

Foundation for Apollo 11

U Hill Optimist Club

7/11/2019

John Oss

This presentation is available at: <http://oss4us.com/noodle/>

Genesis 1

1In the beginning, God created ...

3And God said, “Let there be
light,”

The Great Commandment

37 ...you shall love the Lord your God with all your heart and with all your soul and with all your **mind**. ...

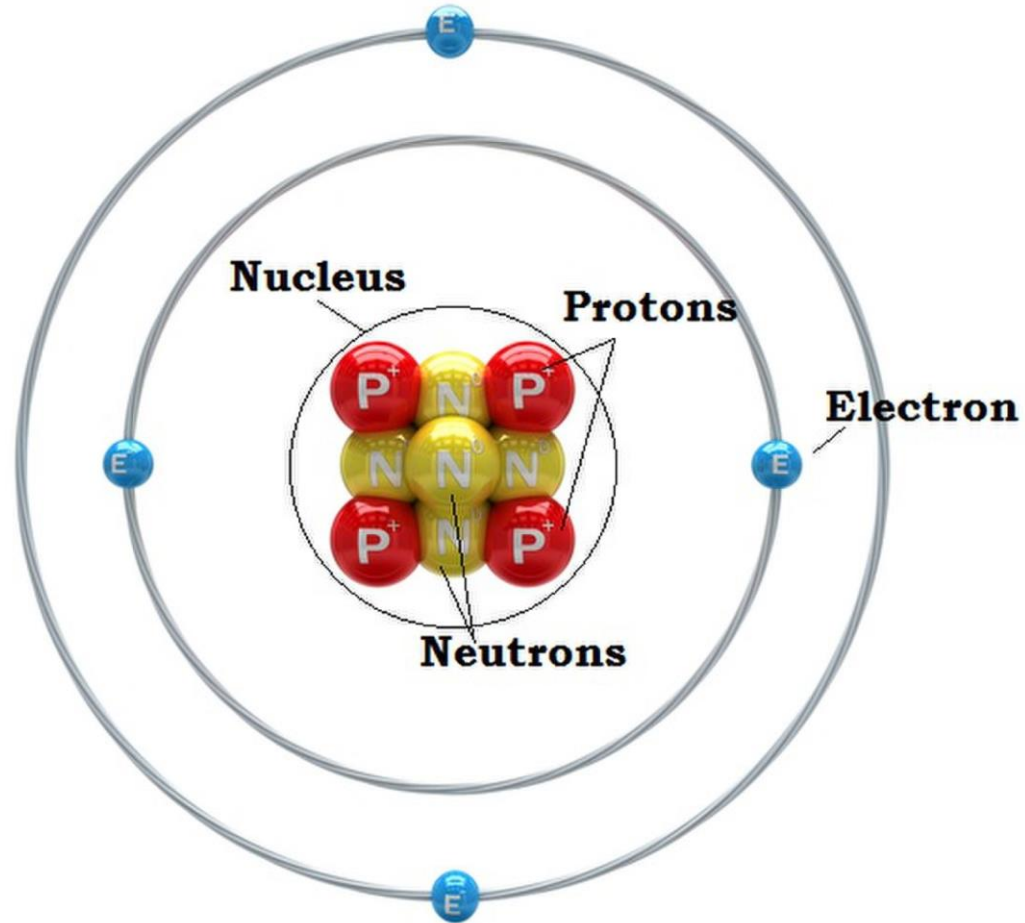
Matt 22 from ESV

Some speak of using your **noodle**, meaning use your **mind**.

$$E = mc^2$$

"Energy equals mass times the speed of light squared." On the most basic level, the equation says that energy and mass (matter) are interchangeable; they are different forms of the same thing. Under the right conditions, energy can become mass, and vice versa."

An Atom



Atoms are made up of three particles: protons, neutrons and electrons.

<https://www.livescience.com/37206-atom-definition.html>

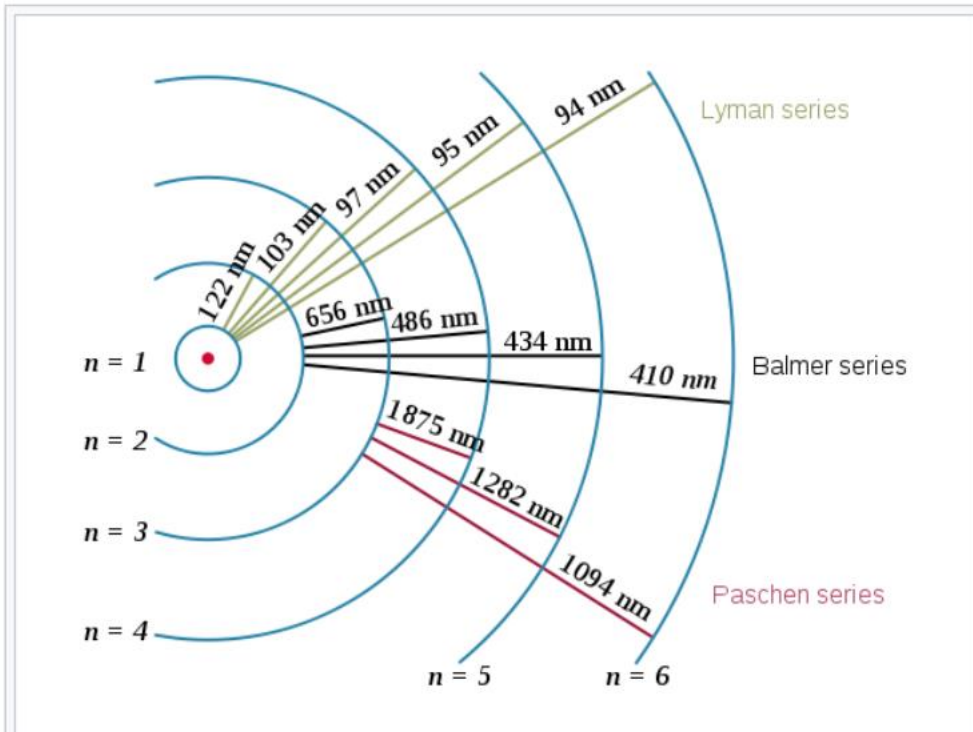
Hydrogen spectral series

Balmer series ($n' = 2$) [edit]

Main article: *Balmer series*



The four visible hydrogen emission spectrum lines in the Balmer series. H-alpha is the red line at the right.



Electron transitions and their resulting wavelengths for hydrogen. Energy levels are not to scale.

Hydrogen Balmer Spectral Series (fingerprint)

- 4 Hydrogen Balmer Spectral lines seen above
- Energy state diagram seen to the left

All atoms have a unique spectra (fingerprint)

All molecules have unique spectra (fingerprint)

https://en.wikipedia.org/wiki/Hydrogen_spectral_series

Periodic Table of Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																														
1	H Hydrogen 1.00794																		He Helium 4.002602																													
2	Li Lithium 6.941	Be Beryllium 9.012182																		Ne Neon 20.1797																												
3	Na Sodium 22.98976928	Mg Magnesium 24.3050																		Ar Argon 39.948																												
4	K Potassium 39.0983	Ca Calcium 40.078	Sc Scandium 44.955912	Ti Titanium 47.887	V Vanadium 50.9415	Cr Chromium 51.9961	Mn Manganese 54.938045	Fe Iron 55.845	Co Cobalt 58.933195	Ni Nickel 58.6934	Cu Copper 63.546	Zn Zinc 65.38	Ga Gallium 69.723	Ge Germanium 72.64	As Arsenic 74.92160	Se Selenium 78.96	Br Bromine 79.904	Kr Krypton 83.798																														
5	Rb Rubidium 85.4678	Sr Strontium 87.62	Y Yttrium 88.90585	Zr Zirconium 91.224	Nb Niobium 92.90638	Mo Molybdenum 95.96	Tc Technetium (97.9072)	Ru Ruthenium 101.07	Rh Rhodium 102.90550	Pd Palladium 106.42	Ag Silver 107.8682	Cd Cadmium 112.411	In Indium 114.818	Sn Tin 118.710	Sb Antimony 121.760	Te Tellurium 127.60	I Iodine 126.90447	Xe Xenon 131.293																														
6	Cs Caesium 132.9054519	Ba Barium 137.327	57-71		Hf Hafnium 178.49	Ta Tantalum 180.94788	W Tungsten 183.84	Re Rhenium 186.207	Os Osmium 190.23	Ir Iridium 192.217	Pt Platinum 195.084	Au Gold 196.966569	Hg Mercury 200.59	Tl Thallium 204.3833	Pb Lead 207.2	Bi Bismuth 208.98040	Po Polonium (209.9824)	At Astatine (209.9871)	Rn Radon (222.0176)																													
7	Fr Francium (223)	Ra Radium (226)	89-103		Rf Rutherfordium (261)	Db Dubnium (262)	Sg Seaborgium (266)	Bh Bohrium (264)	Hs Hassium (277)	Mt Meitnerium (268)	Ds Darmstadtium (271)	Rg Roentgenium (272)	Uub Ununbium (285)	Uut Ununtrium (284)	Uuq Ununquadium (289)	Uup Ununpentium (288)	Uuh Ununhexium (292)	Uus Ununseptium (294)	Uuo Ununoctium (294)																													
<p>For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.</p> <p>Design and Interface Copyright © 1997 Michael Dayah (michael@dayah.com). http://www.ptable.com/</p>																																																
<table border="1"> <tbody> <tr> <td>La Lanthanum 138.90547</td> <td>Ce Cerium 140.116</td> <td>Pr Praseodymium 140.90765</td> <td>Nd Neodymium 144.242</td> <td>Pm Promethium (145)</td> <td>Sm Samarium 150.36</td> <td>Eu Europium 151.964</td> <td>Gd Gadolinium 157.25</td> <td>Tb Terbium 158.92535</td> <td>Dy Dysprosium 162.500</td> <td>Ho Holmium 164.93032</td> <td>Er Erbium 167.259</td> <td>Tm Thulium 168.93421</td> <td>Yb Ytterbium 173.054</td> <td>Lu Lutetium 174.9668</td> </tr> <tr> <td>Ac Actinium (227)</td> <td>Th Thorium 232.03806</td> <td>Pa Protactinium 231.03888</td> <td>U Uranium 238.02891</td> <td>Np Neptunium (237)</td> <td>Pu Plutonium (244)</td> <td>Am Americium (243)</td> <td>Cm Curium (247)</td> <td>Bk Berkelium (247)</td> <td>Cf Californium (251)</td> <td>Es Einsteinium (282)</td> <td>Fm Fermium (257)</td> <td>Md Mendelevium (258)</td> <td>No Nobelium (259)</td> <td>Lr Lawrencium (262)</td> </tr> </tbody> </table>																			La Lanthanum 138.90547	Ce Cerium 140.116	Pr Praseodymium 140.90765	Nd Neodymium 144.242	Pm Promethium (145)	Sm Samarium 150.36	Eu Europium 151.964	Gd Gadolinium 157.25	Tb Terbium 158.92535	Dy Dysprosium 162.500	Ho Holmium 164.93032	Er Erbium 167.259	Tm Thulium 168.93421	Yb Ytterbium 173.054	Lu Lutetium 174.9668	Ac Actinium (227)	Th Thorium 232.03806	Pa Protactinium 231.03888	U Uranium 238.02891	Np Neptunium (237)	Pu Plutonium (244)	Am Americium (243)	Cm Curium (247)	Bk Berkelium (247)	Cf Californium (251)	Es Einsteinium (282)	Fm Fermium (257)	Md Mendelevium (258)	No Nobelium (259)	Lr Lawrencium (262)
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Unique Atoms
are
Elements

92 natural

118 total

1	1	Atomic #
H		Symbol
Hydrogen		Name
1.00794		Atomic Mass
3	2	
Li		
Lithium		
6.941		
4	2	
Be		
Beryllium		
9.012182		
11	2	
Na		
Sodium		
22.98976928		
12	2	
Mg		
Magnesium		
24.3050		

The table of the elements has the simple top left. The most complex are at the bottom.

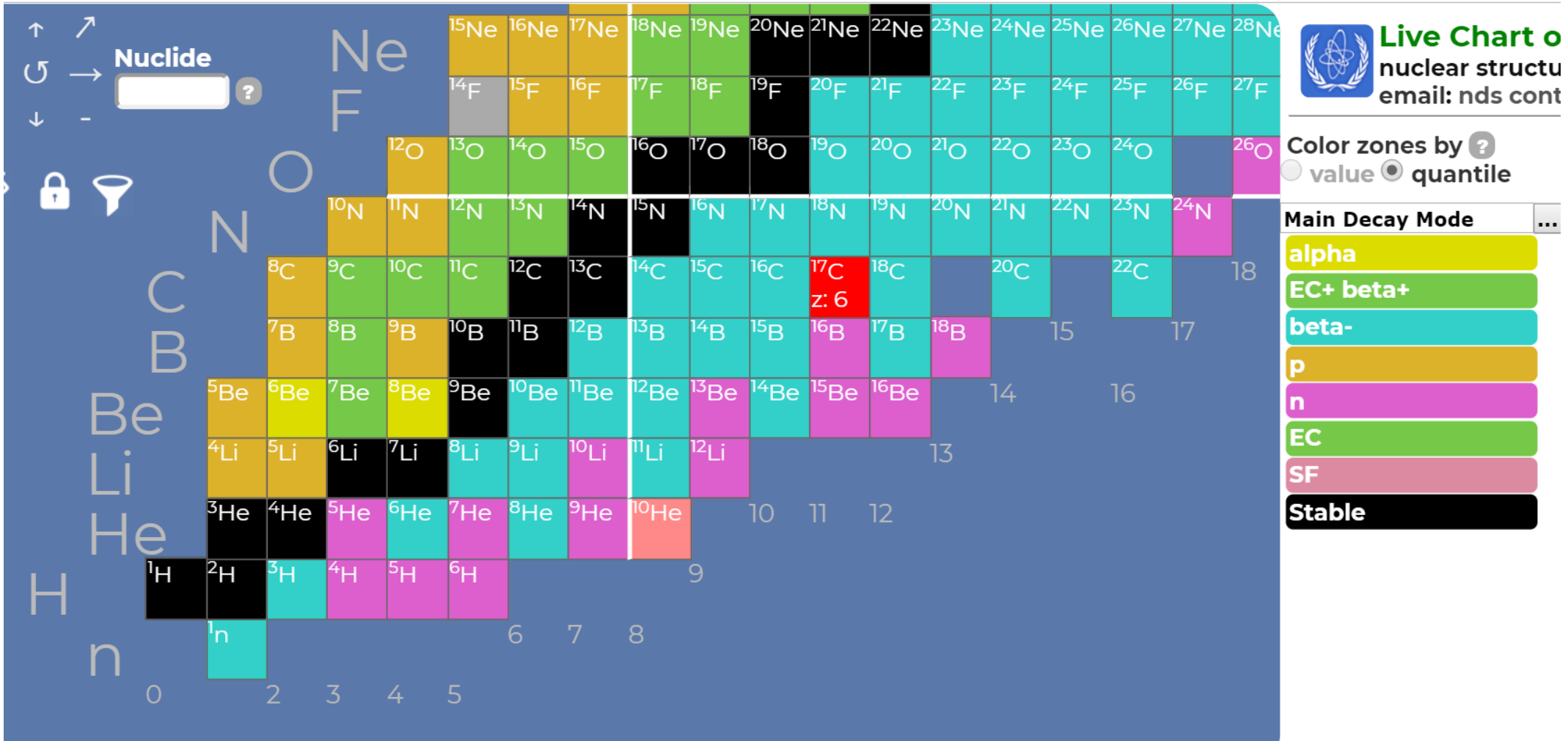
The elements are all made up of protons, electrons and neutrons.

All of the elements are numbered by how many protons they contain.

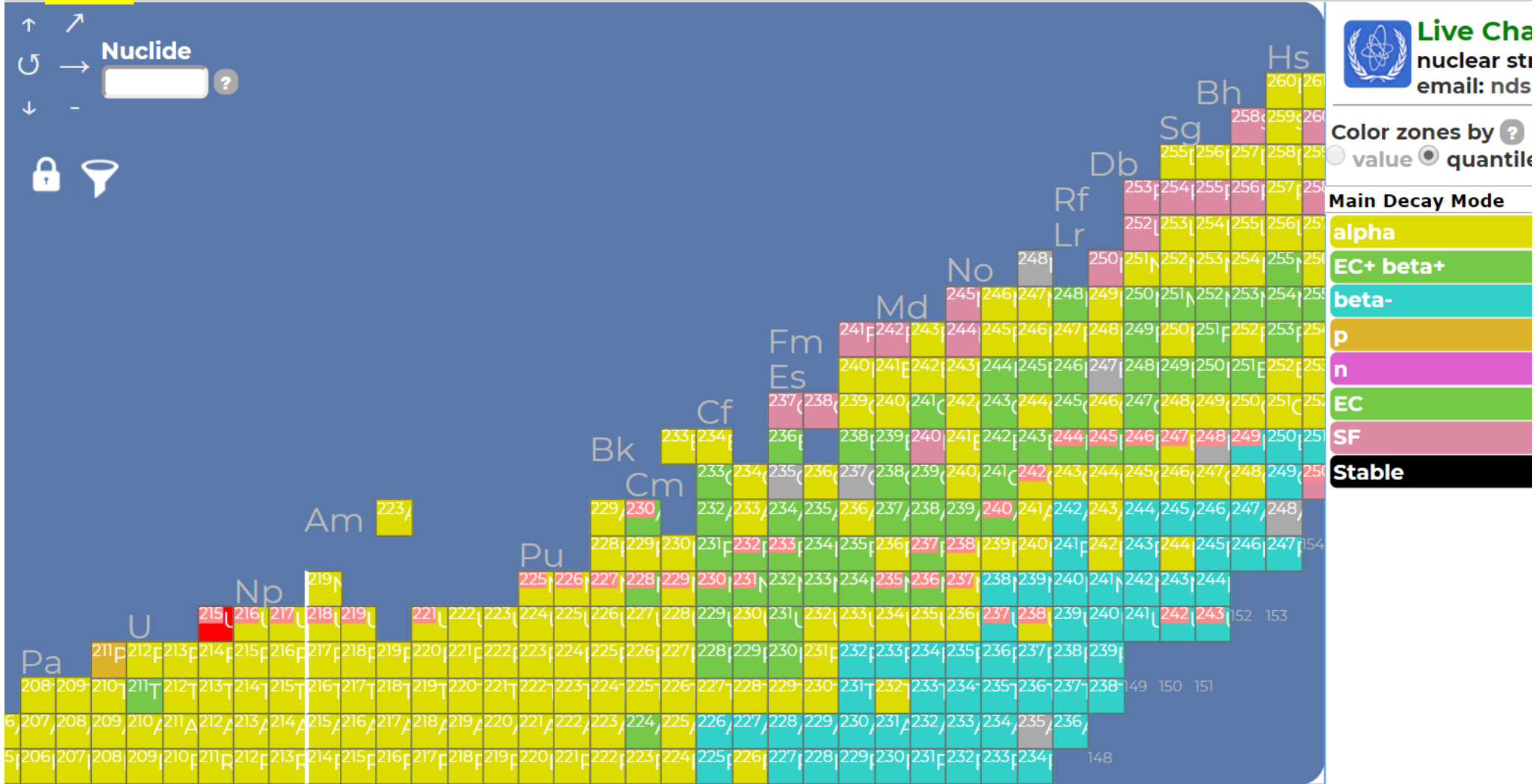
118 Elements
 92 natural
 26 transuranic

158	²⁵⁶ Cf	²⁵⁷ Es	²⁵⁸ Fm	²⁵⁹ Md	²⁶⁰ No	²⁶¹ Lr	²⁶² Rf	²⁶³ Db	²⁶⁴ Sg	²⁶⁵ Bh	²⁶⁶ Hs			111	
159		²⁵⁸ Es	²⁵⁹ Fm	²⁶⁰ Md		²⁶² Lr	²⁶³ Rf		²⁶⁵ Sg	²⁶⁶ Bh	²⁶⁷ Hs	²⁶⁸ Mt	²⁶⁹ Ds	Rg	
160			²⁶⁰ Fm		²⁶² No				²⁶⁶ Sg	²⁶⁷ Bh	²⁶⁸ Hs		²⁷⁰ Ds		
161							²⁶⁵ Rf	²⁶⁶ Db	²⁶⁷ Sg		²⁶⁹ Hs	²⁷⁰ Mt	²⁷¹ Ds	²⁷² Rg	
162							²⁶⁶ Rf	²⁶⁷ Db			²⁷⁰ Hs			112 113	
163						²⁶⁶ Lr	²⁶⁷ Rf	²⁶⁸ Db	²⁶⁹ Sg	²⁷⁰ Bh	²⁷¹ Hs		²⁷³ Ds	²⁷⁴ Rg	Cn Nh
164							²⁶⁸ Rf			²⁷¹ Bh					
165								²⁷⁰ Db	²⁷¹ Sg	²⁷² Bh	²⁷³ Hs	²⁷⁴ Mt		²⁷⁷ Cn	²⁷⁸ Nh
166							²⁷⁰ Rf					²⁷⁵ Mt			
167									²⁷⁴ Bh	²⁷⁵ Hs	²⁷⁶ Mt	²⁷⁷ Ds	²⁷⁸ Rg		
168											²⁷⁷ Mt	²⁷⁹ Rg			114
169									²⁷⁷ Hs	²⁷⁸ Mt	²⁷⁹ Ds	²⁸⁰ Rg	²⁸¹ Cn	²⁸² Nh	Fl 115
170									²⁸⁰ Ds	²⁸¹ Rg	²⁸² Cn	²⁸³ Nh	²⁸⁴ Fl	Mc	116
171									²⁸¹ Ds	²⁸² Rg	²⁸³ Cn	²⁸⁴ Nh	²⁸⁵ Fl		Lv 117
172										²⁸⁴ Cn	²⁸⁵ Nh	²⁸⁶ Fl	²⁸⁷ Mc		Ts 118
173										²⁸⁵ Cn	²⁸⁶ Nh	²⁸⁷ Fl	²⁸⁸ Mc		Og
174											²⁸⁸ Fl	²⁸⁹ Mc	²⁹⁰ Lv		
175											²⁸⁹ Fl	²⁹⁰ Mc	²⁹¹ Lv		
176												²⁹² Lv	²⁹³ Ts	²⁹⁴ Og	
177													²⁹³ Lv	²⁹⁴ Ts	

Chart of the Nuclides , Hydrogen bottom Left



Live Chart of the Nuclides , Uranium (U) last natural element shown



<https://www-nds.iaea.org/relnsd/vcharthtml/VChartHTML.html>

The Nuclides

The nuclides primary components

1. Electron
2. Proton
3. Neutron

They each come in only one size.

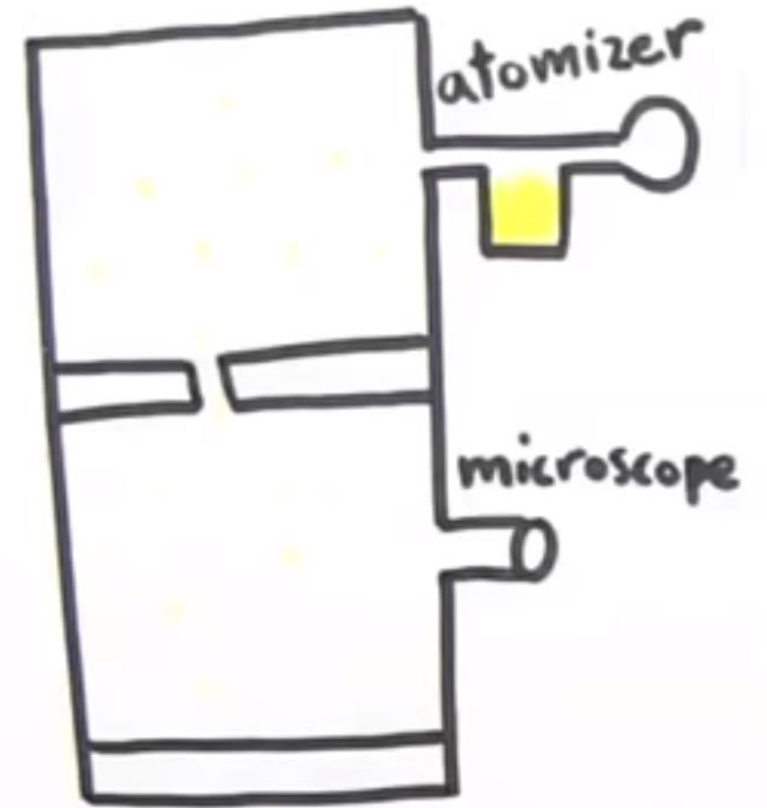
Observing that they each have a unique quantity of mass and charge is the first step toward understanding the elements.

Millikan's Oil Drop Experiment

Measure the Charge of an **Electron**

Oil Drop Experiment: Discovery of the charge on an electron
Robert Millikan and Harvey Fletcher (1913)

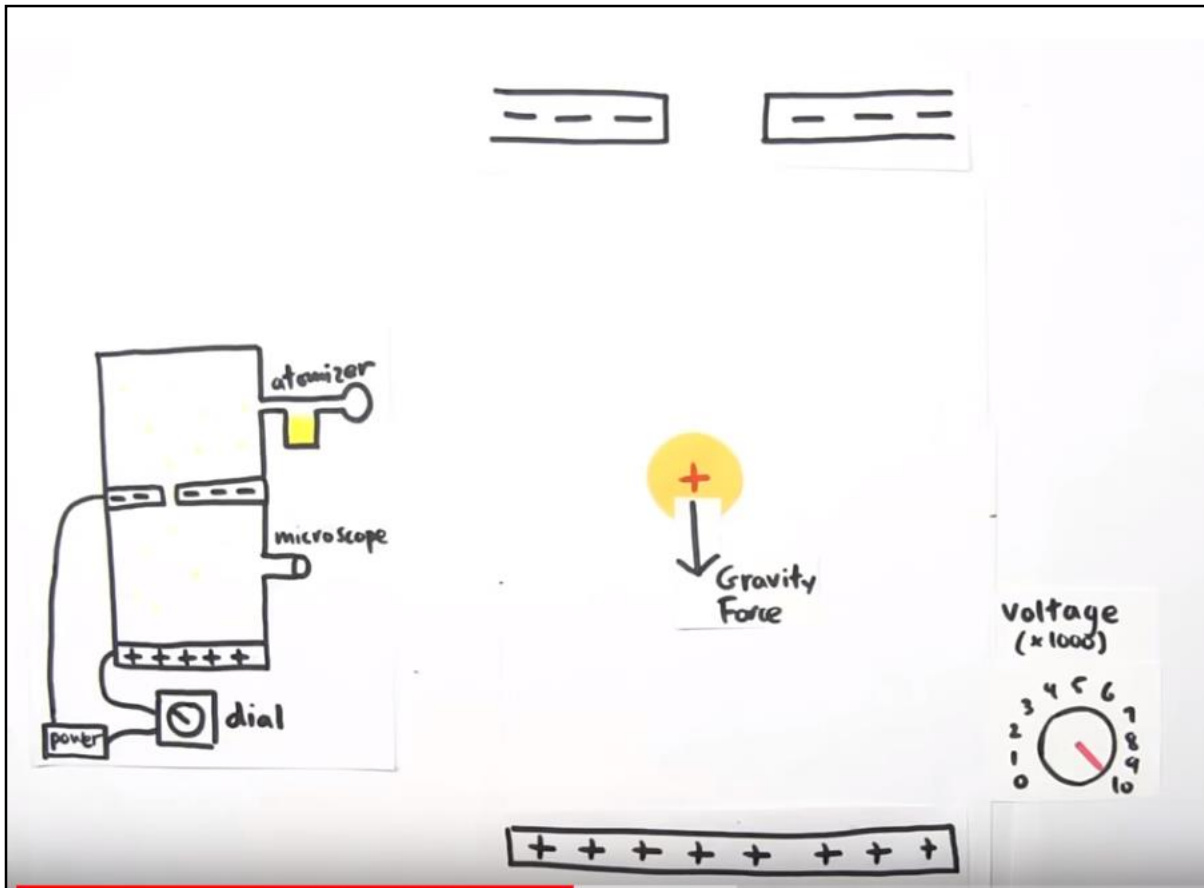
1897 : J.J. Thompson discovers electrons
-discovers they have negative charge



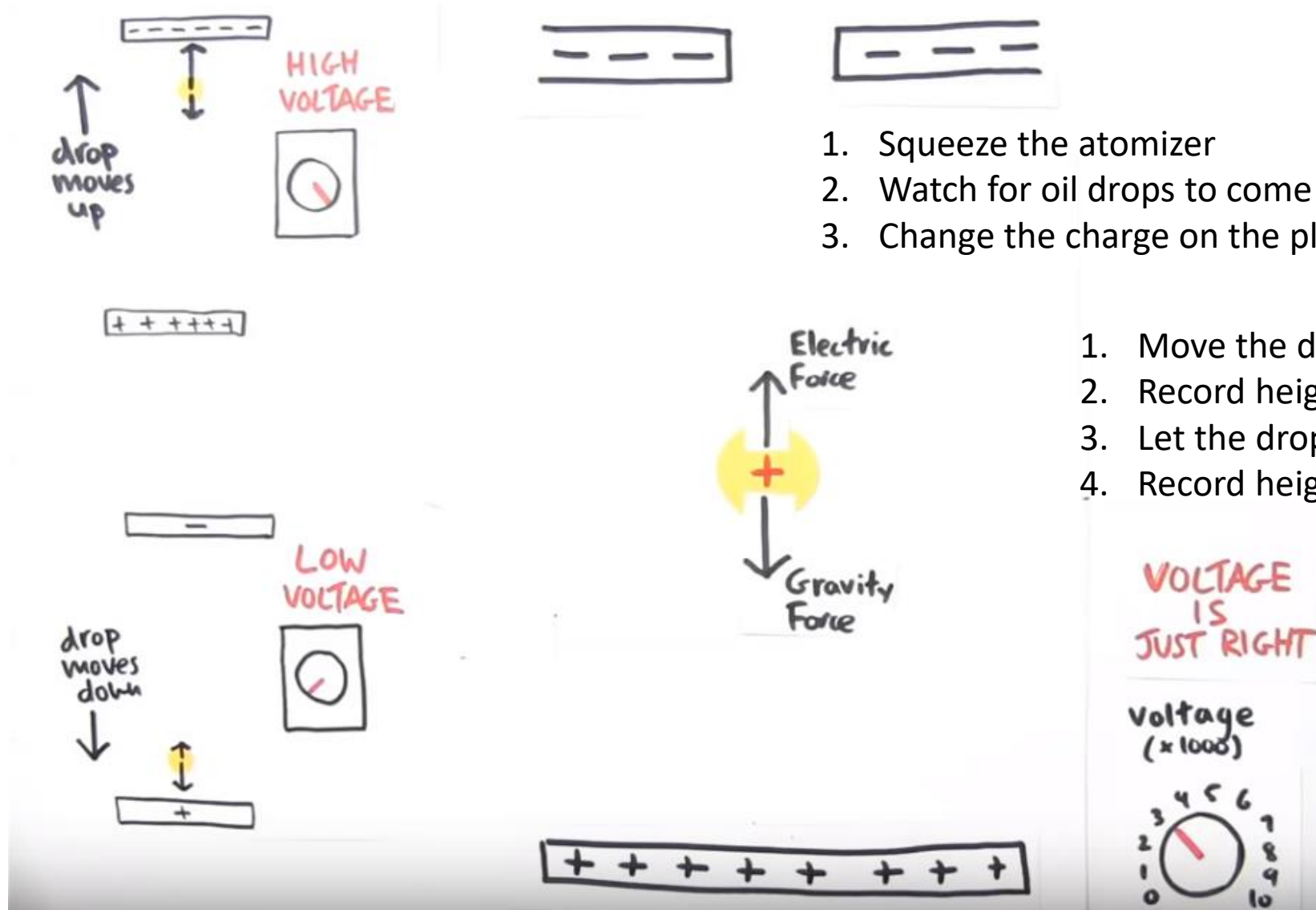
Most of the slides describing this experiment are from:

<https://www.youtube.com/watch?v=2HhaQtvICe8&feature=youtu.be>

Using the Apparatus

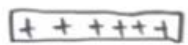
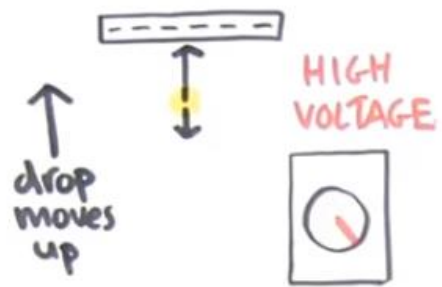


Balancing forces of gravity and electricity



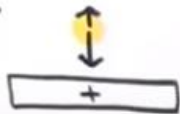
1. Squeeze the atomizer
2. Watch for oil drops to come down through the hole
3. Change the charge on the plates so that a drop stops

1. Move the drop up and stop
2. Record height and the time
3. Let the drop fall and stop it again.
4. Record height and the time

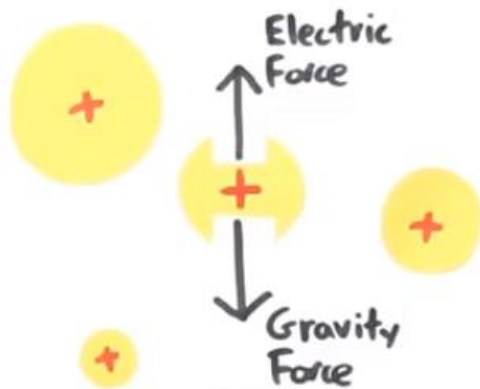


LOW VOLTAGE

drop moves down



When drop stays still,
Electric Force = Gravity Force



Mass ($\times 10^{-15}$ kg)	voltage when balanced (Volts)
5.9	3,551
4.2	1,841
3.7	4,729
9.8	2,501
6.2	2,783
3.3	4,568
5.8	1,787

Mass ($\times 10^{-15}$ kg)	voltage when balanced (Volts)
5.9	3,551
4.2	1,841
3.7	4,729
9.8	2,501
6.2	2,783
3.3	4,568
5.8	1,787

VOLTAGE IS JUST RIGHT

voltage
($\times 1000$)



Laws Obeyed

- Gravity
- Electrical Force
- Aerodynamic Drag

Mind

Observation and reason prevailed

Law

Observe three natural laws to see an electron

- Gravity
- Electrical Force
- Aerodynamic Drag

Some speak of using your **noodle**, meaning use your **mind**.

Law of Universal Gravitation

Every object in the Universe attracts every other object with a force directed along the line of centers for the two objects that is proportional to the product of their masses and inversely proportional to the square of the separation between the two objects.

$$F_g = G \frac{m_1 m_2}{r^2}$$



F_g is the gravitational force

m_1 & m_2 are the masses of the two objects

r is the separation between the objects

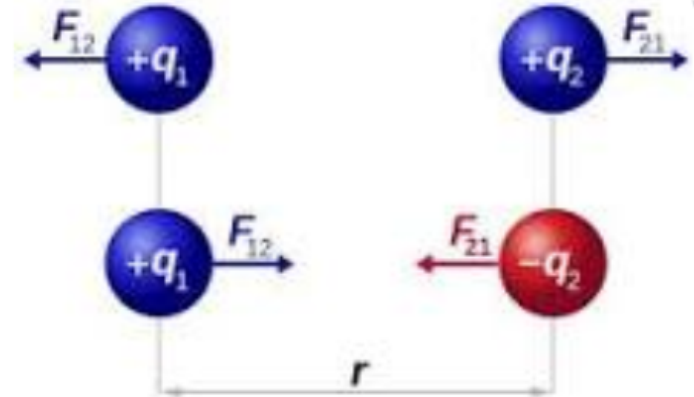
G is the universal gravitational constant

Law for Electrical Force

Coulomb's law states that: The magnitude of the electrostatic force of **attraction** or repulsion between two point charges is directly proportional to the product of the magnitudes of charges and inversely proportional to the square of the distance between them.

[Coulomb's law - Wikipedia](https://en.wikipedia.org/wiki/Coulomb%27s_law)

https://en.wikipedia.org/wiki/Coulomb%27s_law



x-engineer.org $F = F_{21} = k \frac{q_1 q_2}{r^2}$

(Law of) Aerodynamic Drag


NASA NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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The Drag Equation


$$D = C_d \frac{\rho V^2 A}{2}$$

Drag = coefficient x density x velocity squared x reference area
two

Coefficient **C_d** contains all the complex dependencies and is usually determined experimentally.

Choice of reference area **A** affects the value of **C_d**.

Drag depends on the density of the air, the square of the velocity, the air's viscosity and compressibility, the size and shape of the body, and the body's inclination to the flow. In general, the dependence on body shape, inclination, air viscosity, and compressibility is very complex.

One way to deal with complex dependencies is to characterize the dependence by a single variable. For drag, this variable is called the drag coefficient, designated "C_d." This allows us to collect all the effects, simple and complex, into a single equation. The drag equation states that drag D is equal to the drag coefficient C_d times the density times half of the

For this experiment, the equation can be simplified to:

Drag = Constant x radius² x Velocity²
Knowing the density of the oil used, and the observed speed of the drops falling enables calculating the weight of each drop and the drag force on each drop.

Matter and Mind

3And God said, “Let there be light,”

energy and mass (matter) are interchangeable
(light is and gives evidence of energy)

love the Lord your God with all your heart and with all your soul and with all your mind.

Millikan loved God by using his mind, trusted His laws, and saw an electron.

Microscopes

1. Optical

2. Electron

3. Ion

4. Raman

Optical Microscope



[Google search for optical microscope](#)

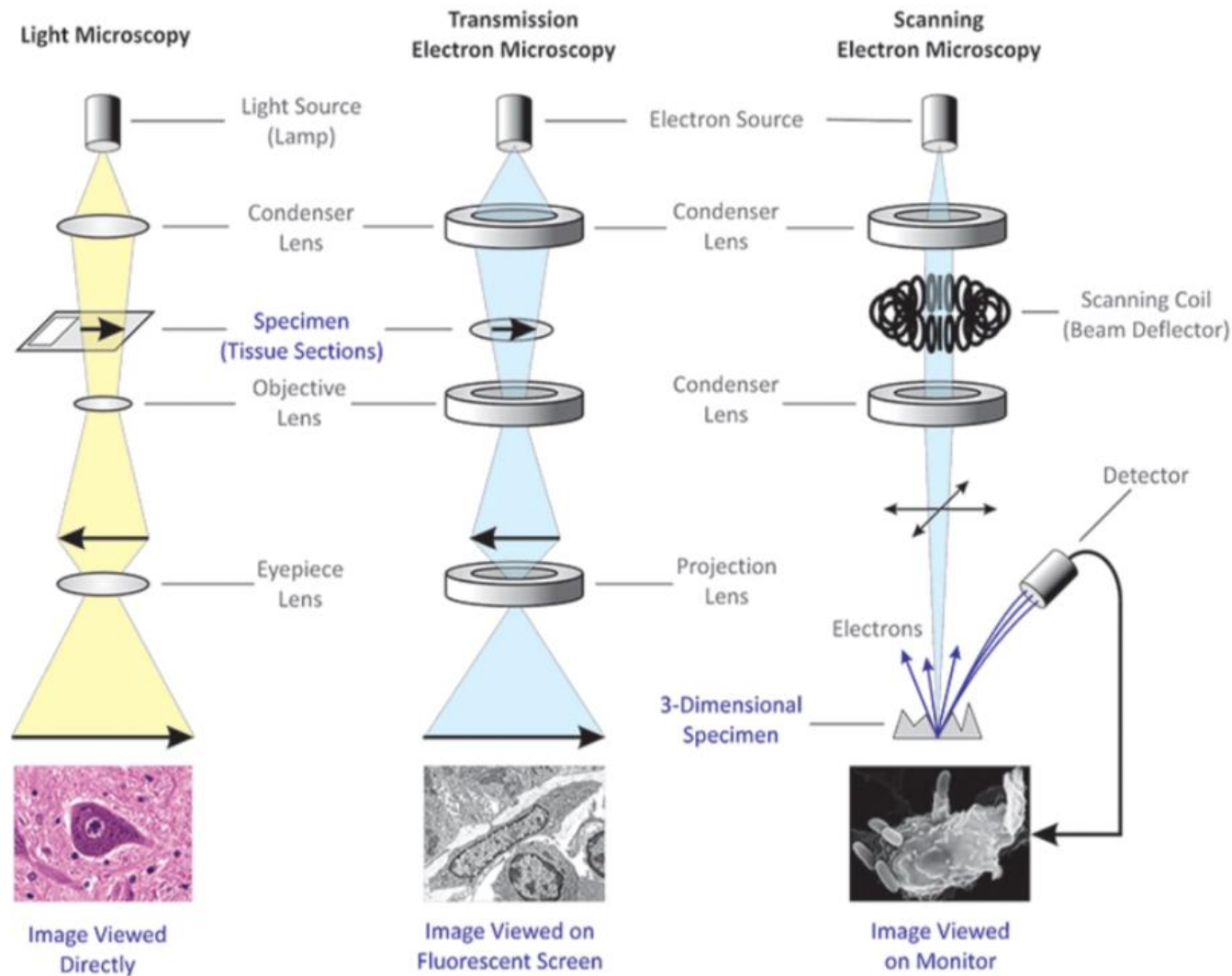
Electron Microscope



[Google Search for electron microscope](#)

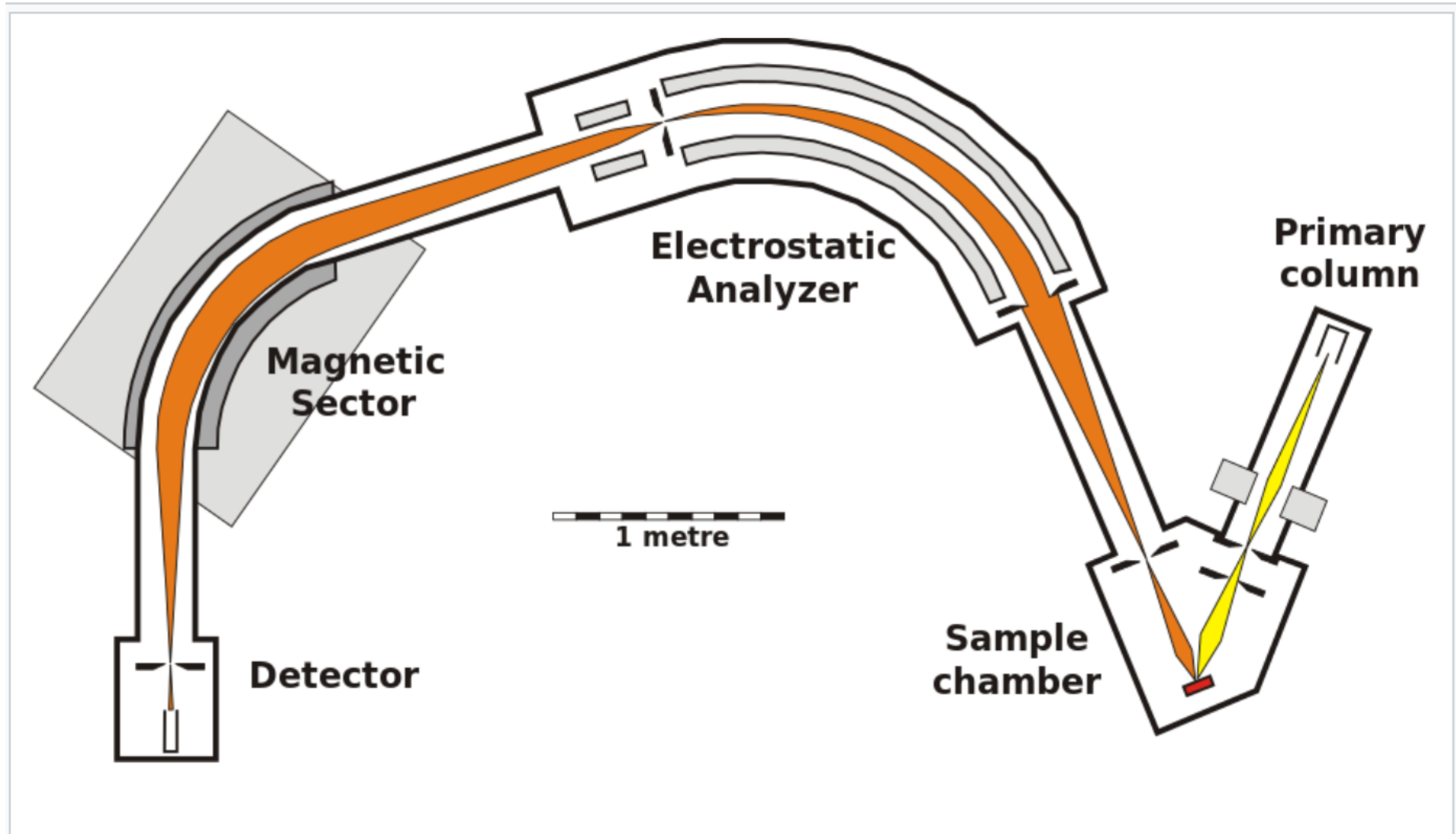
Scanning Electron Microscope

Differences between Light and Electron Microscopes



<https://microbiologyinfo.com/differences-between-light-microscope-and-electron-microscope/>

Ion Microscope

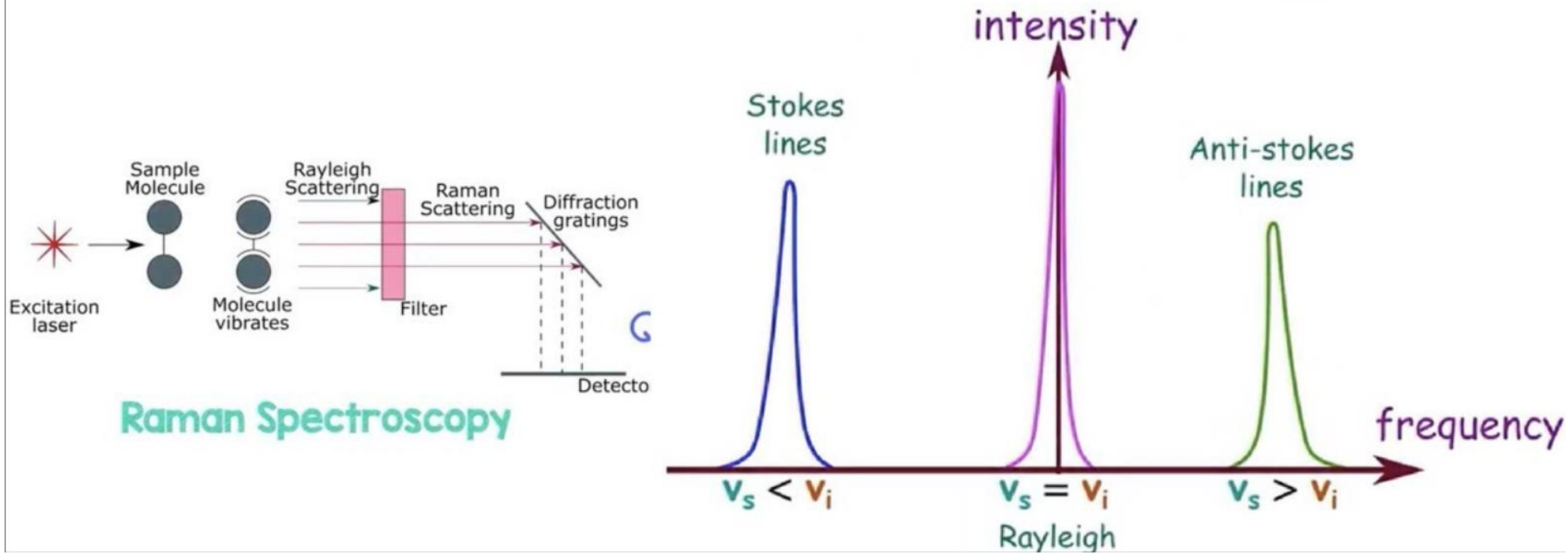


Schematic diagram of a SHRIMP instrument illustrating the ion beam path. After Figure 4, Williams, 1998.^[26]

Raman Spectroscopy

It is possible to build a Raman microscope

Basics and Principles



[Raman spectroscopy Google Reference](#)

Maxwell's Equations

- Gauss' law
- Gauss' law for magnetism
- Faraday's lawAmpère's law
- Ampère's law

Four [differential equations](#) that form the theoretical basis for describing classical [electromagnetism](#)

Understanding these laws of Physics mandatory for electron, and ion microscopes, radio, electricity, computers, and the Van Allen Belts.

Engineering Achievements

Air Craft WW-I

V-2 rockets WW-II

Satellites, Sputnik, October 4, 1957

Saturn Launch Vehicle

Before and after Apollo 11

Russian atomic bomb, August 29, 1949

Russian hydrogen bomb, hydrogen bomb test conducted, November 22, 1955

Berlin Wall

Sputnik, October 4, 1957

Nuclear armed bombers flying over Alaska 24/7

Strontium-90 in milk in the middle of the US, 1963

Apollo 1 fire, Jan. 27, 1967

Super Bowl III, Jan. 12, 1969

Advanced Vela nuclear detection satellites were launched in 1967, 1969 and 1970

Mutual assured destruction (**MAD**) defense policy in force

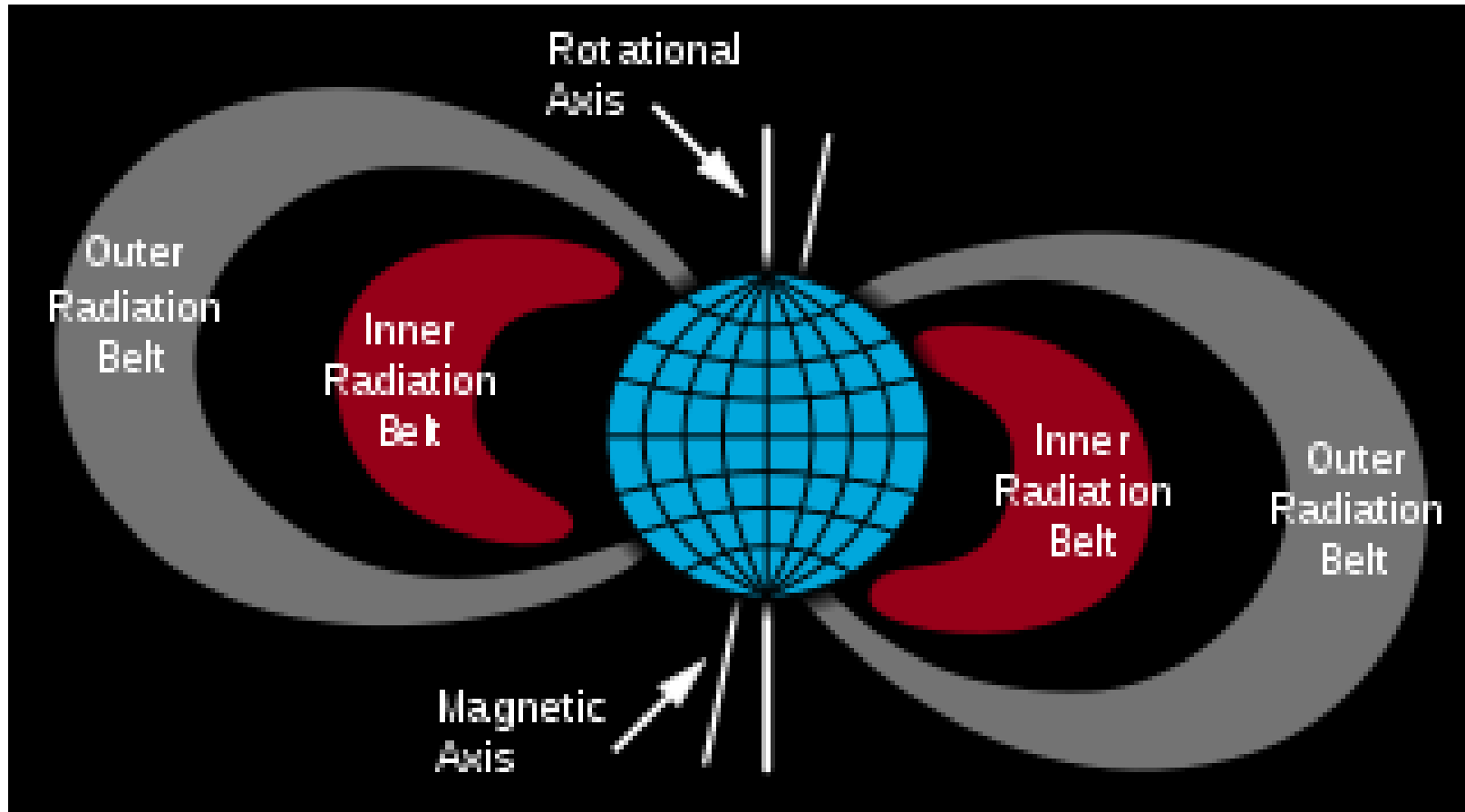
Apollo 11 lands on moon, July 20, 1969

Xerox machine, after Apollo 11

cell phone

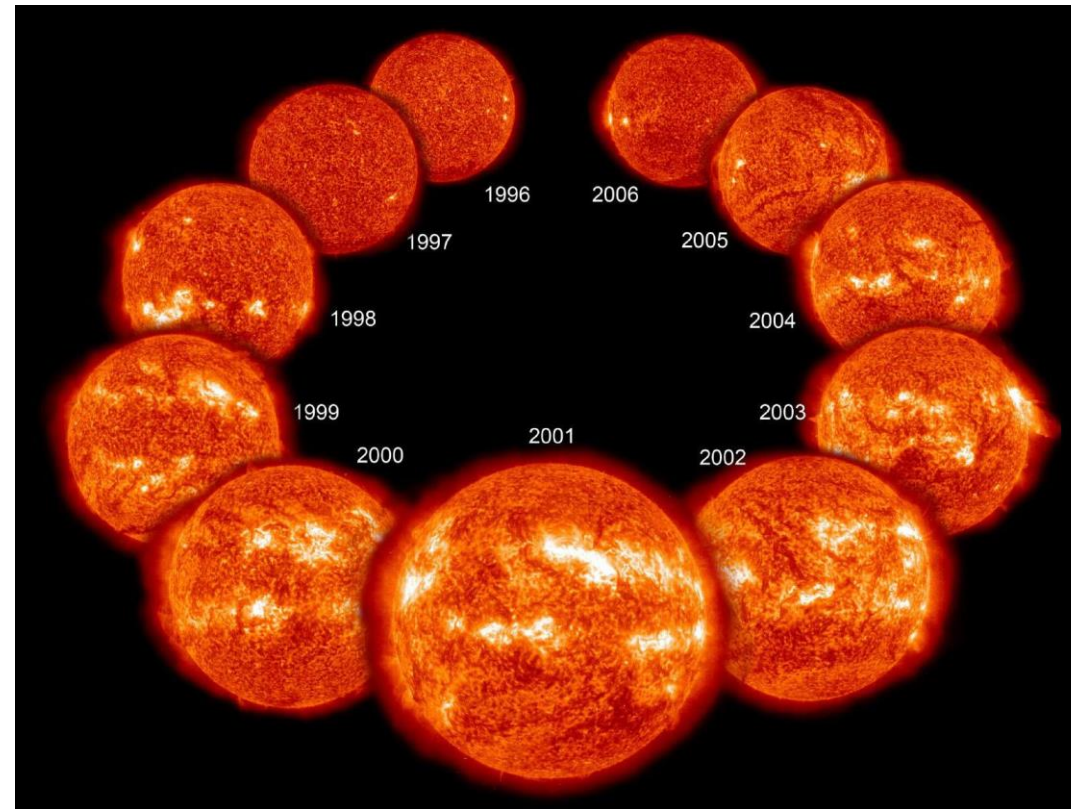
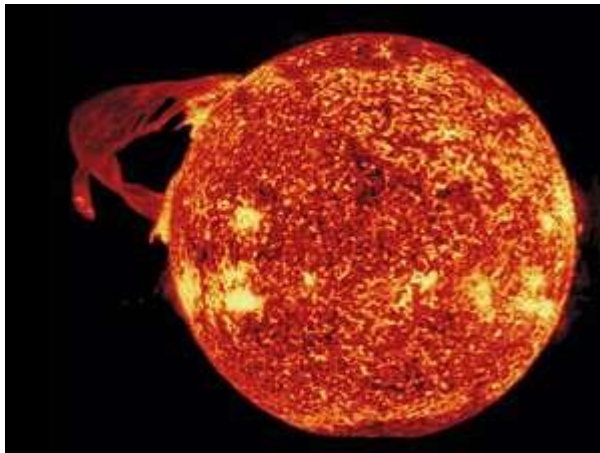
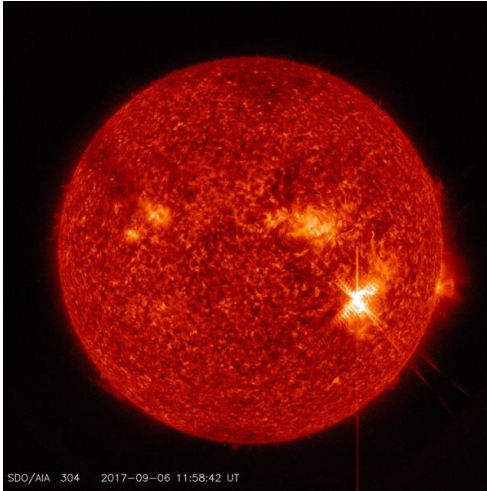
Berlin Wall taken down, November 9, 1989

Van Allen Radiation Belts



Sun

Eleven year Cycle shown



Apollo

Missions all included a team to monitor weather on the moon.

Assets

- NOA
- NCAR
- [Vela](#) Satellites



The Great Commandment

37 ...you shall love the Lord your God with all your heart and with all your soul and with all your **mind**. ...

Matt 22 from ESV

Some speak of using your **noodle**, meaning use your **mind**.

Mind And Matter