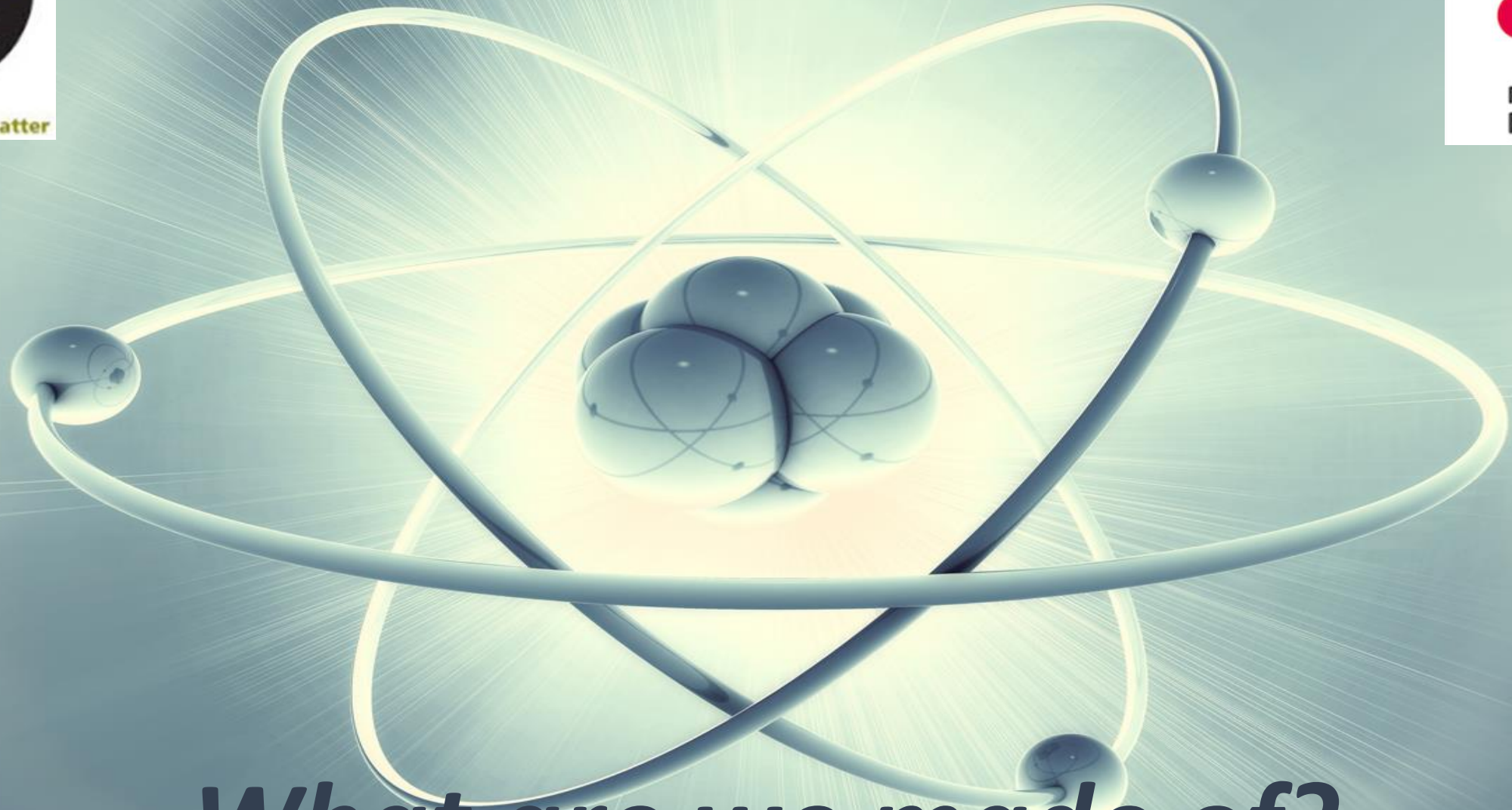
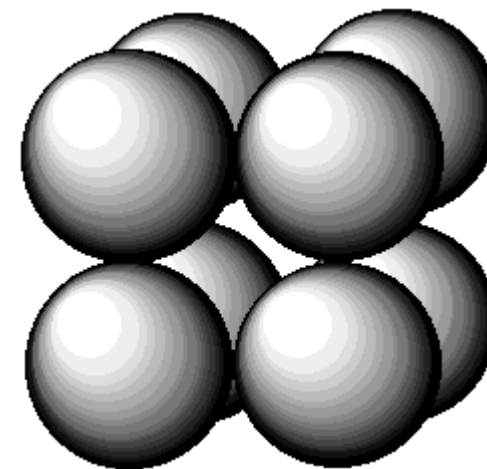


Atomic & Nuclear Physics



What are we made of?

What's inside.....?



A long, long time ago ...

ANCIENT GREEKS

“Atomos” – uncuttable / indivisible
Basic building block



FUR



STONE

A long time ago ...

ROMANS

“On the Nature of Things” Lucretius - 1st Century BC

Honey and milk, when they are rolled in the mouth, cause an agreeable sensation to the tongue.

But bitter wormwood and astringent centaury screw the mouth awry with their nauseating savour.

You may readily infer that such substances as agreeably titillate the senses are composed of smooth round atoms.

Those that seem bitter and harsh are more tightly compacted of hooked particles and accordingly tear their way to our senses and rend our bodies by their inroads.

Things that seem to us hard and stiff must be composed of deeply indented and hooked atoms and held firm by their intertangling branches. In the front rank of this class stand diamonds

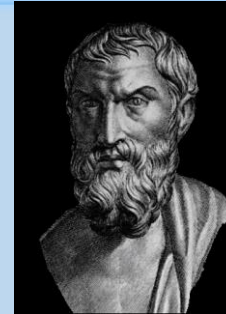
Liquids, on the other hand, must owe their fluid consistency to atoms that are smooth and round.

For poppy seed can be poured as easily as if it were water; the globules do not hold one another back, and when they are jolted they tend to roll downhill as water does.

A third class is constituted by things such as smoke, cloud and flames.

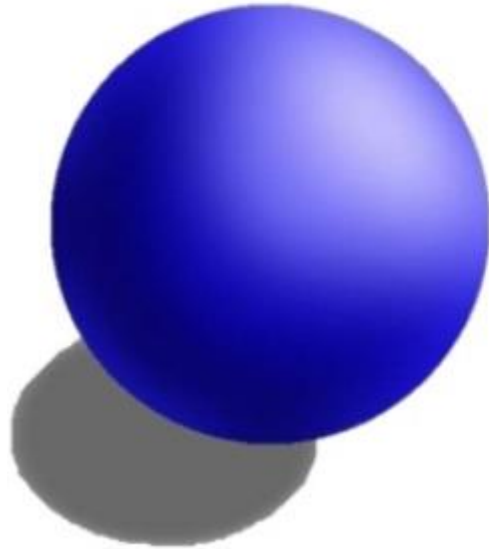
If their atoms are not all smooth and round, yet they cannot be jagged and intertangled.

They must be such as to prick the body and even to penetrate rocks but not to stick together; so you can readily grasp that substances hurtful to the senses but not solid are sharp-pointed but without projections.



Moving forward to 1803

Dalton's Model



- **Solid Sphere Model or Bowling Ball Model**
- **Proposed by John Dalton**



Practical Challenge

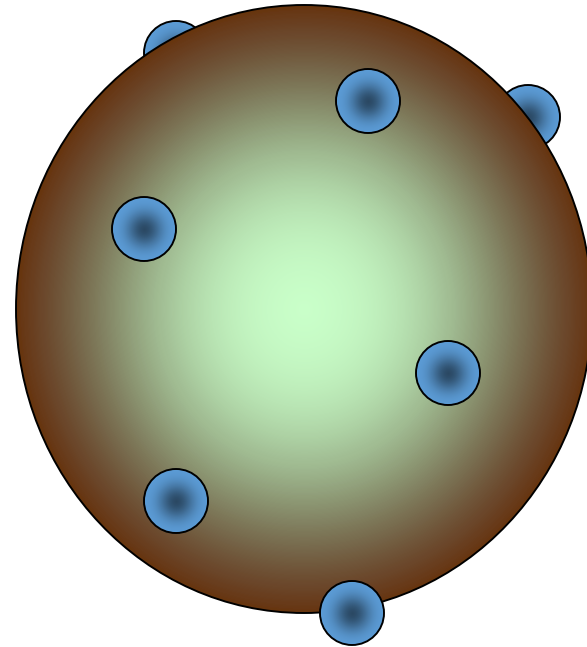
Using the kit provided take measurements to estimate the diameter of an atom

[Oil drop - estimating atomic diameter](#)

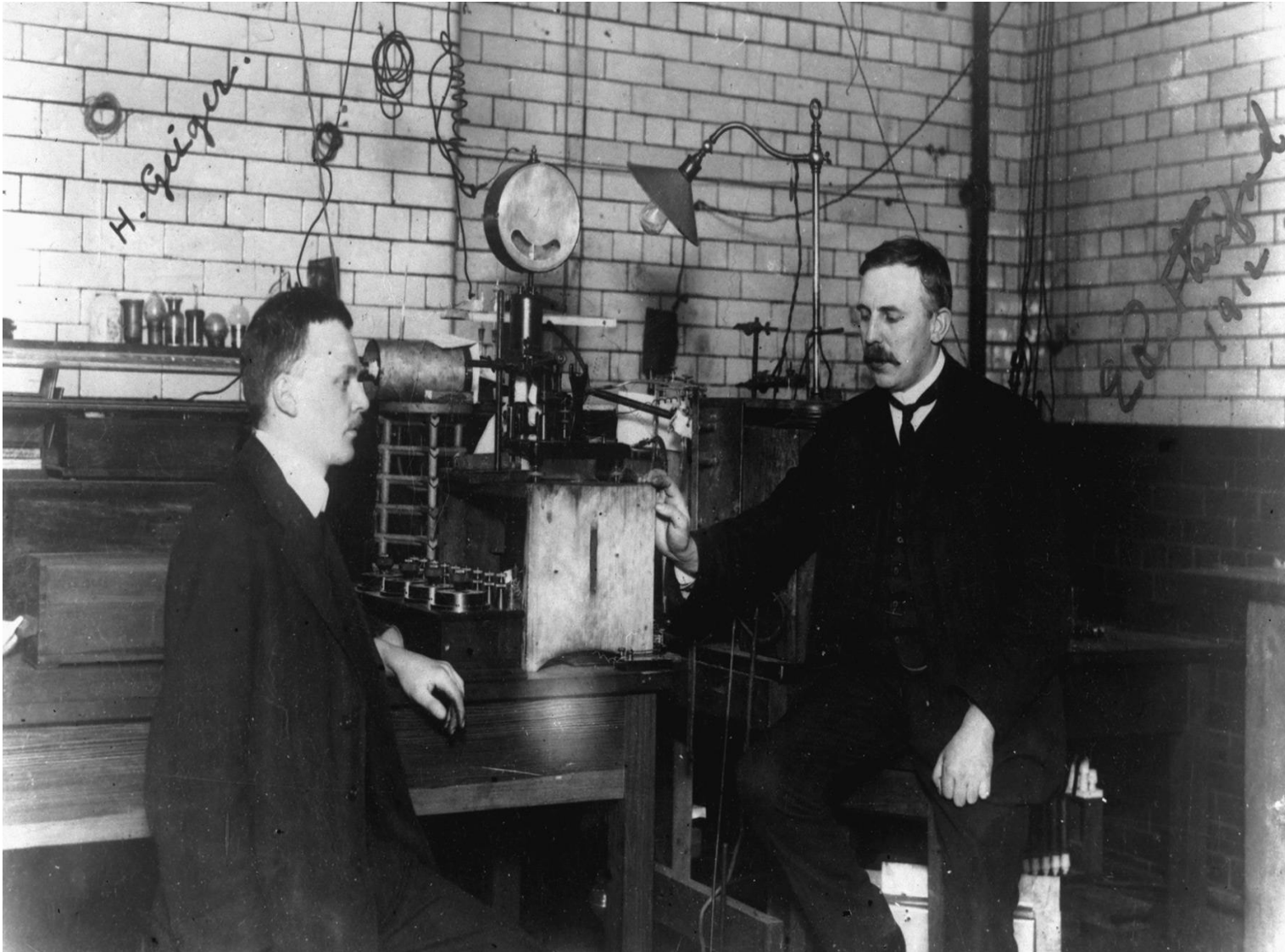
1904 Thomson's Plum Pudding Model

1. Spheres of positive charge.
2. With negative charges spread through it.

This resembled a plum-pudding, so it was called the 'Plum -pudding' model.



But new evidence from Rutherford's experiment led to a new model!

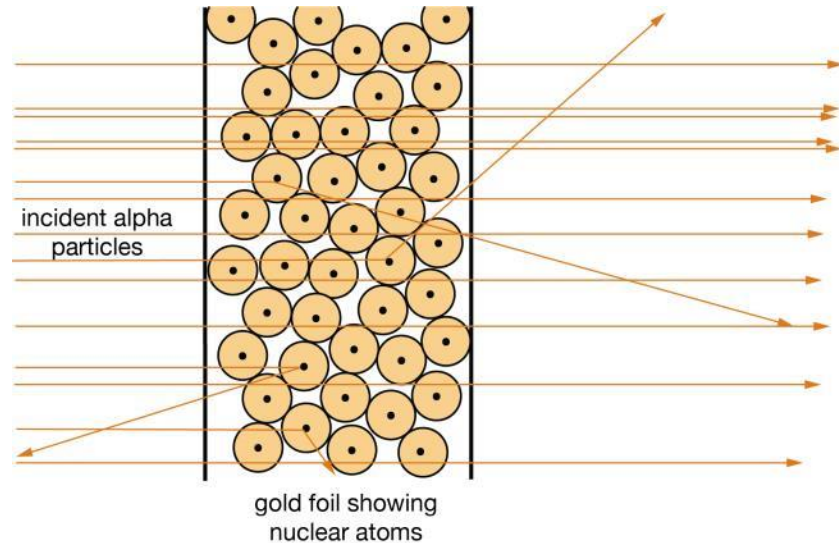
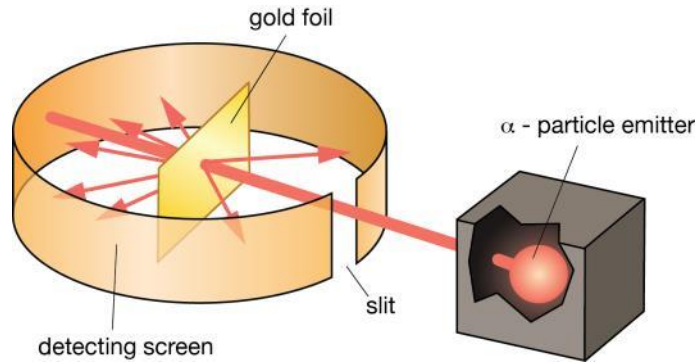


SCATTERING OF ALPHA PARTICLES BY GOLD
(Experimental test by Geiger and Marsden)

EXPERIMENTAL MEASUREMENTS		TEST OF THEORETICAL PREDICTION	
<i>Angle of Deflection*</i>	<i>Experimental Count†</i>	<i>Proportion predicted (on a special scale)</i>	<i>The test N</i>
<i>A</i>	<i>N</i>		<i>proportion predicted</i>
150°	33	1.15	29
135°	43	1.15	31
120°	52	1.79	29
105°	69.5	2.53	28
75°	211	7.25	29
60°	477	16.0	30
45°	1 435	46.6	31
30°	7 800	223	33
15°	120 570	3 445	35
10°	502 570	17 330	29
5°	8 289 000	276 300	30

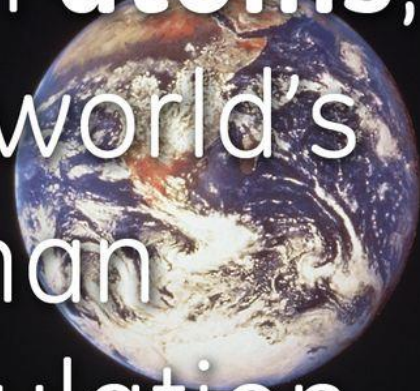
Rutherford, Geiger & Marsden, 1909-11

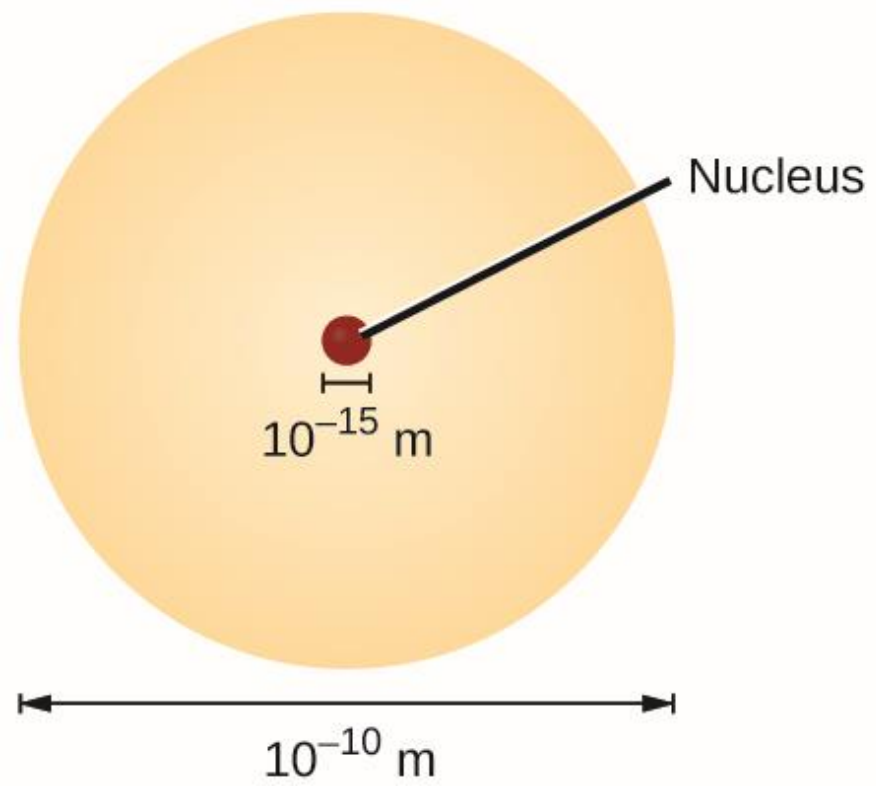
The nuclear atom



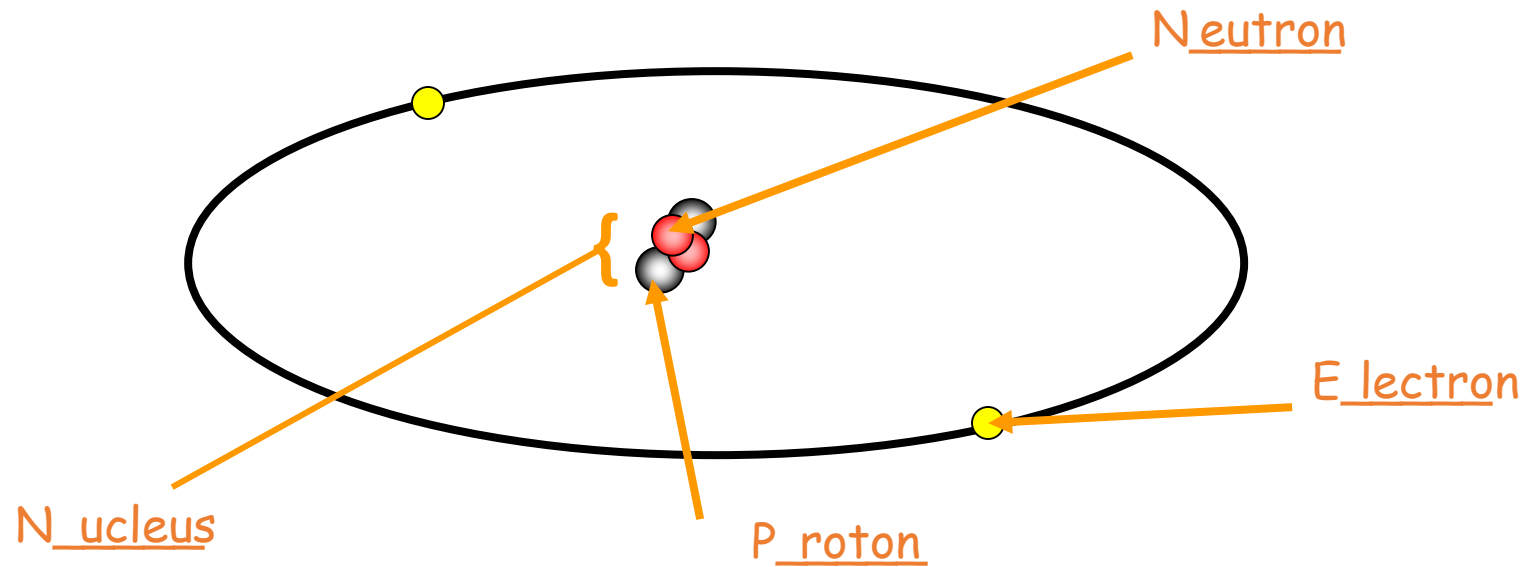
Observation	Conclusion
Most alpha particles went straight through the foil.	Atoms are mostly space.
A few were deflected through large angles.	The nucleus is very small compared to the size of the atom and it contains most of the mass and all the positive charge.
A very few were reflected straight back.	

If you removed
the empty space
from **atoms**,
the world's
human
population
would fit in the
volume of a
sugar cube.



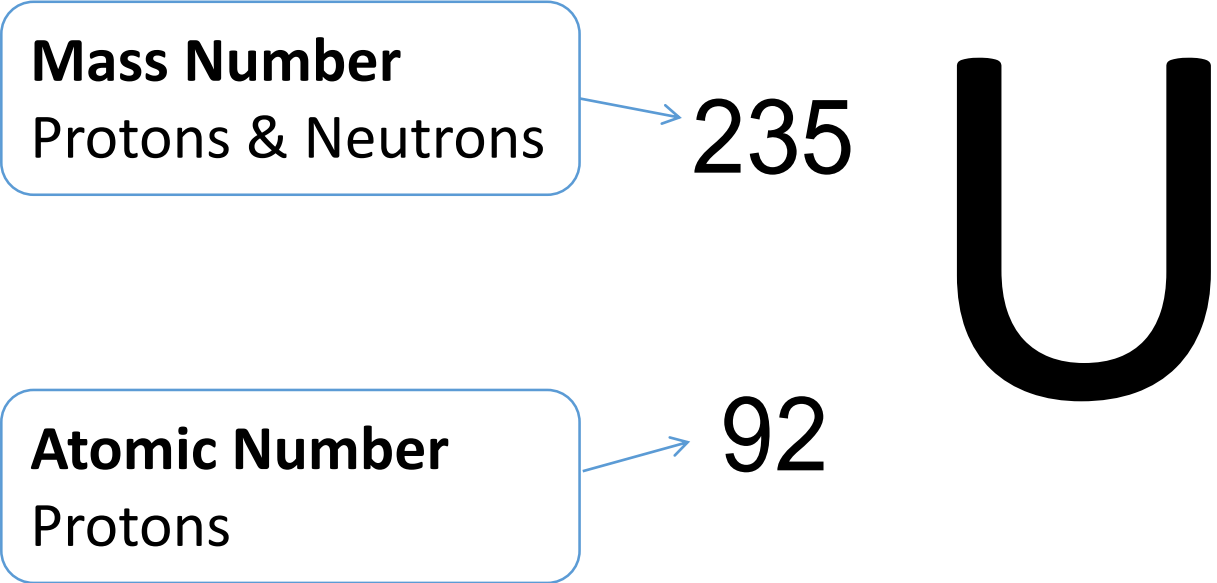


Label the helium atom and fill in the table:



Particle	Mass	Charge
Proton	1	+1
Neutron	1	none
Electron	1/1840th	-1

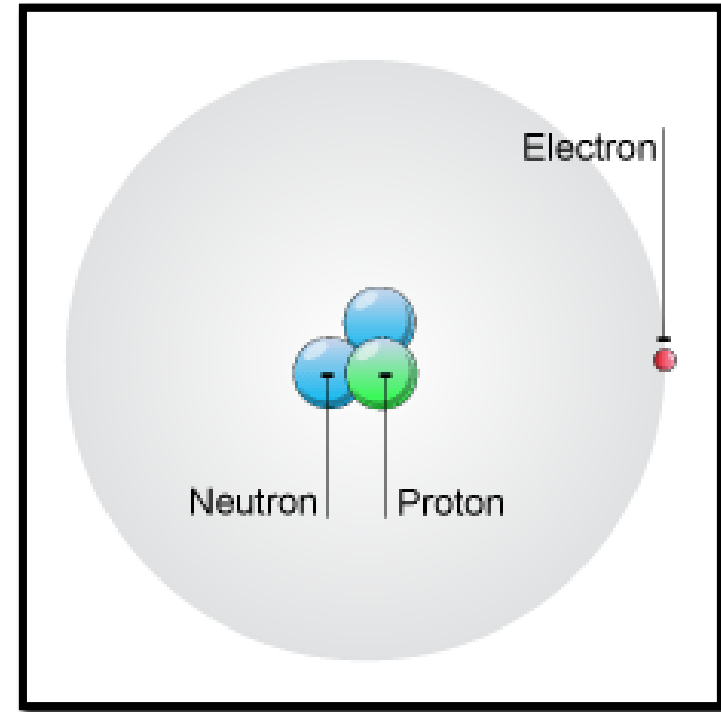
Atomic Number and Mass Number



Isotopes

Isotopes are atoms of the **same element** (same protons & electrons) with **different numbers of neutrons**.

This makes them **unstable**.



Hydrogen



Deuterium

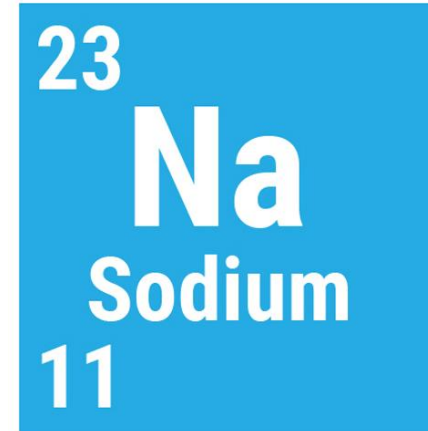
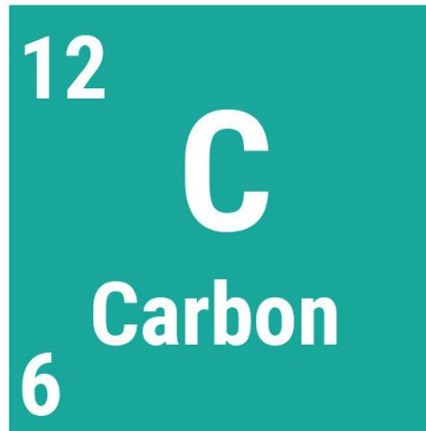


Tritium



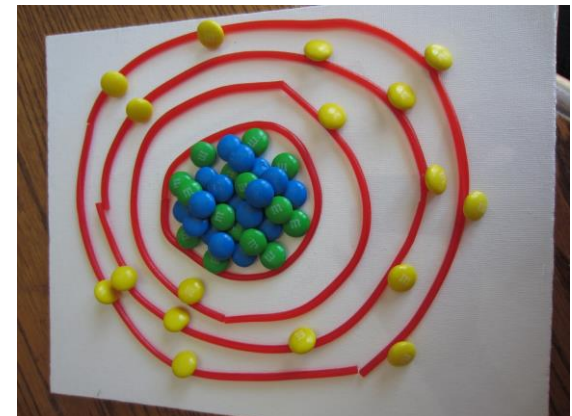
Atomic structure with sweets

Choose appropriate amounts of sweets
to make a model of the following atoms



Remember - in a neutral atom
number of protons = number of electrons

Electrons are arranged in shells – the first has 2, then 8, 8 ...



periodic table

hydrogen 1 H 1.01																	helium 2 He 4.00
lithium 3 Li 6.94	beryllium 4 Be 9.01											boron 5 B 10.81	carbon 6 C 12.01	nitrogen 7 N 14.01	oxygen 8 O 16.00	fluorine 9 F 18.99	neon 10 Ne 20.18
sodium 11 Na 22.99	magnesium 12 Mg 24.31											aluminum 13 Al 26.98	silicon 14 Si 28.09	phosphorus 15 P 30.97	sulfur 16 S 32.06	chlorine 17 Cl 35.45	argon 18 Ar 39.95
potassium 19 K 39.10	calcium 20 Ca 40.08	scandium 21 Sc 44.96	titanium 22 Ti 47.87	vanadium 23 V 50.94	chromium 24 Cr 51.99	manganese 25 Mn 54.94	iron 26 Fe 55.85	cobalt 27 Co 58.93	nickel 28 Ni 58.69	copper 29 Cu 63.55	zinc 30 Zn 65.38	gallium 31 Ga 69.72	germanium 32 Ge 72.63	arsenic 33 As 74.92	selecnium 34 Se 78.96	bromine 35 Br 79.90	krypton 36 Kr 83.80
rubidium 37 Rb 85.47	strontium 38 Sr 87.62	yttrium 39 Y 88.91	zirconium 40 Zr 91.22	niobium 41 Nb 92.91	molybdenum 42 Mo 95.94	technetium 43 Tc 98	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29
cesium 55 Cs 132.91	barium 56 Ba 137.33	lanthanum 57 La* 138.91	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.20	bismuth 83 Bi 208.98	polonium 84 Po 209	astatine 85 At 210	radon 86 Rn 222
francium 87 Fr 223	radium 88 Ra 226	actinium 89 Ac~ 227	rutherfordium 104 Rf 261	dubnium 105 Db 262	seaborgium 106 Sg 266	bohrium 107 Bh 264	hassium 108 Hs 277	meitnerium 109 Mt 268	darmstadtium 110 Ds 285	roentgenium 111 Rg 288	copernicium 112 Cn 285	unnilium 113 Uut 288	ununquadium 114 Uuq 289	ununpentium 115 Uup 288	ununhexium 116 Uuh 289	ununseptium 117 Uus 289	ununoctium 118 Uuo 289
* Lanthanides			cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm 145	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.05	lutetium 71 Lu 174.97	
~ Actinides			thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np 237	plutonium 94 Pu 244	americium 95 Am 243	curium 96 Cm 247	berkelium 97 Bk 247	californium 98 Cf 251	einsteinium 99 Es 252	fermium 100 Fm 257	mendelevium 101 Md 258	nobelium 102 No 259	lawrencium 103 Lr 260	

ITCH



Ideas for Science Projects

Key Science Themes

Periodic Table
Chemical Reactions
Radiation and the Human Body
Radioactive Materials
Mining
Energy Resources
Particle Accelerators

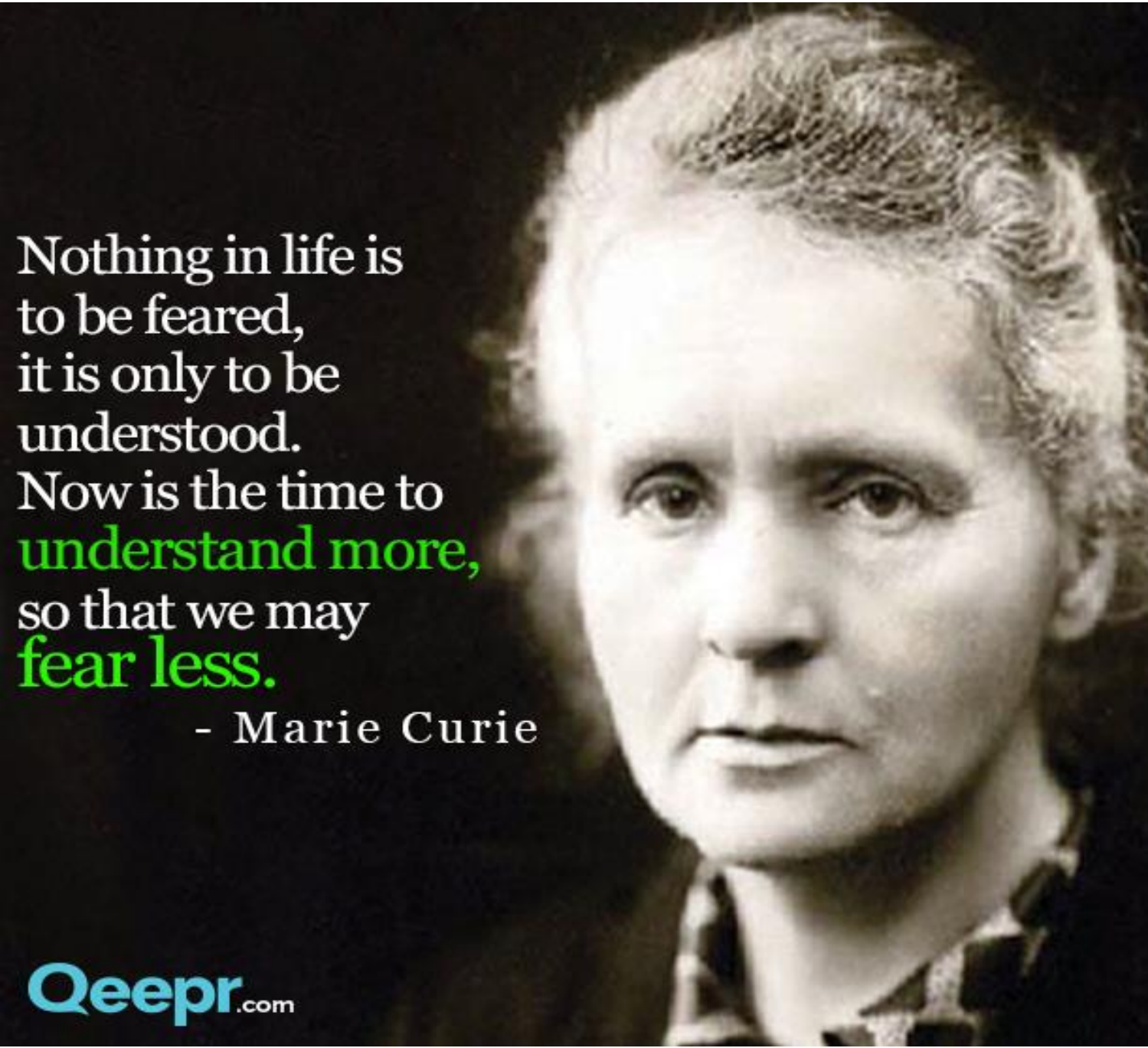
Other Curriculum ideas

Ideas for English and History Projects



Ideas for Art/Creative Projects

- [Atom clip](#)



Nothing in life is
to be feared,
it is only to be
understood.
Now is the time to
understand more,
so that we may
fear less.

- Marie Curie