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Jigyasa: Adventures of Science

Observing the universe through the eyes of science...

Introduction to the basic physical quantities:

Space-Time

Energy (Light) – Mass (Matter)

**Teamwork between
Physics, Chemistry & Biology**

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Jigyasa: Adventures of a curious crew

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Jigyasa: Adventures of a curious crew

Its all so empty
All so dark

But lets begin the journey
No matter what!

For that can you make
The smallest mark?

• **Dot**
0 Dimension

Right! Its a dot!

Dot by Dot if we add

Like beads of pearls in a
Straight long thread

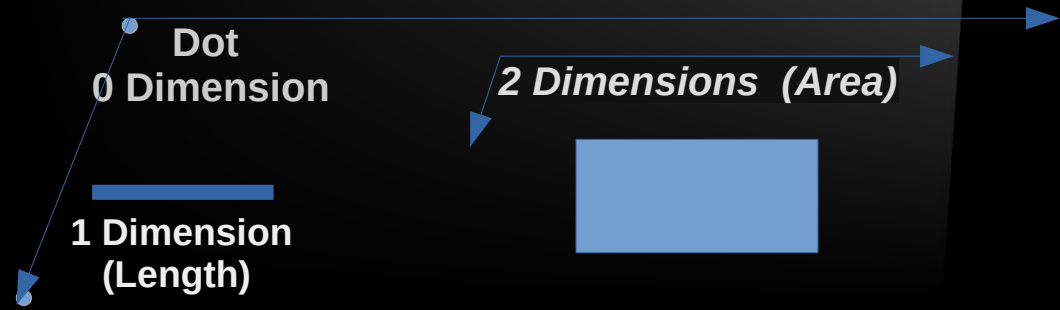
A word that rhymes with mine and pine

Dot dot dot, dot dot dot forms a

Right again!
Dot by dot forms a line!

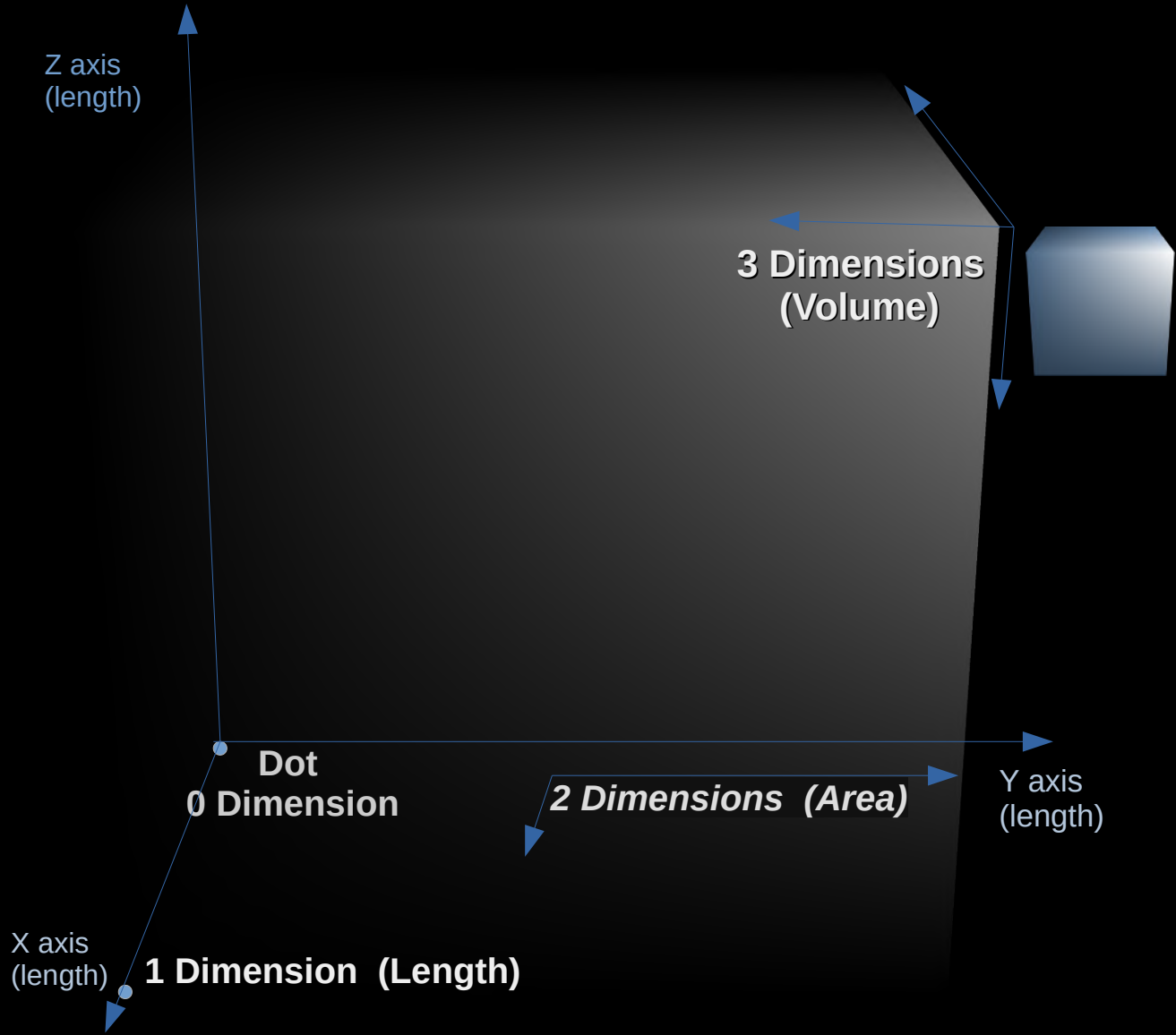
Line by line students stand
They cover a huge _____
Of land!





Area over area
Stacked in case,
Would fill up
the whole





Z axis
(length)

**3 Dimensions
(Volume)**

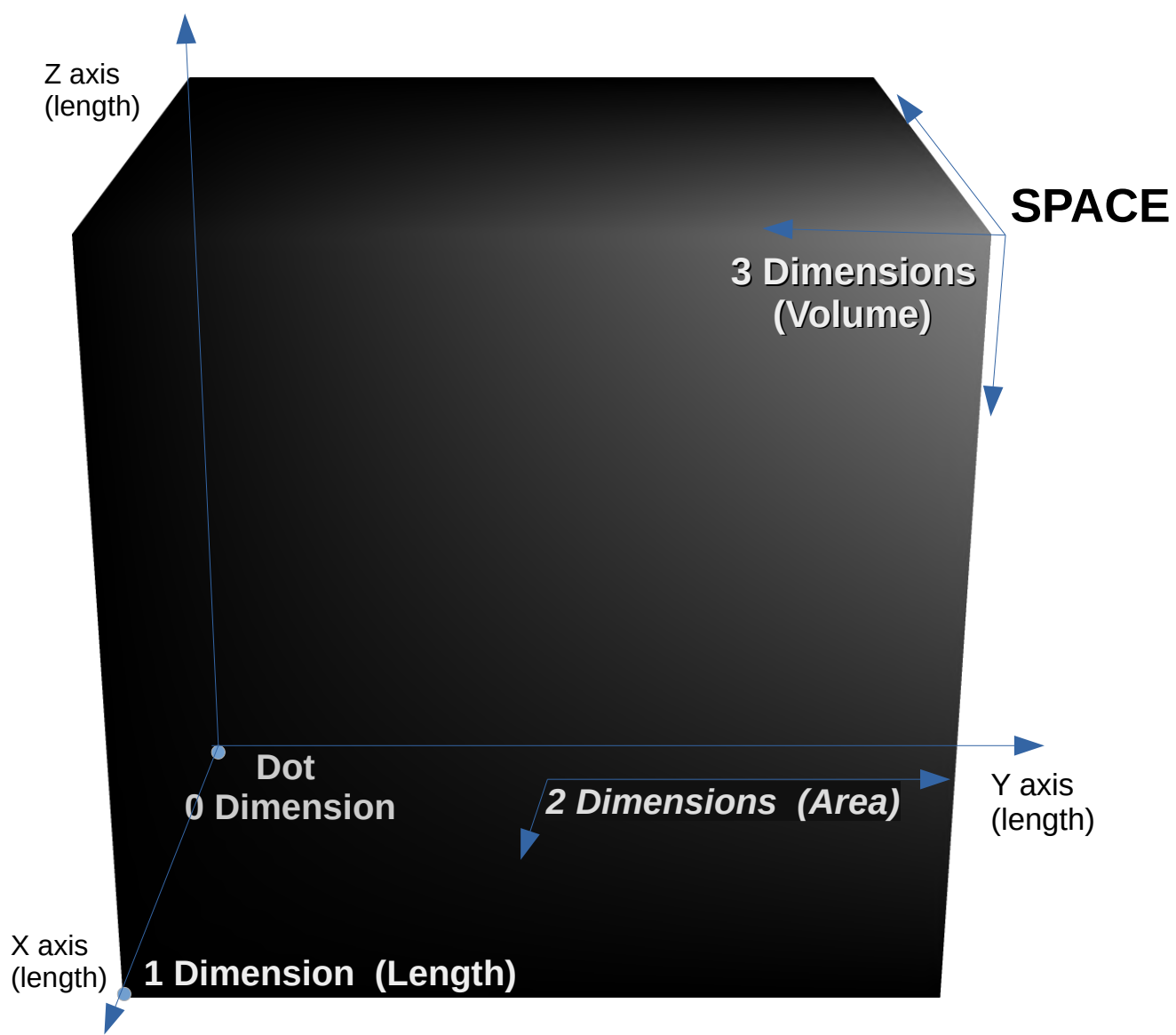
Dot
0 Dimension

2 Dimensions (Area)

Y axis
(length)

X axis
(length)

1 Dimension (Length)



A dot!



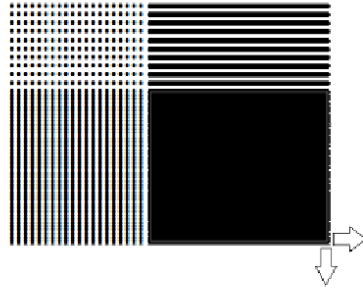
0 D

Dot dot dot.... A line!



1 D

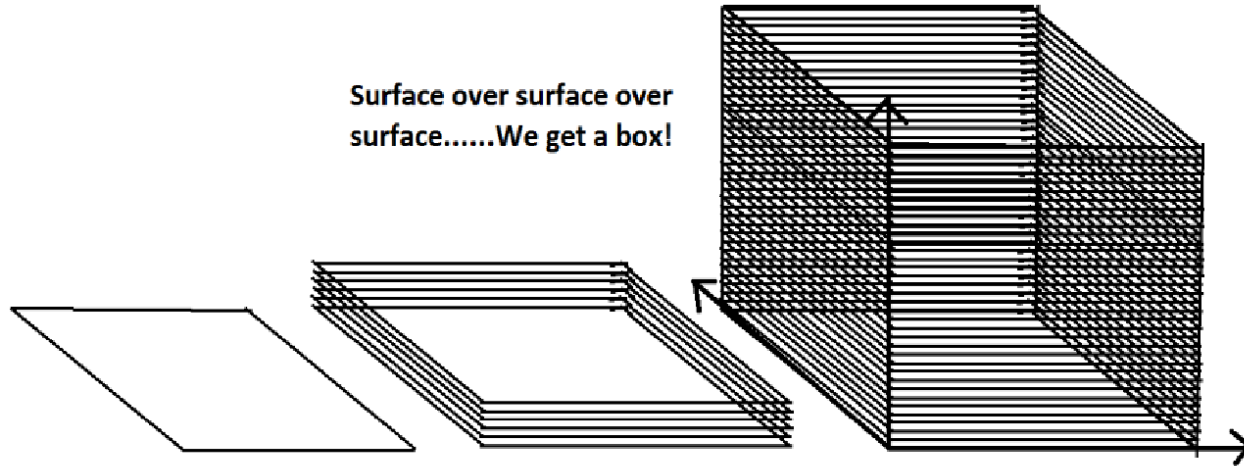
Line over line over line....a surface!

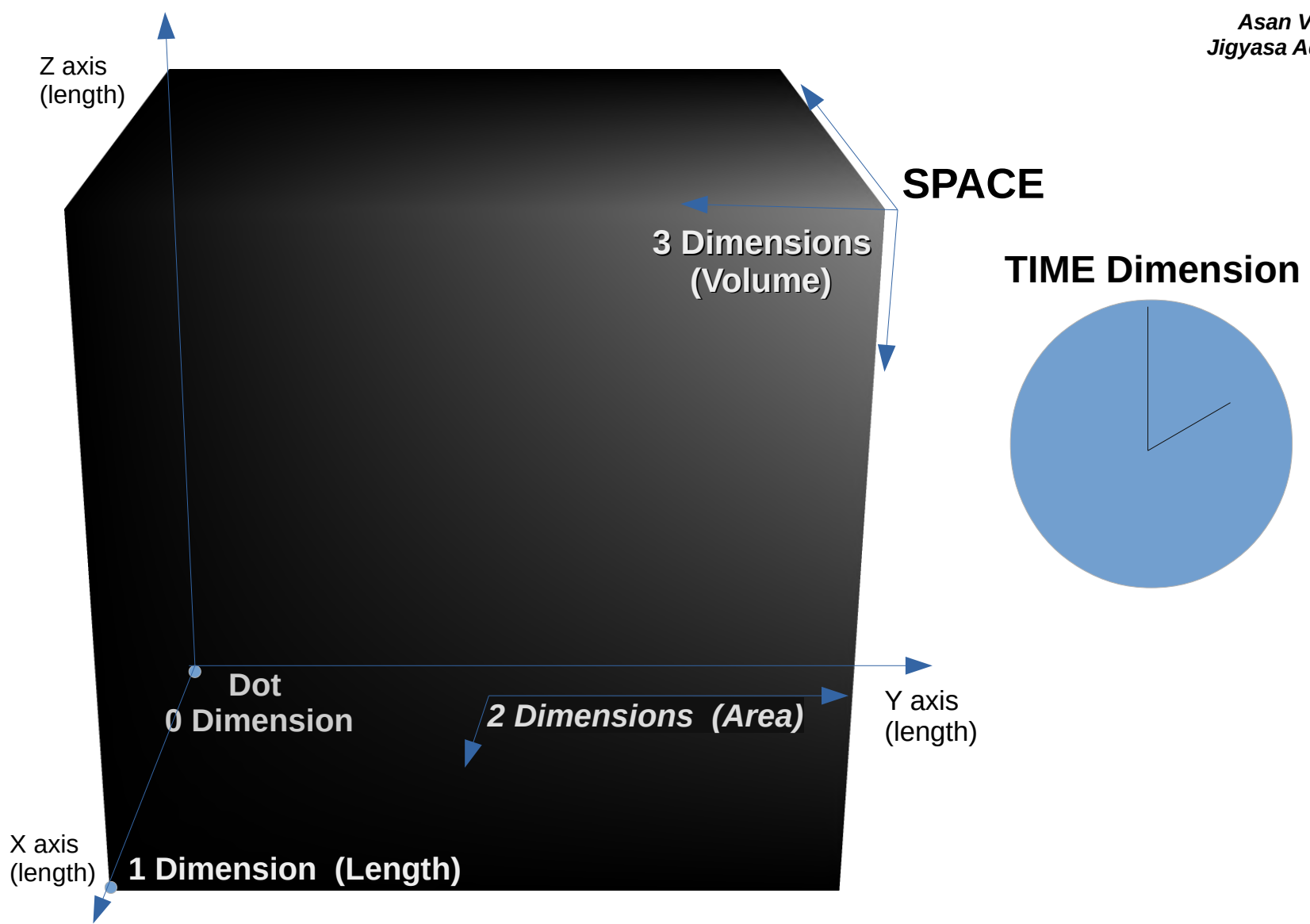


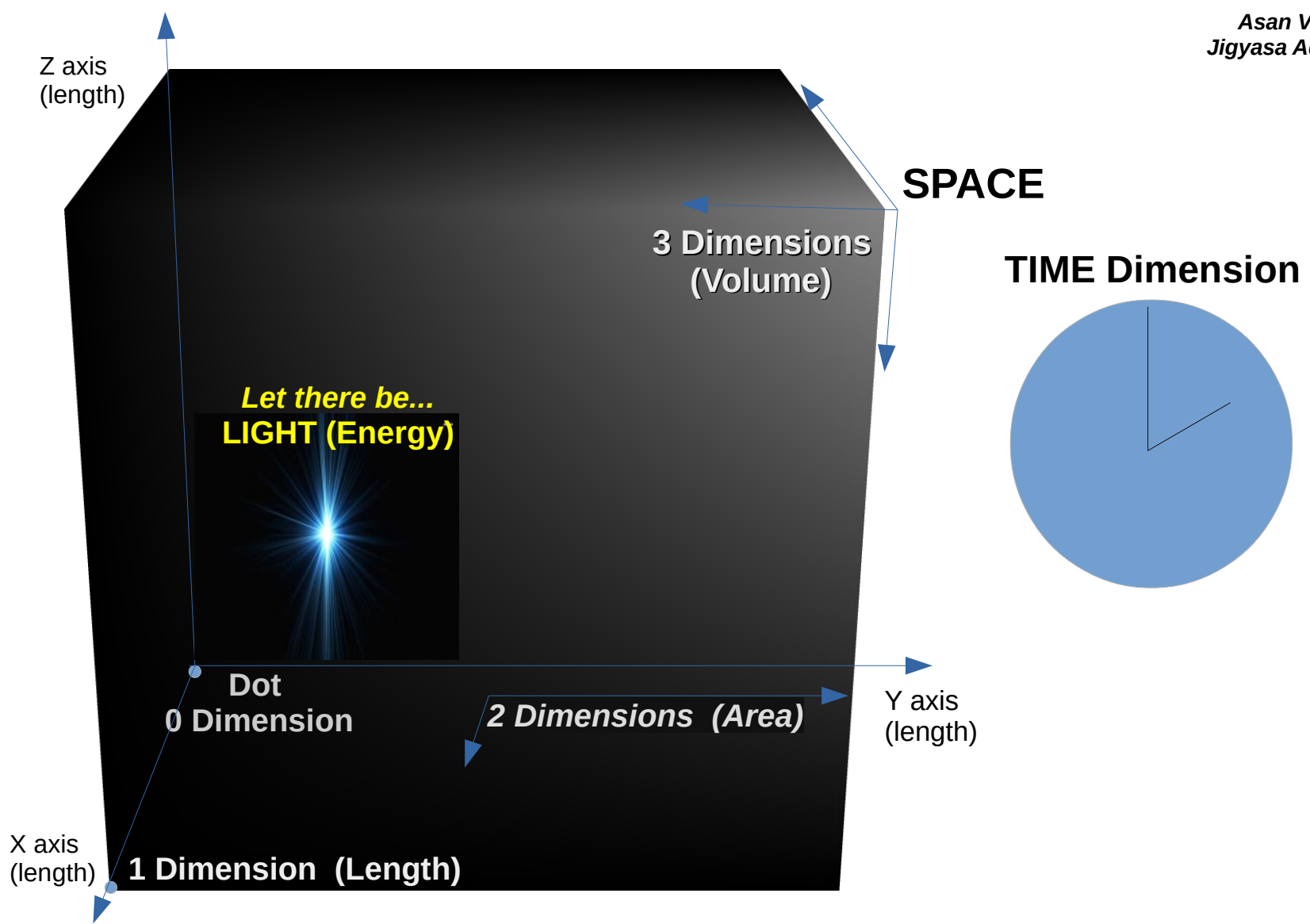
2 D

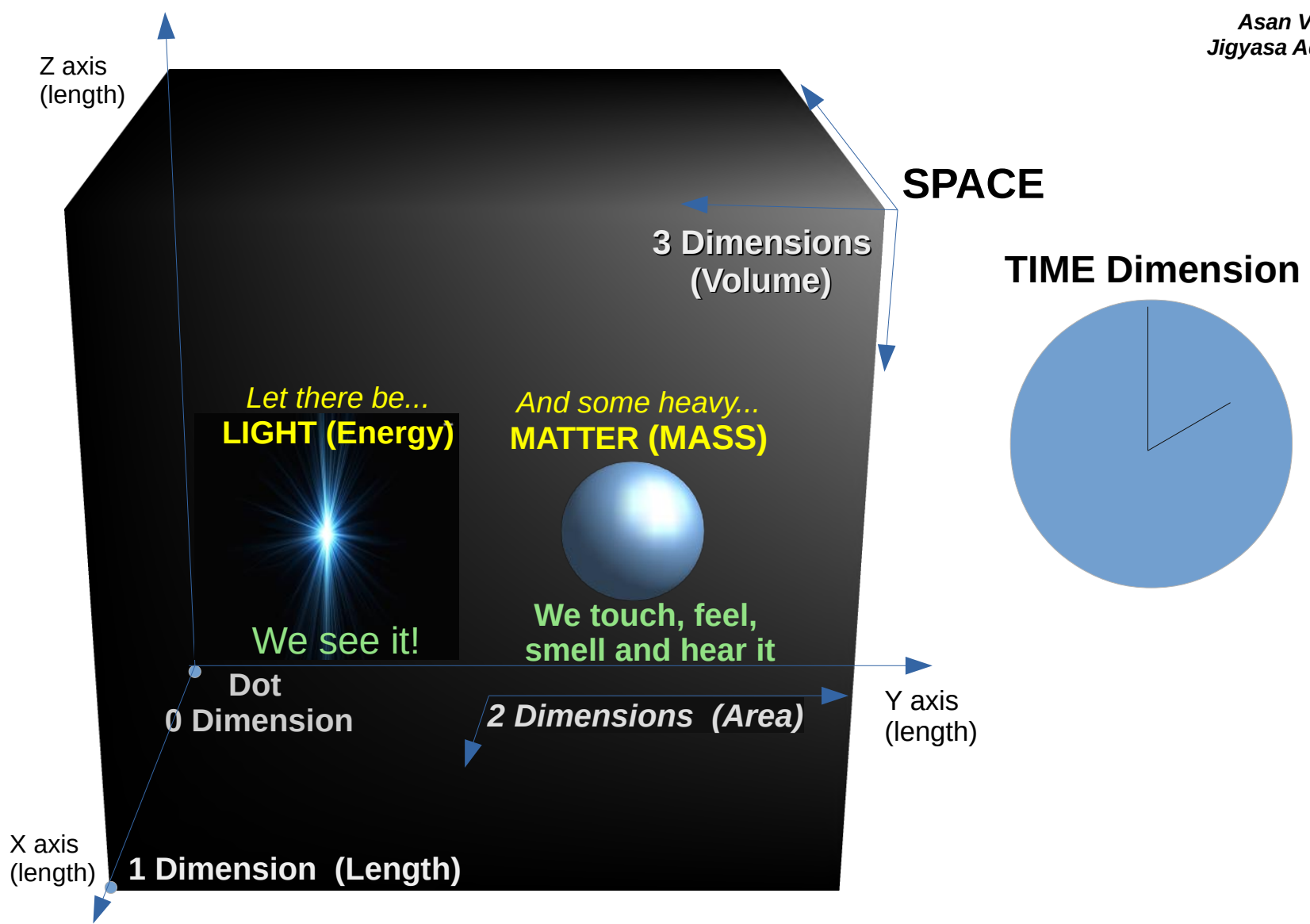
3 D

Surface over surface over surface.....We get a box!





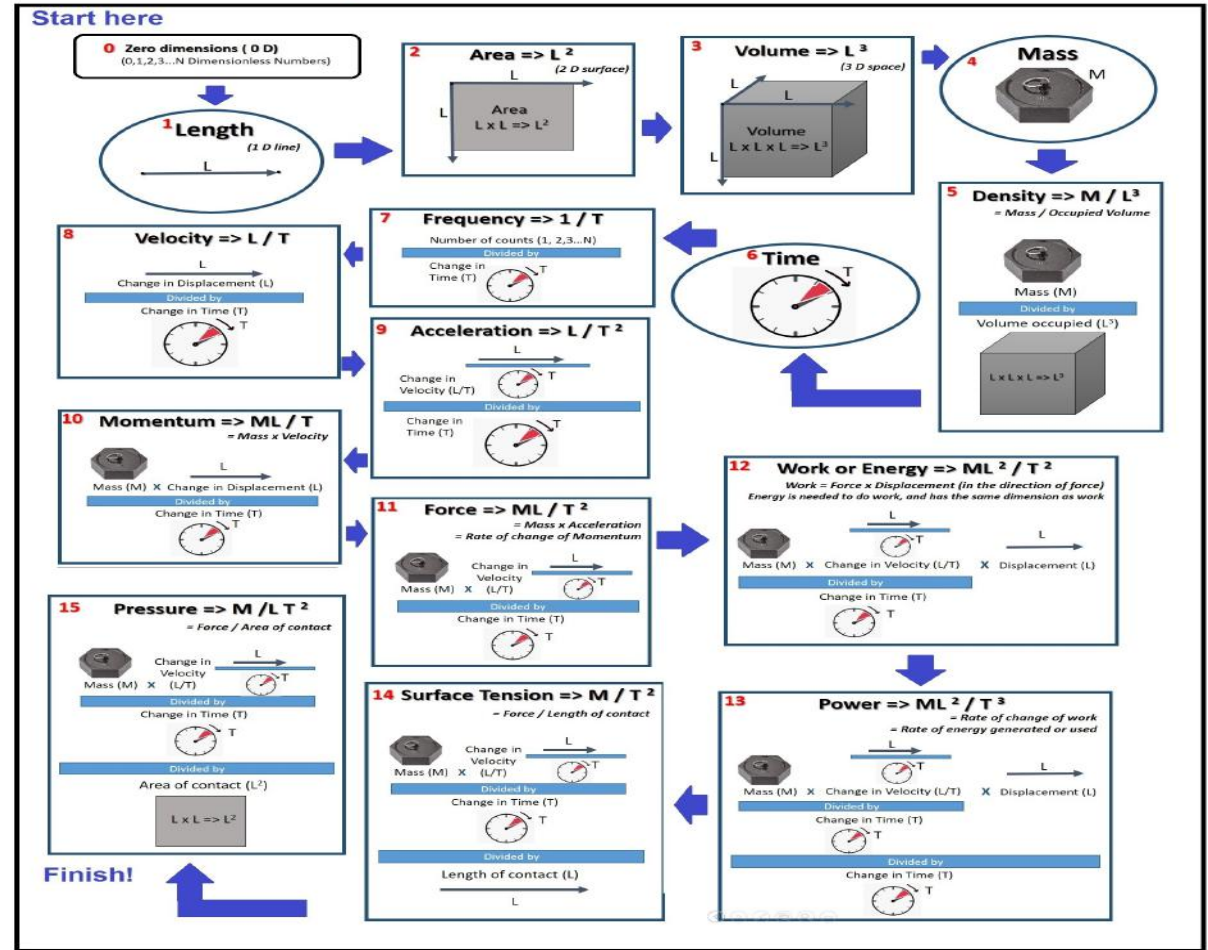




MuLTi-Dimensions and motion: Follow the blue trail!

Quantity	Dimension	Unit
length	[L]	metre
area	[L ²]	metre ²
volume	[L ³]	Metre ³
density	[ML ⁻³]	kg m ⁻³
Speed (Velocity)	[LT ⁻¹]	ms ⁻¹
acceleration	[LT ⁻²]	ms ⁻²
Momentum or Impulse	[MLT ⁻¹]	kg ms ⁻¹
force	[MLT ⁻²]	newton (N)
pressure	[ML ⁻¹ T ⁻²]	Nm ⁻²
energy/work	[ML ² T ⁻²]	joule (J)
power	[ML ² T ⁻³]	J s ⁻¹ or watt

The Map of MuLTi - Dimensions



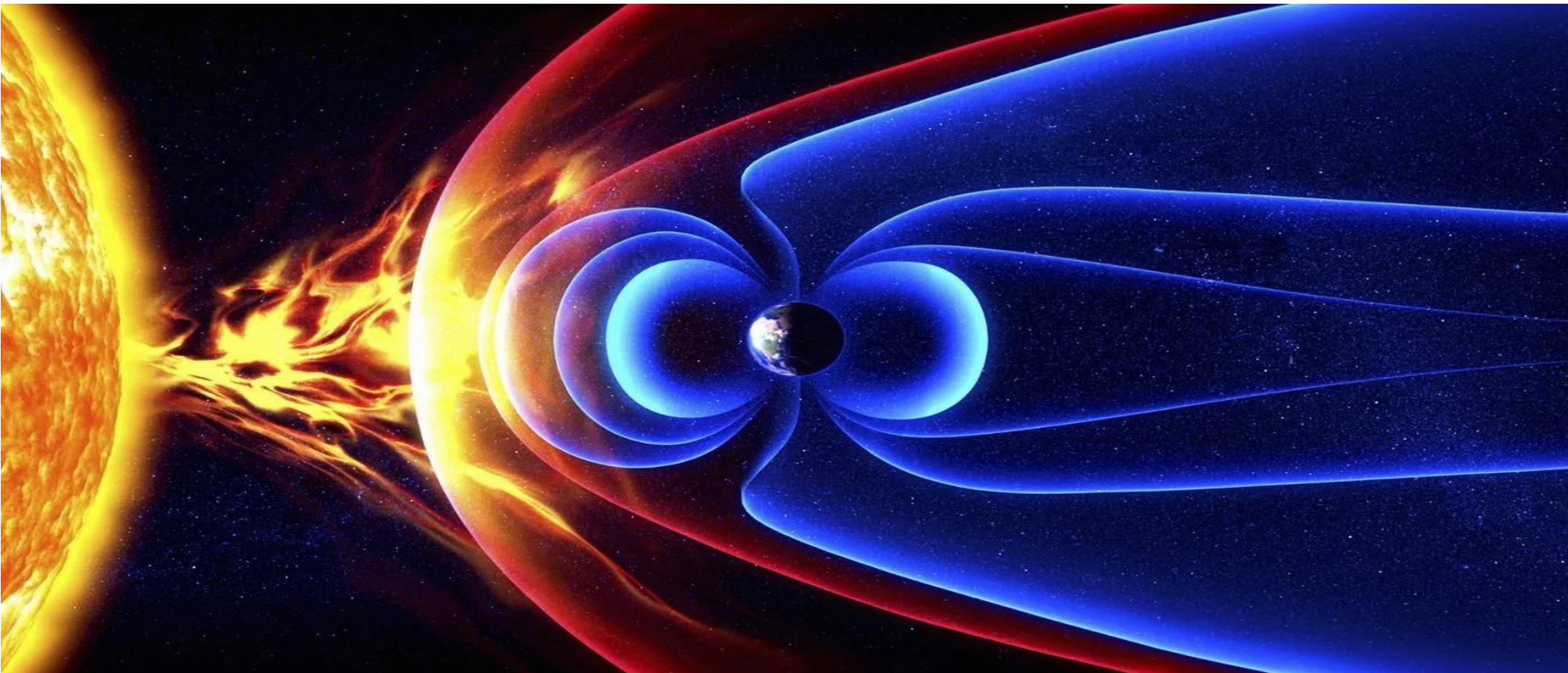
Mass explains gravitation...but...

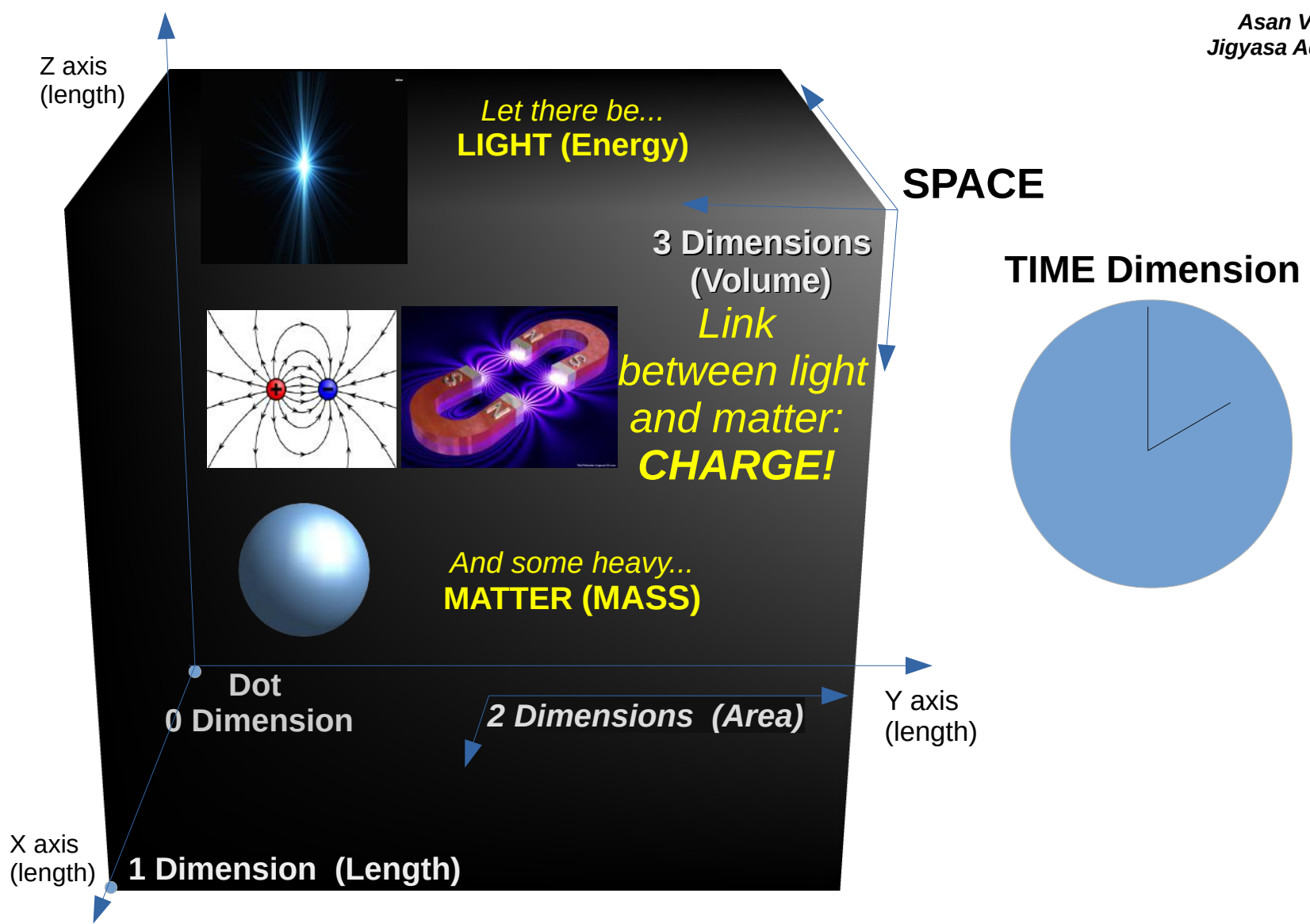


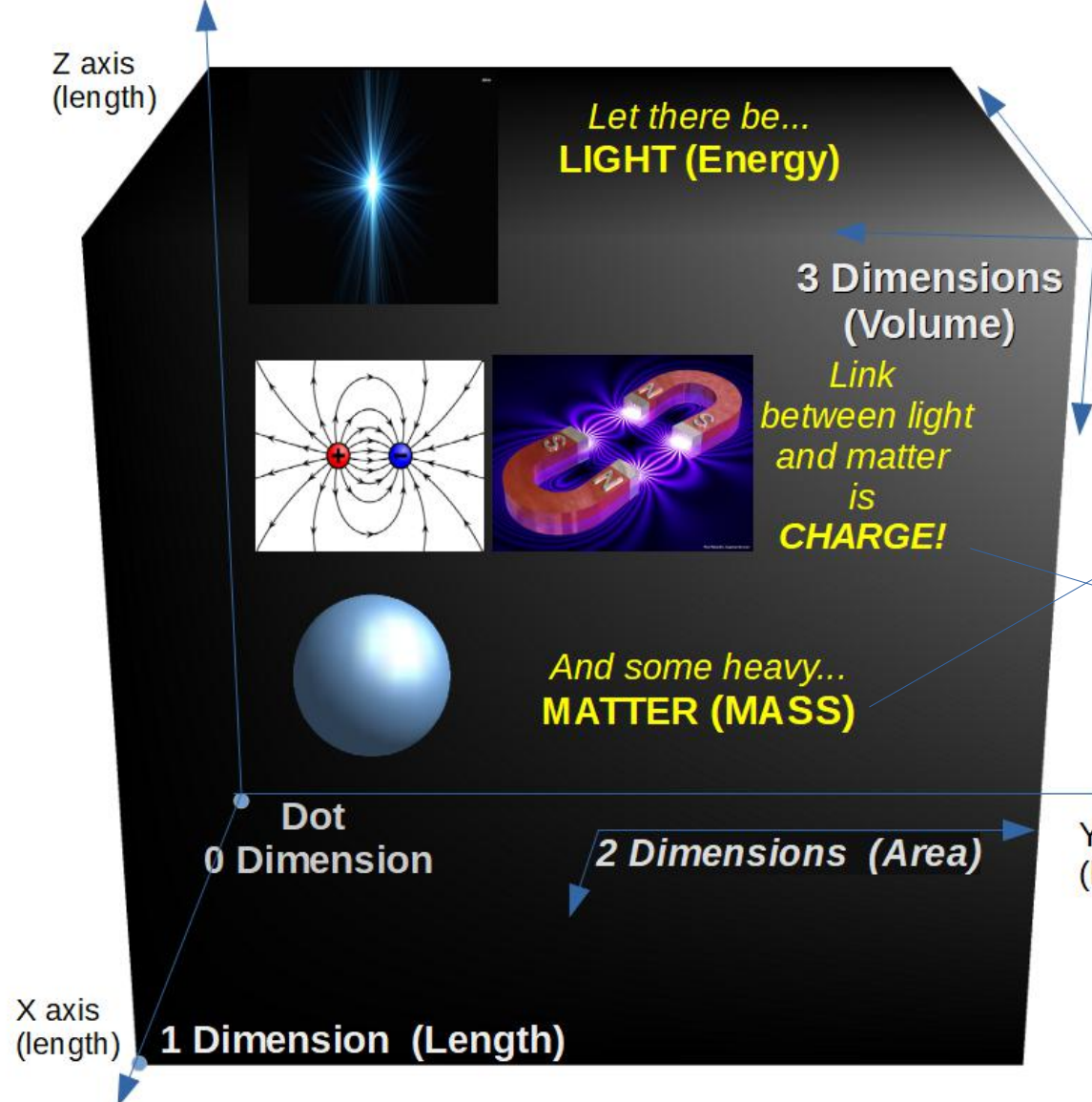
Cannot explain lightning....



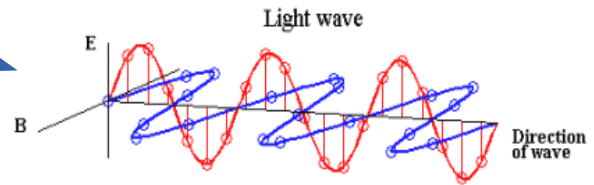
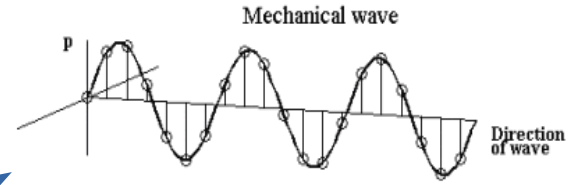
Cannot explain magnetic field...so
matter has mass and something more...







Sound is mechanical wave of atoms Vibrating...

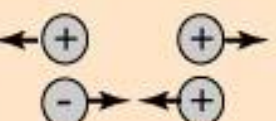


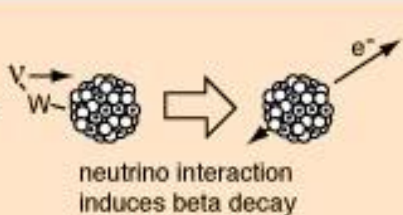
isvr

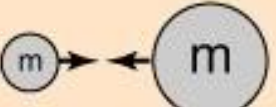
Light is wave of electric & magnetic field vibrating

Fundamental Forces

<i>Strong</i>	 <p>Force which holds nucleus together</p>	Strength 1	Range (m) 10^{-15} (diameter of a medium sized nucleus)	Particle gluons, π (nucleons)
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<i>Electro-magnetic</i>		Strength $\frac{1}{137}$	Range (m) Infinite	Particle photon mass = 0 spin = 1
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<i>Weak</i>	 <p>neutrino interaction induces beta decay</p>	Strength 10^{-6}	Range (m) 10^{-18} (0.1% of the diameter of a proton)	Particle Intermediate vector bosons W^+ , W^- , Z_0 , mass > 80 GeV spin = 1
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<i>Gravity</i>		Strength 6×10^{-39}	Range (m) Infinite	Particle graviton ? mass = 0 spin = 2
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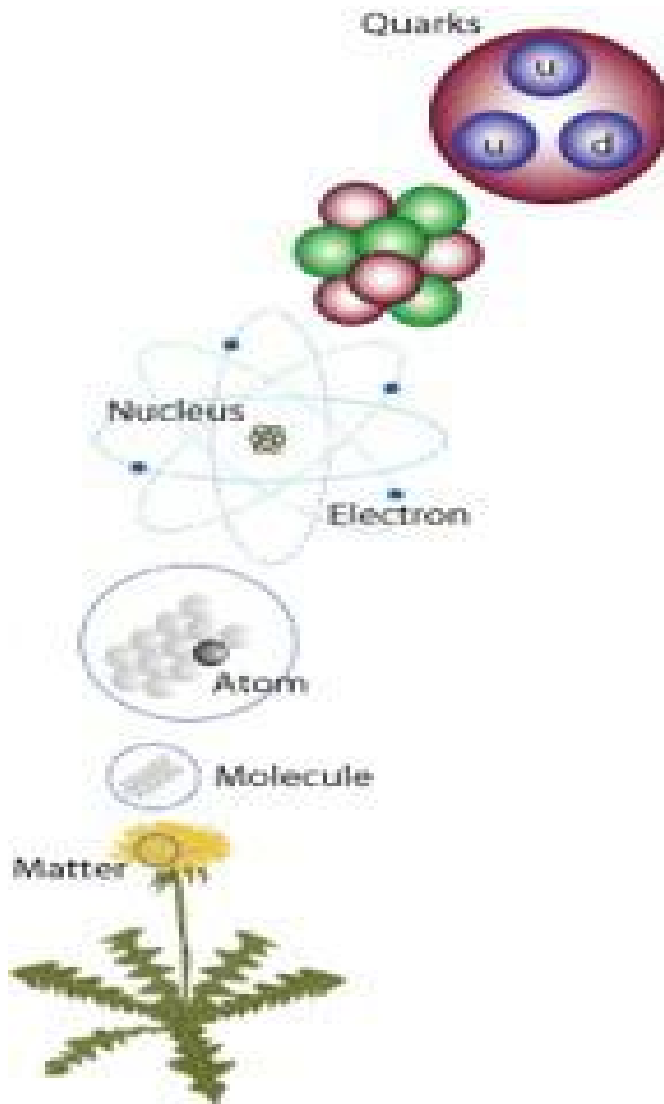
Strong and weak:
inside nucleus,
nuclear science

EM acts between
+ and - , atoms and
matter, chemistry,
electricity, biology

Gravity mainly for
massive matter like
planets and stars,
space mission etc

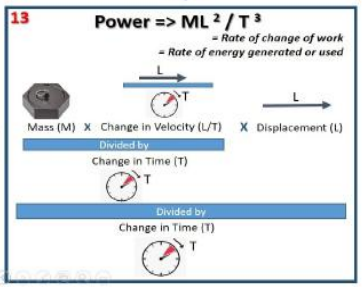
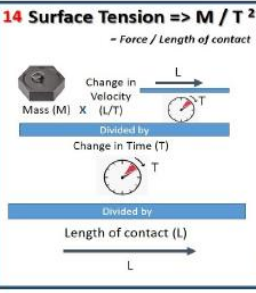
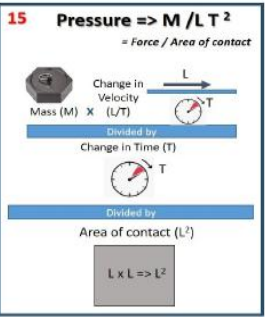
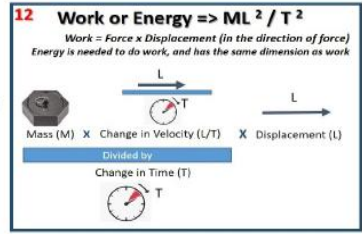
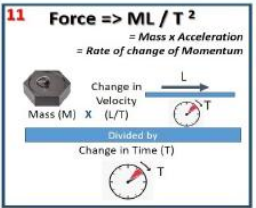
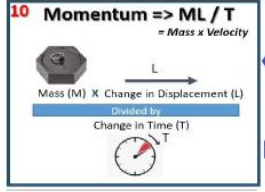
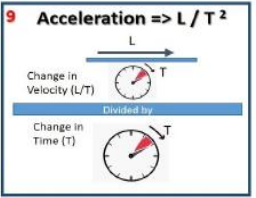
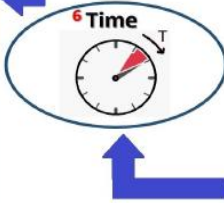
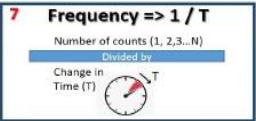
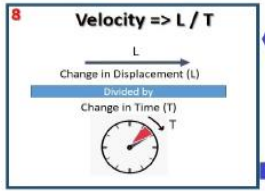
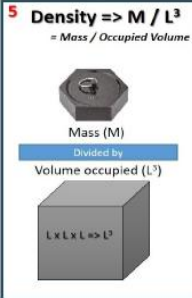
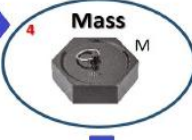
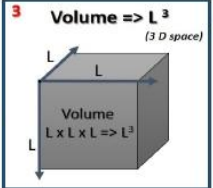
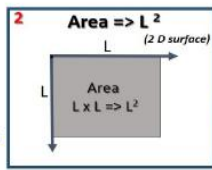
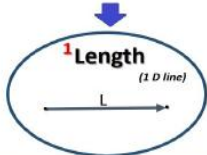
Matter is made up of ???

- Smaller particles
- called ATOMS!



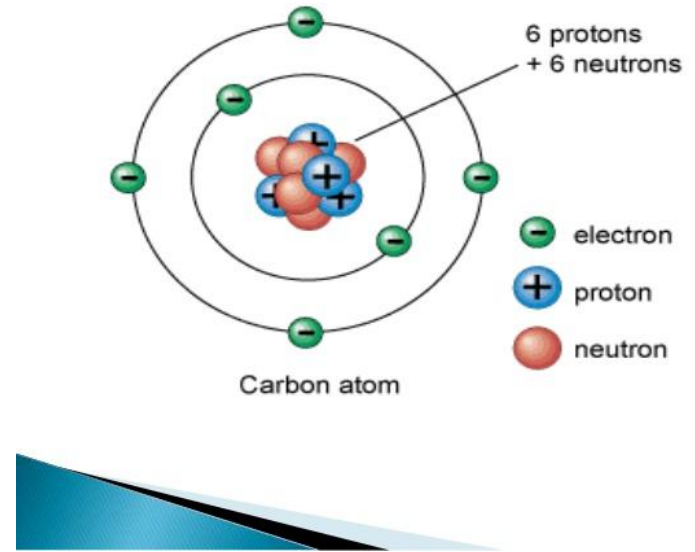
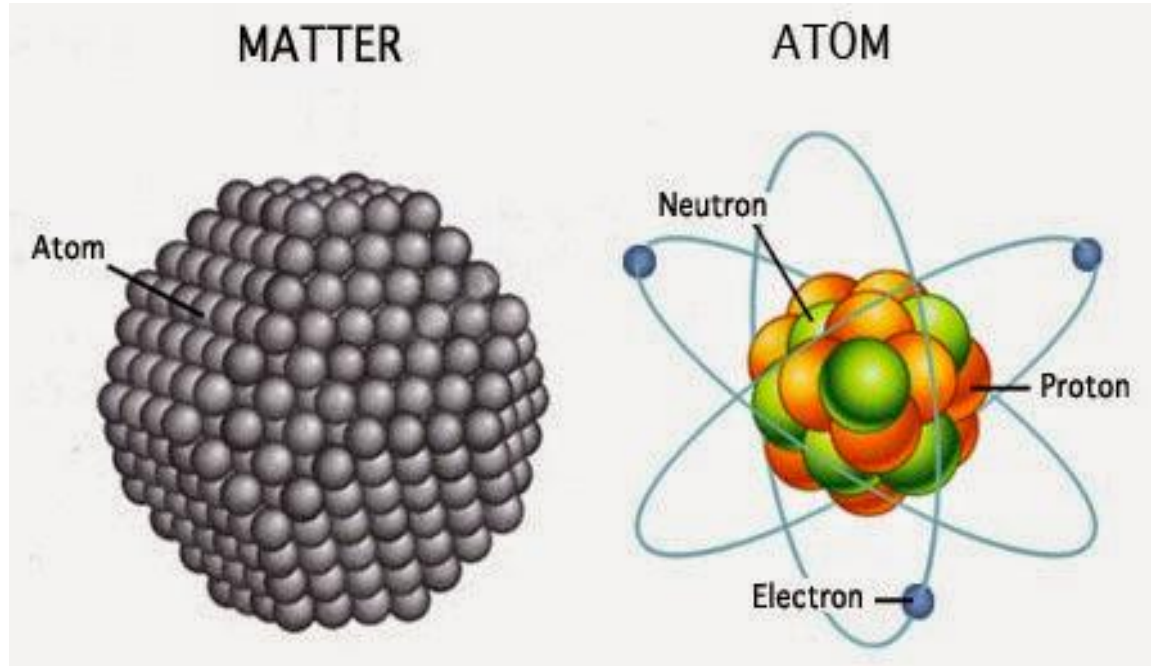
Start here

0 Zero dimensions (0 D)
(0,1,2,3...N Dimensionless Numbers)

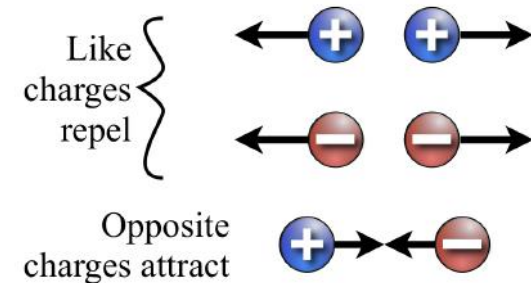


Finish!

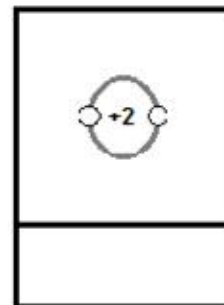
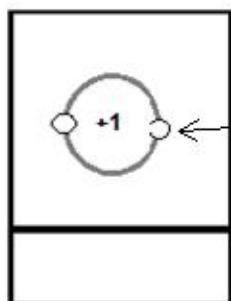
For understanding origin of Charge we have to go inside matter



Physics + Chemistry tells how atoms behave!
How they give, take or share electrons based on Electrostatic forces!



Periodic table of elements: Fill in the electron blanks

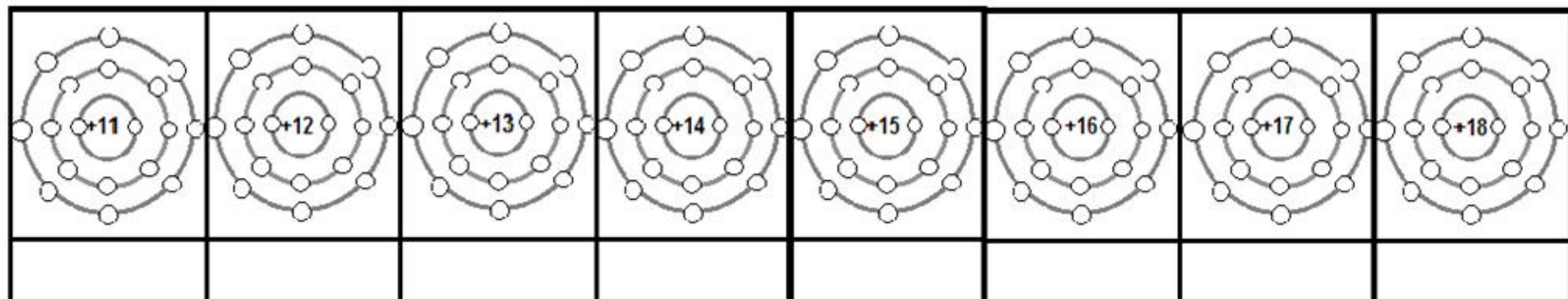
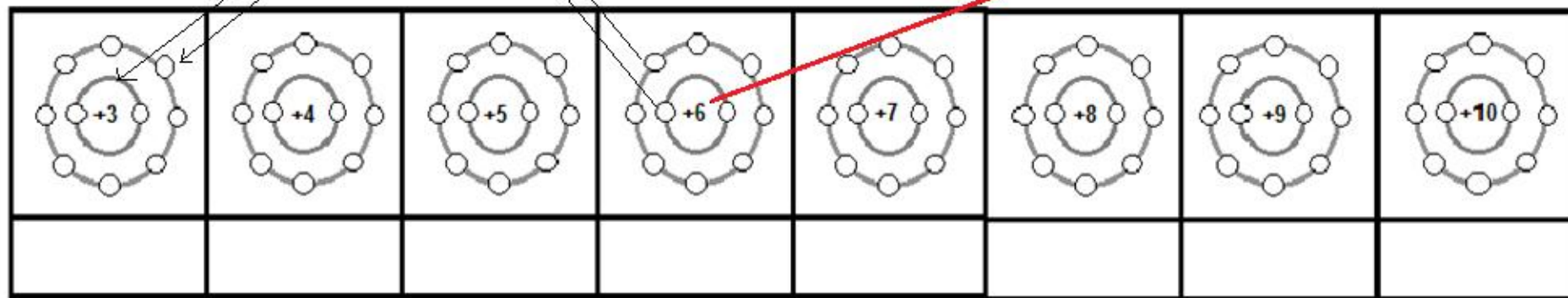


✦ Fill in the holes with electrons (-)

✦ Fill electrons (-) from inner circle to outer circle

✦ Number of electrons filled = Number of protons (+) in the center

1st
2nd



Play 'n' Learn the elements of chemistry and decode the periodic table using VaCE Fundo Card Games

Group समूह

Period आवर्त

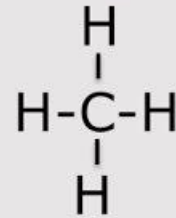
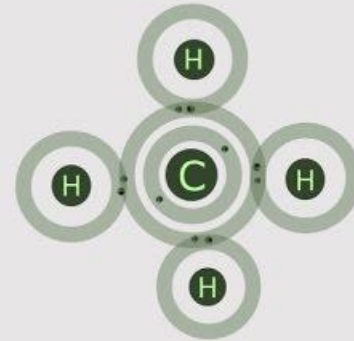
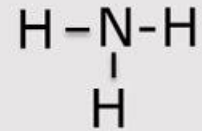
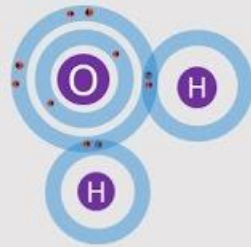
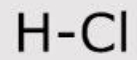
1

2

3

<p>1</p> <p>H Symbol: हाइड्रोजन Atomic Number: 1</p> <p>Hydrogen हाइड्रोजन</p>  <p>Electronic Configuration (1) 1s¹ Gas like at room temperature</p> <p>Periodic Table Location: Group 1, Period 1</p> <p>Property: Non-metal, Gas</p>	<p>2</p> <p>He Symbol: हीलियम Atomic Number: 2</p> <p>Helium हीलियम</p>  <p>Electronic Configuration (2) 1s² Inert gas</p> <p>Periodic Table Location: Group 18, Period 1</p> <p>Property: Inert, Gas</p>	<p>Chemistry FUNDO</p> <p>VaCE</p> <p>Valency Cards of Elements</p>	<p>13</p>	<p>14</p>	<p>15</p>	<p>16</p>	<p>17</p>	<p>18</p>
<p>3</p> <p>Li Symbol: लिथियम Atomic Number: 3</p> <p>Lithium लिथियम</p>  <p>Electronic Configuration (2,1) 1s² 2s¹ Metal</p> <p>Periodic Table Location: Group 1, Period 2</p> <p>Property: Metal, Solid</p>	<p>4</p> <p>Be Symbol: बेरिलियम Atomic Number: 4</p> <p>Beryllium बेरिलियम</p>  <p>Electronic Configuration (2,2) 1s² 2s² Metal</p> <p>Periodic Table Location: Group 2, Period 2</p> <p>Property: Metal, Solid</p>	<p>Science Didi</p>	<p>5</p> <p>B Symbol: बोरॉन Atomic Number: 5</p> <p>Boron बोरॉन</p>  <p>Electronic Configuration (2,3) 1s² 2s² 2p¹ Metalloid</p> <p>Periodic Table Location: Group 13, Period 2</p> <p>Property: Metalloid, Solid</p>	<p>6</p> <p>C Symbol: कार्बन Atomic Number: 6</p> <p>Carbon कार्बन</p>  <p>Electronic Configuration (2,4) 1s² 2s² 2p² Non-Metal</p> <p>Periodic Table Location: Group 14, Period 2</p> <p>Property: Non-Metal, Solid</p>	<p>7</p> <p>N Symbol: नाइट्रोजन Atomic Number: 7</p> <p>Nitrogen नाइट्रोजन</p>  <p>Electronic Configuration (2,5) 1s² 2s² 2p³ Non-Metal</p> <p>Periodic Table Location: Group 15, Period 2</p> <p>Property: Non-Metal, Gas</p>	<p>8</p> <p>O Symbol: ऑक्सीजन Atomic Number: 8</p> <p>Oxygen ऑक्सीजन</p>  <p>Electronic Configuration (2,6) 1s² 2s² 2p⁴ Non-Metal</p> <p>Periodic Table Location: Group 16, Period 2</p> <p>Property: Non-Metal, Gas</p>	<p>9</p> <p>F Symbol: फ्लोरिन Atomic Number: 9</p> <p>Fluorine फ्लोरिन</p>  <p>Electronic Configuration (2,7) 1s² 2s² 2p⁵ Non-Metal</p> <p>Periodic Table Location: Group 17, Period 2</p> <p>Property: Non-Metal, Gas</p>	<p>10</p> <p>Ne Symbol: नियोन Atomic Number: 10</p> <p>Neon नियोन</p>  <p>Electronic Configuration (2,8) 1s² 2s² 2p⁶ Inert gas</p> <p>Periodic Table Location: Group 18, Period 2</p> <p>Property: Inert, Gas</p>
<p>11</p> <p>Na Symbol: सोडियम Atomic Number: 11</p> <p>Sodium सोडियम</p>  <p>Electronic Configuration (2,8,1) 1s² 2s² 2p⁶ 3s¹ Metal</p> <p>Periodic Table Location: Group 1, Period 3</p> <p>Property: Metal, Solid</p>	<p>12</p> <p>Mg Symbol: मैग्नीशियम Atomic Number: 12</p> <p>Magnesium मैग्नीशियम</p>  <p>Electronic Configuration (2,8,2) 1s² 2s² 2p⁶ 3s² Metal</p> <p>Periodic Table Location: Group 2, Period 3</p> <p>Property: Metal, Solid</p>	<p>असान अद्वैत विज्ञान</p> <p>asanvigan.in</p> <p>Science Education for Social Reconstruction</p>	<p>13</p> <p>Al Symbol: एल्युमीनियम Atomic Number: 13</p> <p>Aluminium एल्युमीनियम</p>  <p>Electronic Configuration (2,8,3) 1s² 2s² 2p⁶ 3s² 3p¹ Metal</p> <p>Periodic Table Location: Group 13, Period 3</p> <p>Property: Metal, Solid</p>	<p>14</p> <p>Si Symbol: सिलिकॉन Atomic Number: 14</p> <p>Silicon सिलिकॉन</p>  <p>Electronic Configuration (2,8,4) 1s² 2s² 2p⁶ 3s² 3p² Metalloid</p> <p>Periodic Table Location: Group 14, Period 3</p> <p>Property: Metalloid, Solid</p>	<p>15</p> <p>P Symbol: फॉस्फोरस Atomic Number: 15</p> <p>Phosphorus फॉस्फोरस</p>  <p>Electronic Configuration (2,8,5) 1s² 2s² 2p⁶ 3s² 3p³ Non-Metal</p> <p>Periodic Table Location: Group 15, Period 3</p> <p>Property: Non-Metal, Solid</p>	<p>16</p> <p>S Symbol: सल्फर Atomic Number: 16</p> <p>Sulphur सल्फर</p>  <p>Electronic Configuration (2,8,6) 1s² 2s² 2p⁶ 3s² 3p⁴ Non-Metal</p> <p>Periodic Table Location: Group 16, Period 3</p> <p>Property: Non-Metal, Solid</p>	<p>17</p> <p>Cl Symbol: क्लोरीन Atomic Number: 17</p> <p>Chlorine क्लोरीन</p>  <p>Electronic Configuration (2,8,7) 1s² 2s² 2p⁶ 3s² 3p⁵ Non-Metal</p> <p>Periodic Table Location: Group 17, Period 3</p> <p>Property: Non-Metal, Gas</p>	<p>18</p> <p>Ar Symbol: आर्गन Atomic Number: 18</p> <p>Argon आर्गन</p>  <p>Electronic Configuration (2,8,8) 1s² 2s² 2p⁶ 3s² 3p⁶ Inert gas</p> <p>Periodic Table Location: Group 18, Period 3</p> <p>Property: Inert, Gas</p>

VALENCY



+1

H	+2	<div data-bbox="527 150 974 234" style="border: 1px solid black; padding: 5px; display: inline-block;">Valency Table</div>					
Li	Be						
Na	Mg						
K	Ca						
Rb	Sr						
Cs	Ba						
Fr	Ra						

transition metals

Members of this group of metals display a number of valencies

	-4 <i>or</i> +4				0
+3	+4	-3	-2	-1	He
B	C	N	O	F	Ne
Al	Si	P	S	Cl	Ar
Ga	Ge	As	Se	Br	Kr
In	Sn	Sb	Te	I	Xe
Tl	Pb	Bi	Po	At	Rn

1 group
2 group

3 group
4 group
5 group
6 group
7 group
8 group

Metals give electrons: becomes +ive

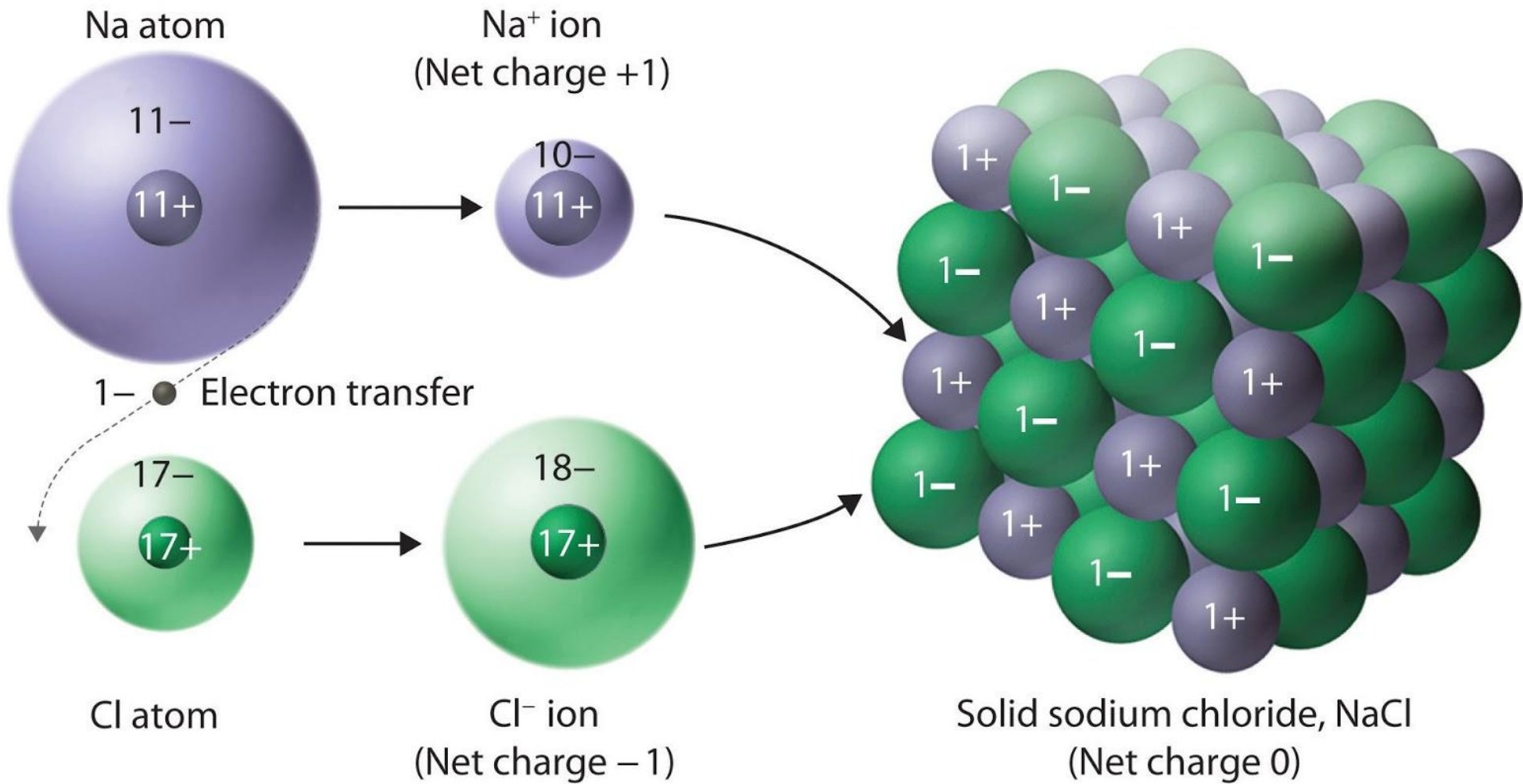
Non-metals takes electrons: becomes -ive

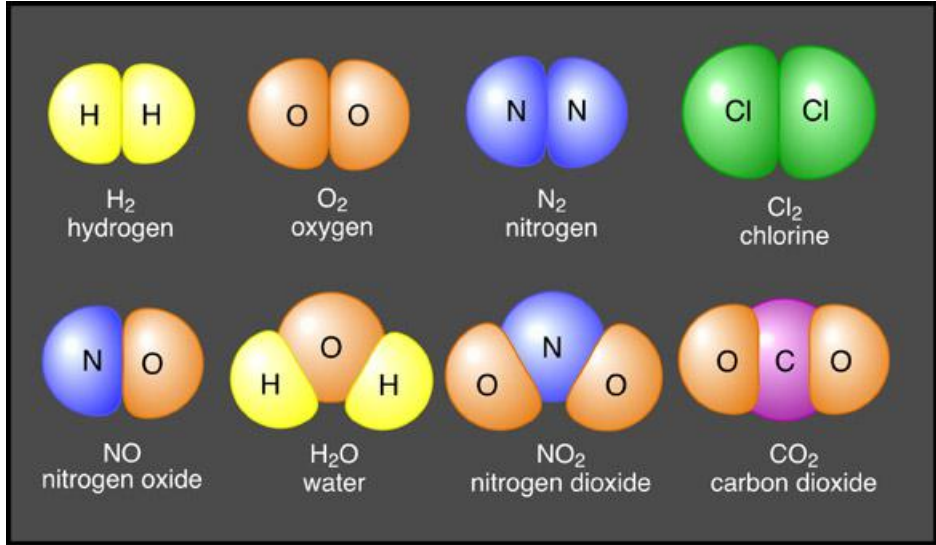
BONDING

Which families on the Periodic Table are UNSTABLE because of their electron configurations?

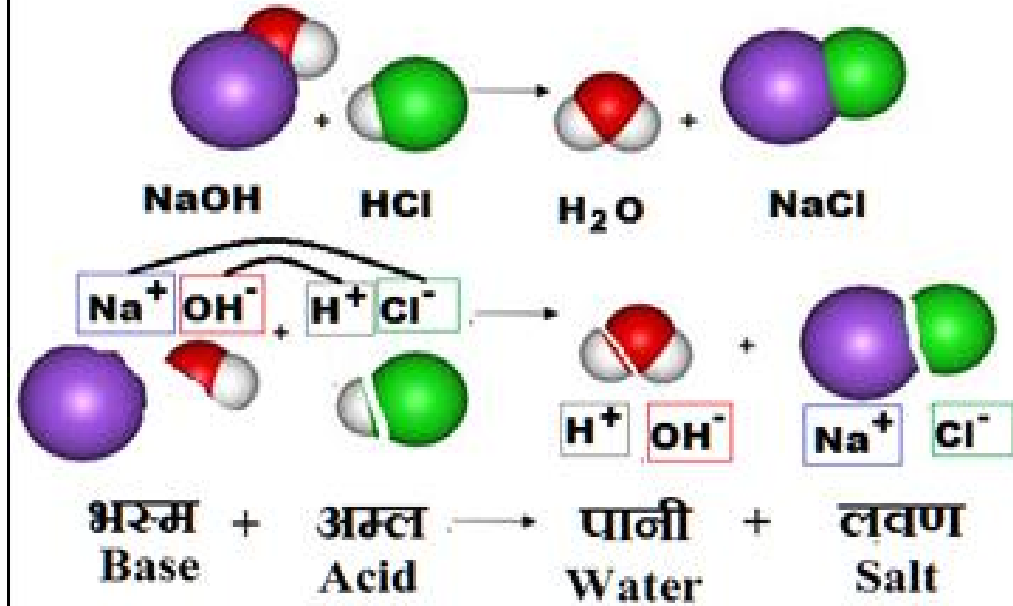
CIRCLE THEM.

Electron Dot Diagrams for Some Group A Elements							
Group							
1A	2A	3A	4A	5A	6A	7A	8A
H•							He••
Li•	•Be•	•B•	•C•	•N•	•O•	•F•	•Ne•
Na•	•Mg•	•Al•	•Si•	•P•	•S•	•Cl•	•Ar•
K•	•Ca•	•Ga•	•Ge•	•As•	•Se•	•Br•	•Kr•





उदासीनीकरण / Neutralization

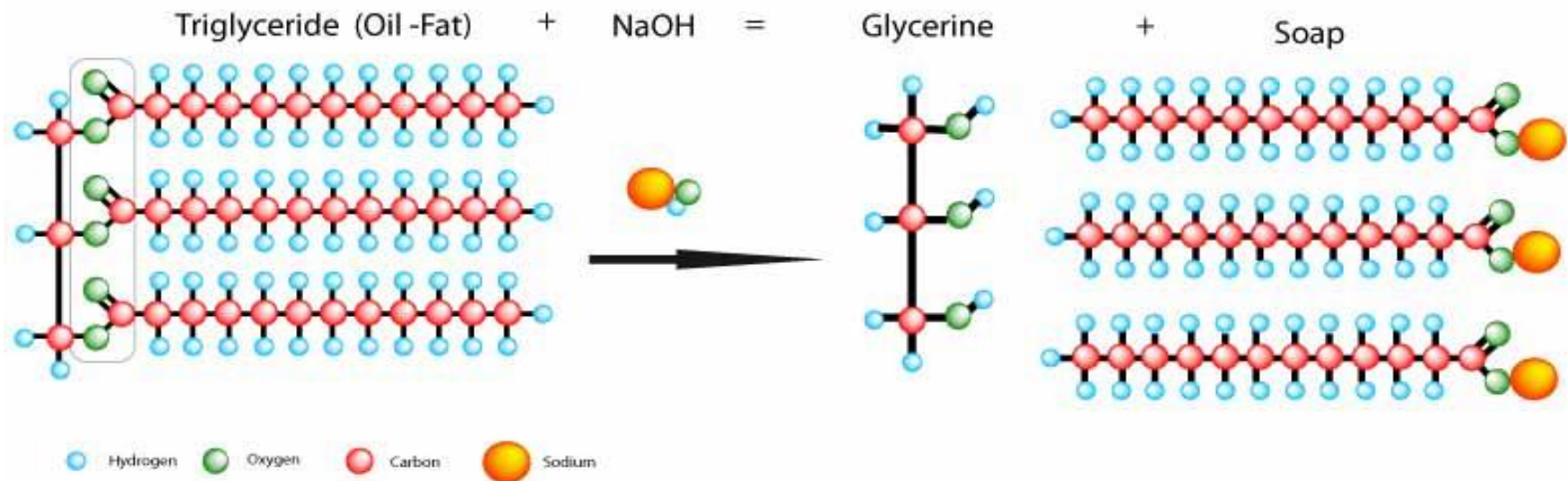


$\text{pH} = -\log[\text{H}^+]$
 $[\text{H}^+] = \text{antilog}(-\text{pH})$
Acidic/आम्ल

pH श्रेणी pH Scale
 $[\text{H}^+][\text{OH}^-] = 1 \times 10^{-14}$
 $\text{pH} + \text{pOH} = 14$

$\text{pOH} = -\log[\text{OH}^-]$
 $[\text{OH}^-] = \text{antilog}(-\text{pOH})$
Basic/भस्म / आम्लारी





Grouping Elements

- Metals
 - Good conductors of heat
 - Good conductors of electricity
 - Malleable
 - Can be shaped
 - Ductile
 - Can be drawn into wires



Copper



Lead



Tin



Nickel



Steel



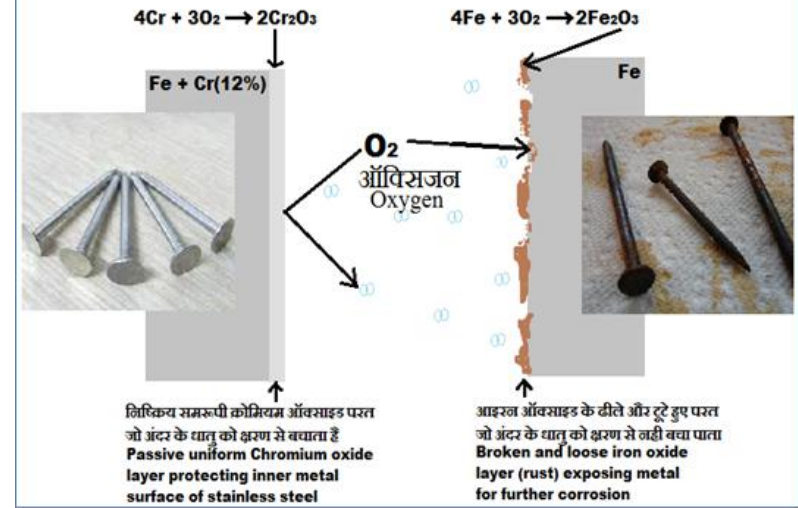
Zinc

Metalworking

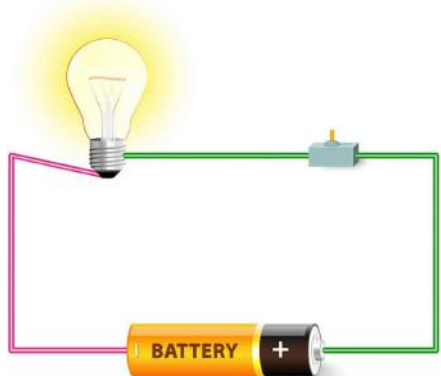


क्षरण: स्टेनलेस स्टील बनाम लोहा

Corrosion: Stainless steel vs Iron

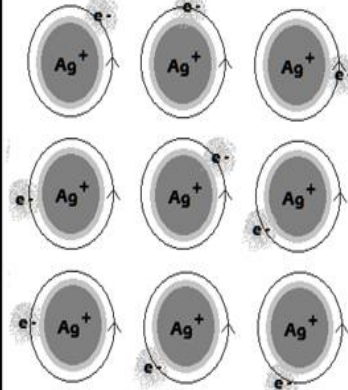


SIMPLE ELECTRIC CIRCUIT

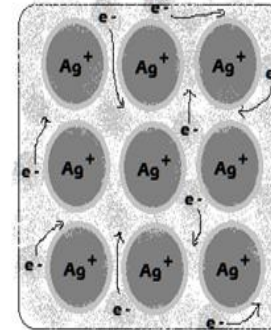


धात्विक बंधन और तन्वयता Metallic bonding and ductility

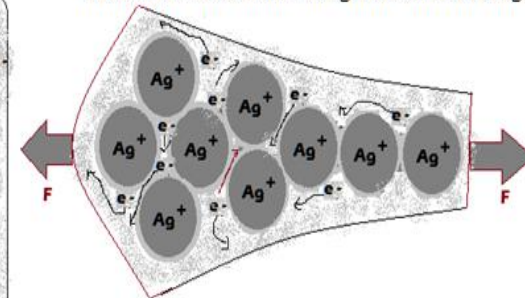
सिल्वर अणु संयोजक एलेक्ट्रॉन्स के साथ
Silver atoms with valence electrons



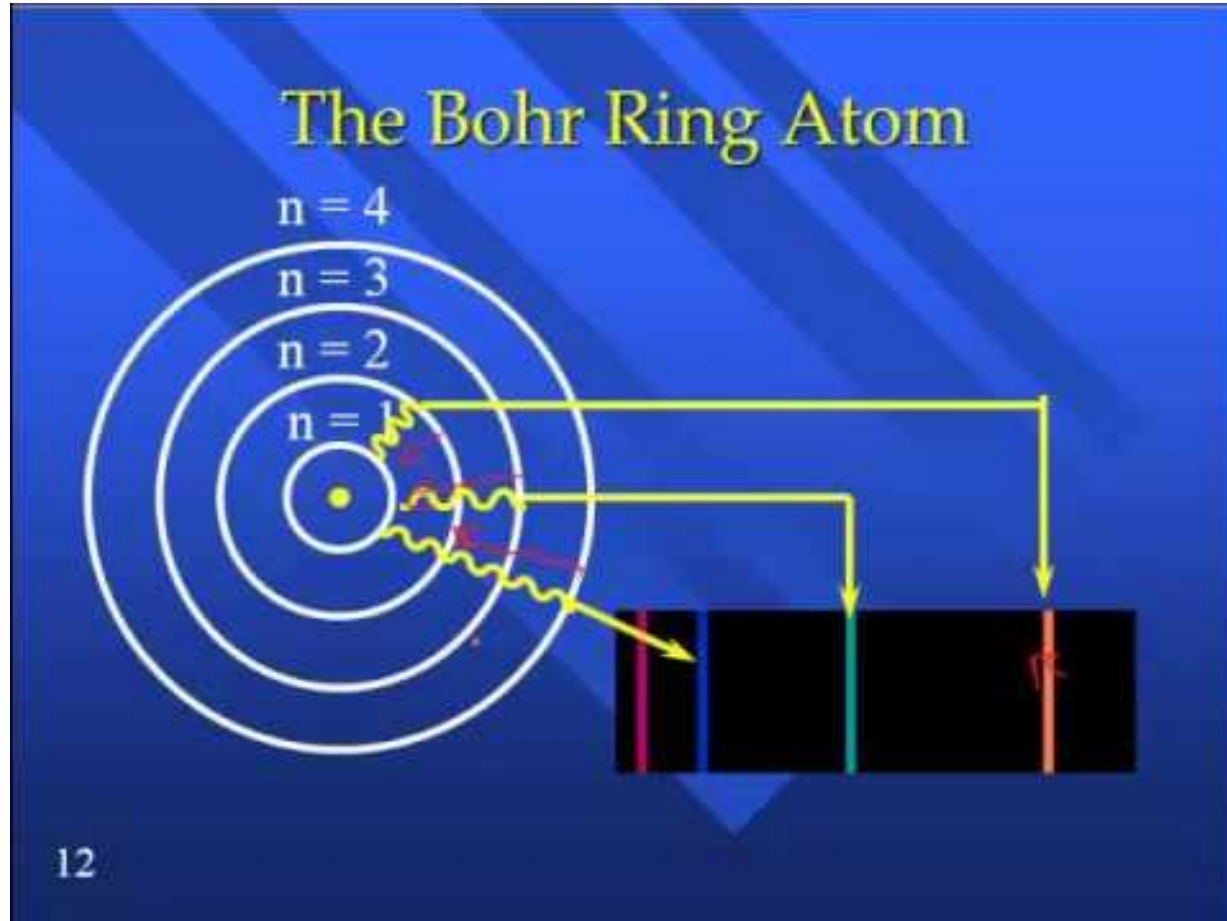
सिल्वर घनत्व की संरचना जिनका मुक्त घूमने वाले एलेक्ट्रॉनों के साथ धात्विक बंधन
Silver cations arranged held by free electrons forming metallic bond



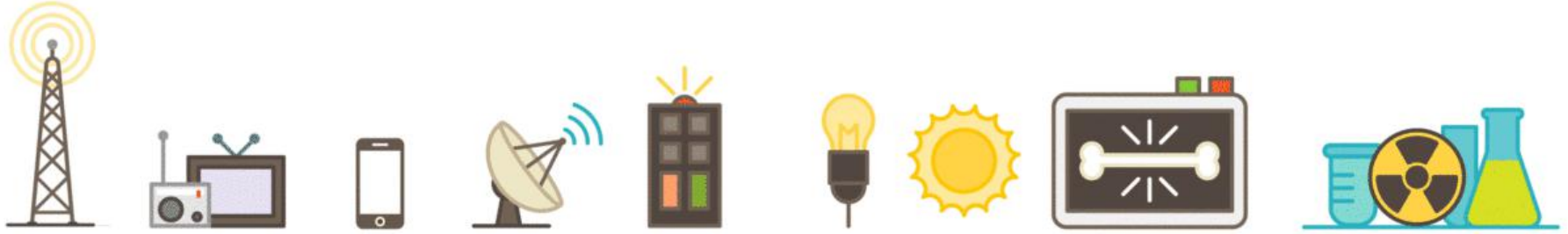
मुक्त इलेक्ट्रॉन सिल्वर अणुओं को हर दिशा से चिपकाके रखते हैं जिससे बल लगने पर अणु टूटते नहीं, सरखते हैं
Free electrons hold silver atoms together from all directions and facilitate sliding instead of cracking



Jumping electrons give colorful light!



Electromagnetic Spectrum



AM

FM TV

Cell Phones

Radar

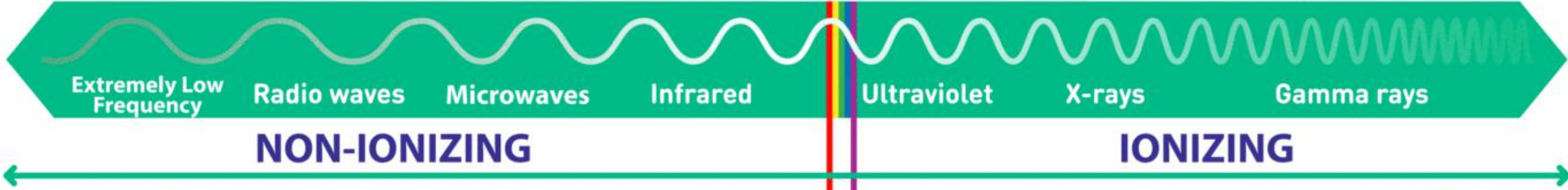
TV Remote

Light Bulb

Sun

X-ray machine

Radioactive Elements



Extremely Low Frequency

Radio waves

Microwaves

Infrared

Ultraviolet

X-rays

Gamma rays

NON-IONIZING

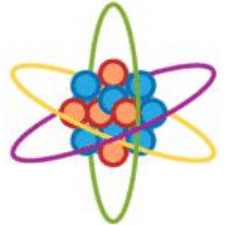
IONIZING



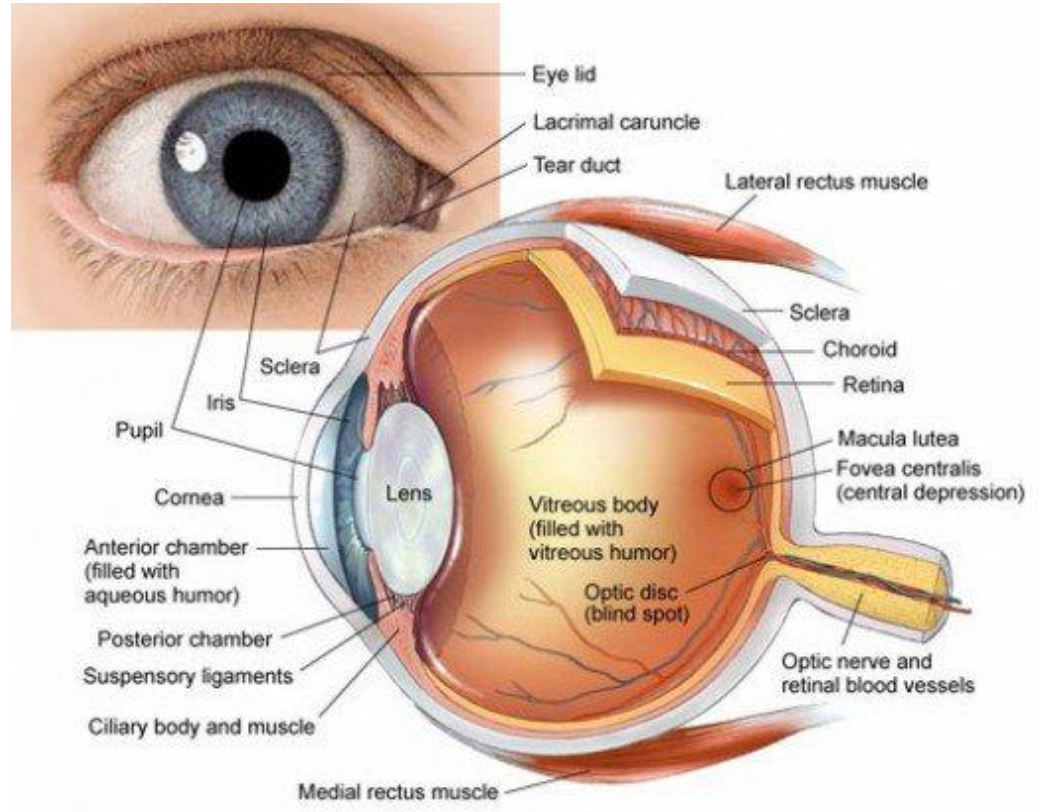
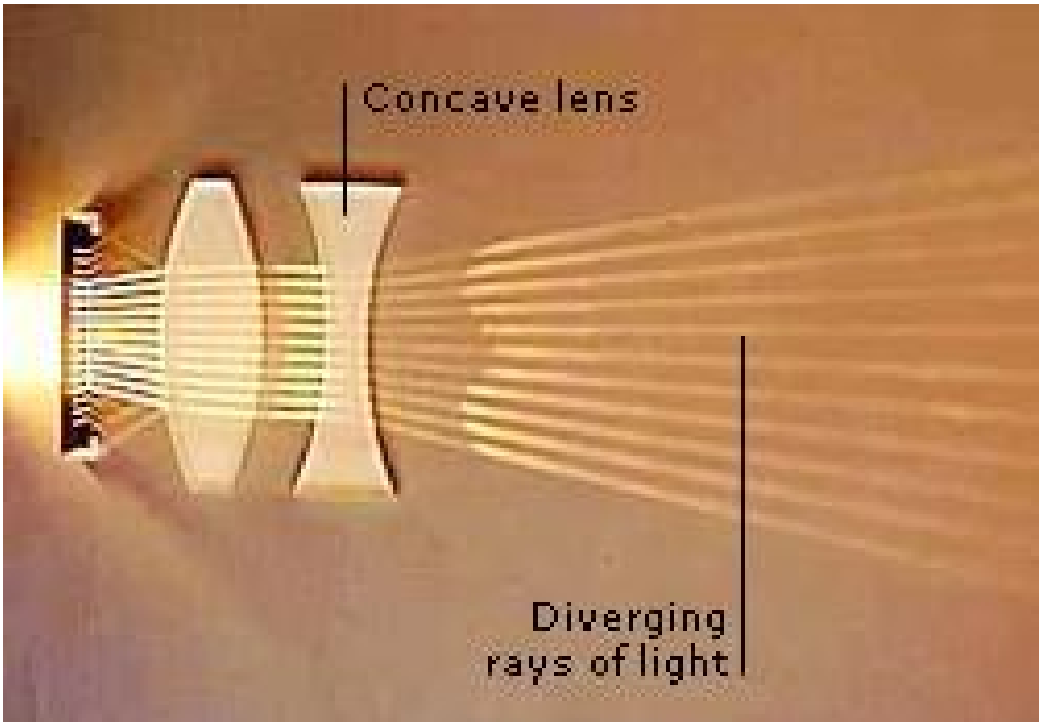
Building Size



VISIBLE SPECTRUM



Atom Size





Levels of organization

Atom

Molecule

From Chemistry
to Biology



Level 1
Cell



Level 2
Tissue



Level 3
Organ



Level 4
System

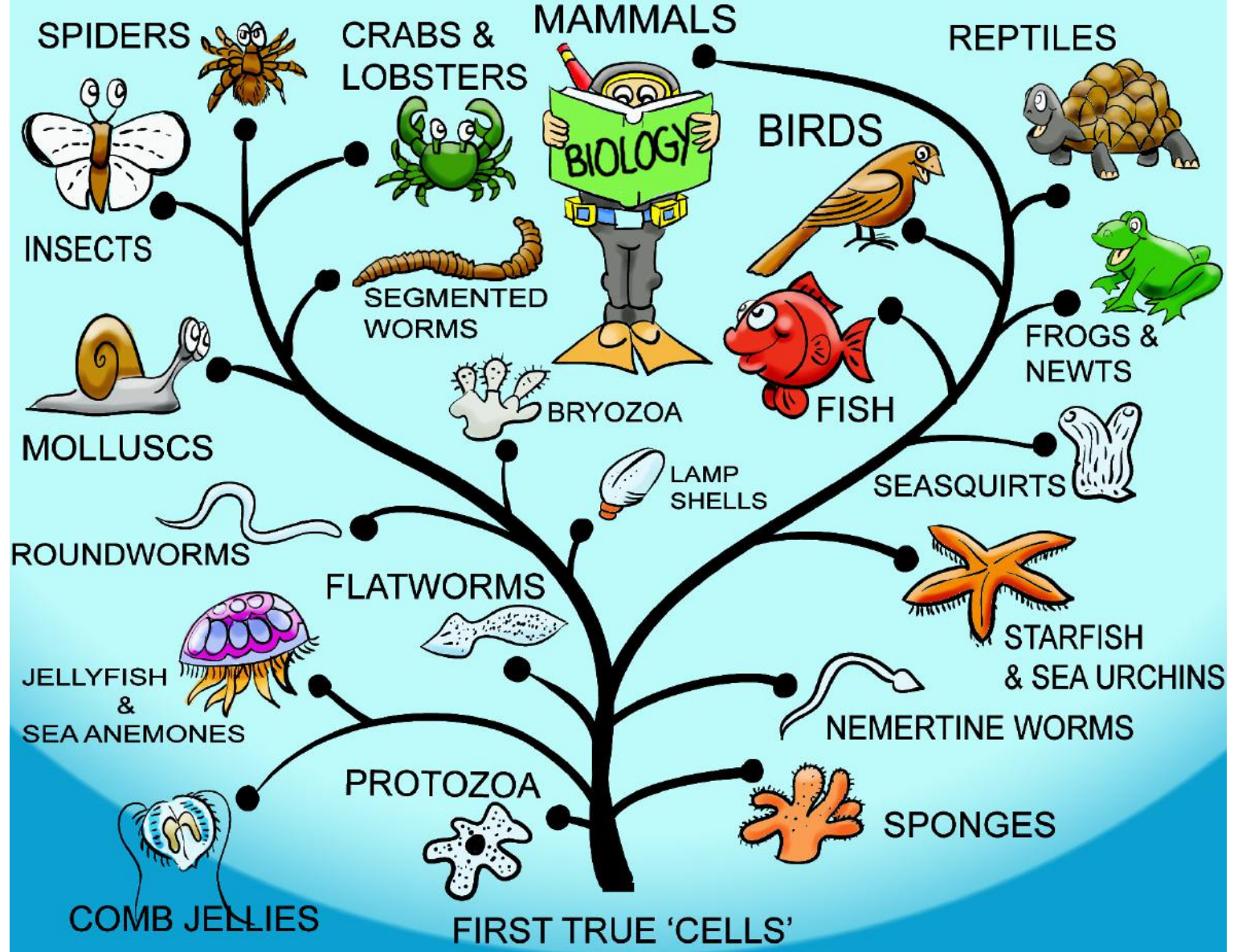


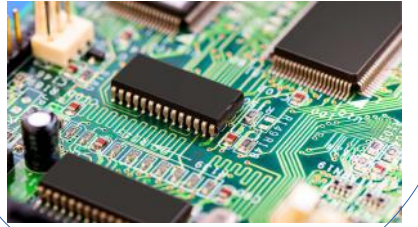
Level 5
Organism



cell → tissue → organ → organ system → organism











SEGREGATION IS A MUST



Thank you!

For more science adventures, exam help and projects:

Contact Curious Couples!

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