

The Periodic Table



1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.998403	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973762	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.95591	22 Ti 47.887	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.9332	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc [98]	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.71	51 Sb 121.76	52 Te 127.6	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba [†] 137.327	57 La [‡] 138.905	58 Ce 140.12	59 Pr 140.90765	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04		
87 Fr [223]	88 Ra ^{†*} [226]	89 Ac ^{**} [227]	90 Th 232.0381	91 Pa 231.03688	92 U 238.02891	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]		

The Periodic Table – long form



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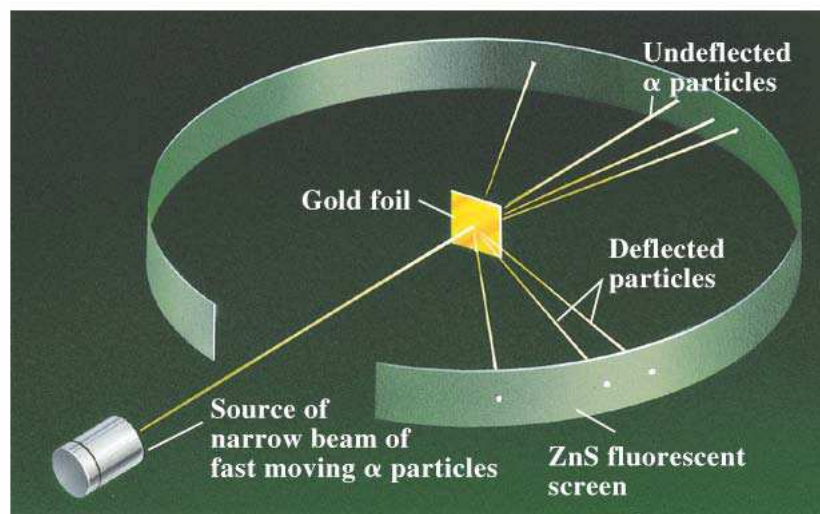
- Hydrogen is unique!
- Alkaline metals
- Inner and outer transition metals
- Semi- and non-metals

A quick summary about atoms:



- Atoms were used by John Dalton (1804) to explain the Law of Definite Proportions: if elements combine only in definite proportions by weight, the simplest explanation is that whole numbers of atoms combine into specific molecules. Atoms were considered to be indivisible, the smallest possible pieces of matter.
- Atoms were not considered real by many chemists for at least 50 years, but...
- In 1899, J.J. Thomson discovered the electron ([Nobel Prize, 1906](#)) and proposed the “plum pudding model” of the atom, in which the atom has simpler structural components.
- In 1905 Albert Einstein proved that atoms must exist (he showed that Brownian Motion would look different if there weren't really atoms and molecules shoving particles around). This later won the [Nobel Prize for Jean Perrin in 1926](#).

Ernest Rutherford's Gold-Foil Experiment (1911)



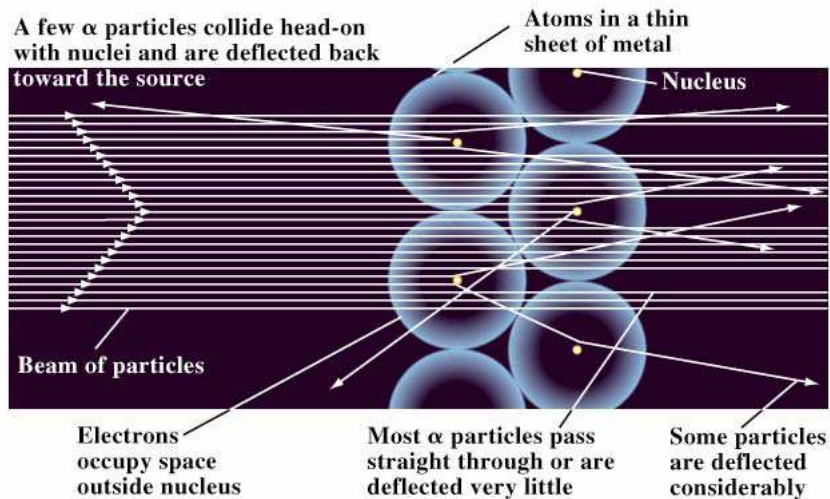
Ernest Rutherford's Gold-Foil Experiment (1911)



“It was almost like firing a 15-inch shell at some tissue paper and having it bounce back.”

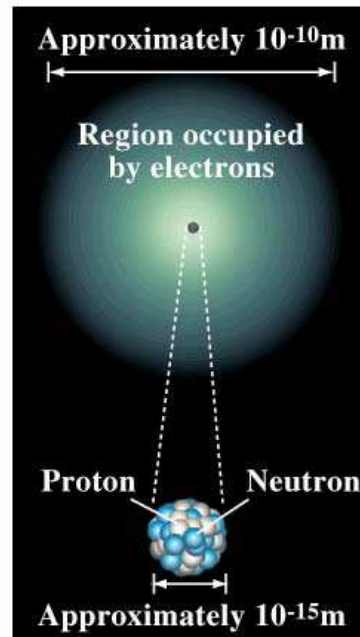
— Ernest Rutherford

Ernest Rutherford discovers the atomic nucleus (1911)



Relative sizes of the atomic nucleus and an atom

- Is the atom mostly empty space!??



Atomic structure: protons and neutrons



- Protons, neutrons & isotopes
- Isotopes and (average) atomic mass
 - Chlorine has two major isotopes, in a roughly 3:1 ratio: ^{35}Cl and ^{37}Cl
 - Bromine has two major isotopes, in a roughly 1:1 ratio: what are they?
 - Tin has 9 isotopes!
 - ^{112}Sn , ^{114}Sn , ^{115}Sn , ^{116}Sn , ^{117}Sn , ^{118}Sn ,
 ^{119}Sn , ^{120}Sn , ^{122}Sn