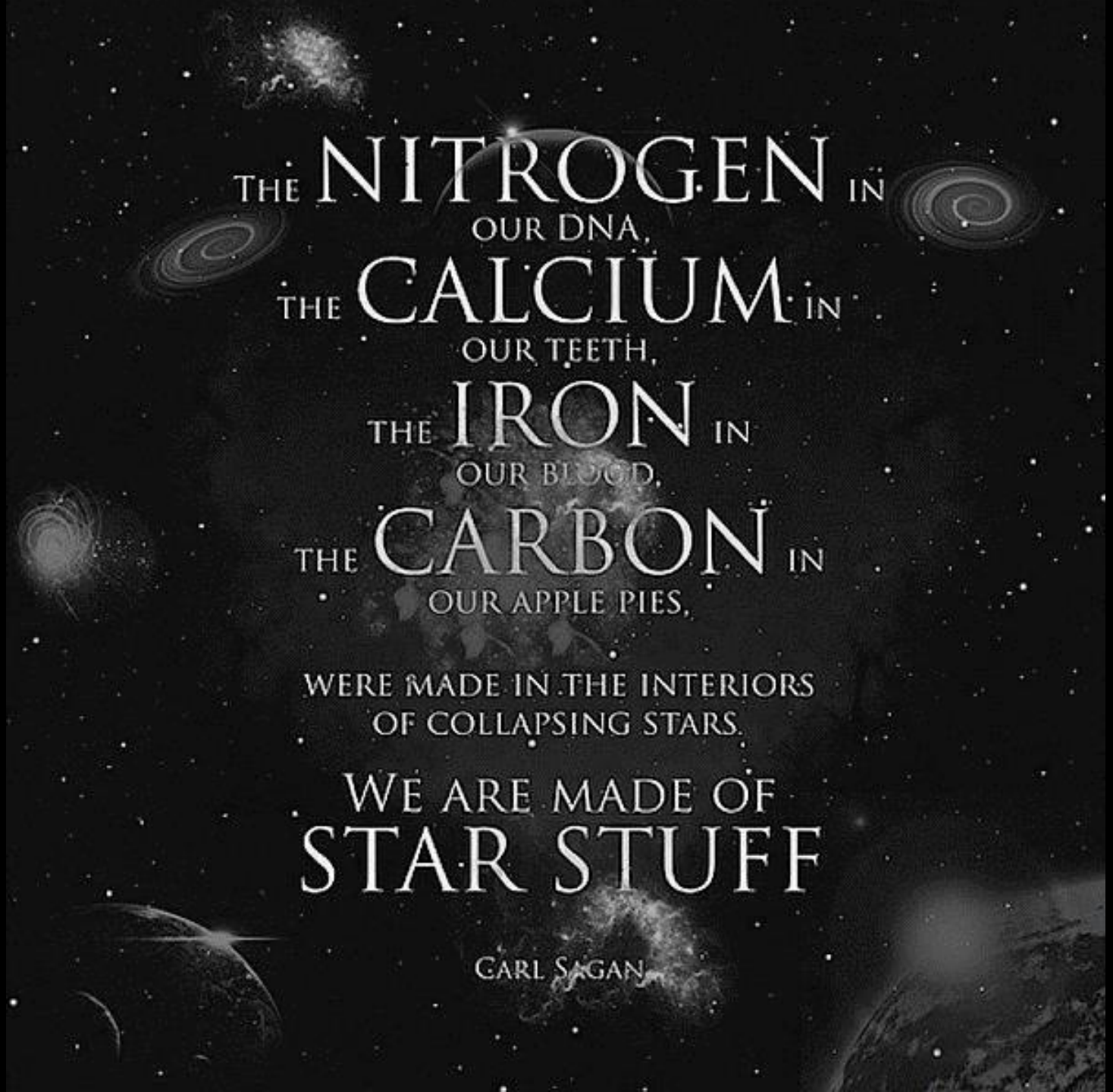


Life from Exploding Stars!



Without supernovae to disperse elements made in stars, there would be no planets, no life as we know it!


THE NITROGEN IN
OUR DNA,
THE CALCIUM IN
OUR TEETH,
THE IRON IN
OUR BLOOD,
THE CARBON IN
OUR APPLE PIES,
WERE MADE IN THE INTERIORS
OF COLLAPSING STARS.
WE ARE MADE OF
STAR STUFF
CARL SAGAN

Neil deGrasse Tyson

Questions?