

Development of the Periodic Table

History of the Periodic Table

Early Attempts to Classify the Elements

➤ Element arrangement by Atomic mass:

Before the discovery of subatomic particles (protons, neutrons and electrons), scientists attempted to arrange the elements based on their atomic mass. By focusing mainly on the atomic mass of the element, the chemical properties of some elements were overlooked. This led to inconsistencies, as some elements were placed in the wrong groups.

➤ Earlier Periodic models :

Earlier models of the periodic table had gaps. Scientists sometimes placed elements in the wrong spots when trying to fill these gaps. As a result, the earlier models of the periodic table were very incomplete.

Mendeleev's periodic table

- In 1869, a Russian chemist called Dmitri Mendeleev created the first modern periodic table.
- Mendeleev arranged the elements in order of increasing atomic mass. However, he also took into account the chemical and physical properties of the elements and their compounds.
- Mendeleev identified patterns with chemically similar elements, as they naturally fell into the same columns. This made it easier to predict the properties of new elements.
- He also changed the order of elements when possible to fit the pattern. This made it much easier to find elements with similar properties.
- At that time, protons had not been discovered, so Mendeleev made predictions based on the properties of the known elements.

C1: Atomic Structure

And periodic table

Gaps in Periodic Table

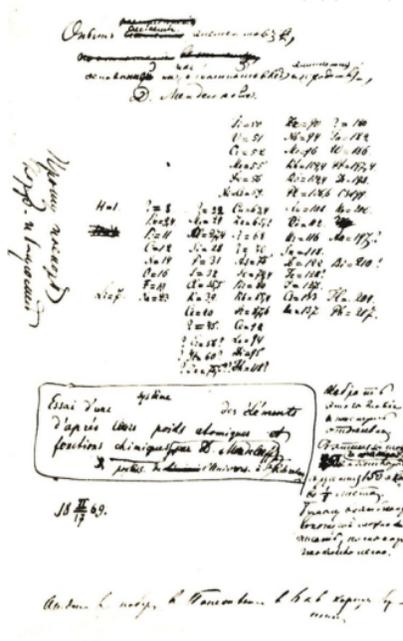
- Mendeleev left gaps for the elements that had not yet been discovered at that time. He realized that he could predict the properties of the undiscovered elements by looking at trends and the properties of elements near the gap.
 - For example, he predicted the properties of 'eka-silicon', which is now known as germanium.
- Mendeleev's approach proved to be successful as the discovery of these missing elements confirmed his predictions.

Mendeleev's Periodic Table

sciencenotes.org

This is Dmitri Mendeleev's original 1869 periodic table.

Title translates: "An experiment on a system of elements based on their atomic weights and chemical similarities."



ОПЫТЪ СИСТЕМЫ ЭЛЕМЕНТОВЪ,
ОСНОВАННОЙ НА ИХЪ АТОМНОМЪ ВѢСѢ И ХИМИЧЕСКОМЪ СХОДСТВѢ.

H=1	Be=9,4	Mg=24	Zn=65,2	Cd=112
B=11	Al=27,3	?=68	Ur=116	Au=197?
C=12	Si=28	?=70	Sn=118	
N=14	P=31	As=75	Sb=122	Bi=210?
O=16	S=32	Se=79,4	Te=128?	
F=19	Cl=35,5	Br=80	I=127	
Li=7	Na=23	K=39	Rb=85,4	Cs=133
		Ca=40	Sr=87,6	Ba=137
			?=45	Ce=92
			?Er=56	La=94
			?Yt=60	Di=95
			?In=75,6	Th=118?

Д. Менделѣевъ

Swapping elements

- Dmitri Mendeleev was flexible when arranging the elements, as he did not always strictly follow the rule of increasing relative atomic mass.
- For example, even though **tellurium (Te)** has a higher relative atomic mass than **iodine (I)**, Mendeleev placed iodine after tellurium. This is because iodine's properties aligned more

C1: Atomic Structure

And periodic table

ASM Tuition Academy

closely with those of its group elements (chlorine, fluorine, and bromine). Tellurium was placed after sulfur, oxygen, and selenium, which it closely resembled.

Rows	Groups							
	I	II	III	IV	V	VI	VII	VIII
1	H	-	-	-	-	-	-	-
2	Li	Be	B	C	N	O	F	-
3	Na	Mg	Al	Si	P	S	Cl	-
4	K	Ca	?	Ti	V	Cr	Mn	Fe, Co, Ni, Cu
5	(Cu)	Zn	?	?	As	So	Br	-
6	Rb	Sr	Yt	Zr	Nb	Mo	?	Ru, Rh, Pd, Ag

The Modern Periodic Table

- Structure of periodic Table same as Mendeleev's periodic table:

The periodic table organizes elements into columns and rows. It generally keeps the same structure as Mendeleev's original design, but it is ordered by atomic number rather than relative atomic mass.

- Arrangement of Element by Atomic number:

The arrangement of elements, from top left to bottom right, is based on their increasing atomic number. For example, hydrogen is positioned first with an atomic number of 1, followed by helium with an atomic number of 2. The vertical columns, known as groups, contain elements that have similar chemical properties.

Periodic Table of the Elements

The periodic table is organized into 7 periods (rows) and 18 groups (columns). Each element cell contains its atomic number, symbol, name, and atomic weight. A callout box for Oxygen (O) highlights its atomic number (8), symbol (O), name (Oxygen), and atomic weight (15.999).

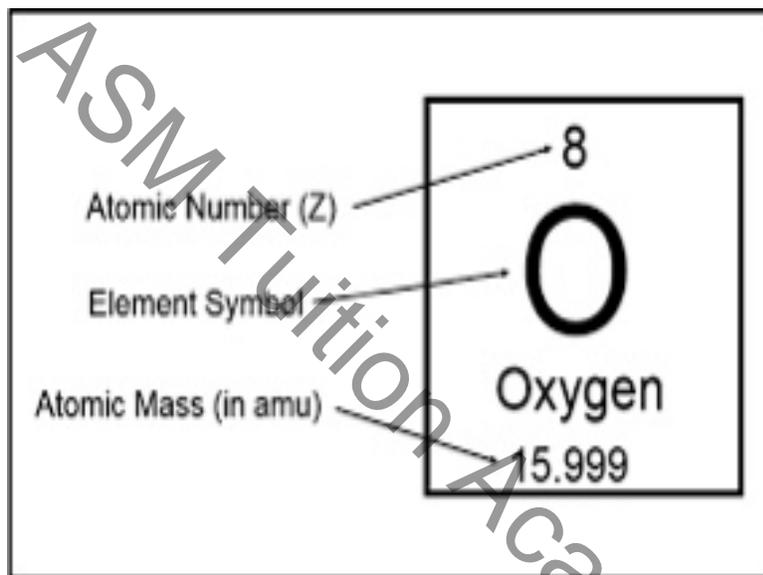
Group ↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H Hydrogen																	2 He Helium
2	3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
3	11 Na Sodium	12 Mg Magnesium											13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur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

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

Alkali Metals	Alkaline Earth Metals	Lanthanide	Actinide	Transition Metals
Post-Transition Metals	Metalloid	Polyatomic nonmetal	Diatomic nonmetal	
Noble gas	Unknown Chemical Properties			

► **Representations of Elements in Periodic Table:**

Each cell (box) in the periodic table displays the element's symbol, atomic number and relative atomic mass. For example, Oxygen has an atomic number of 8 and a relative atomic mass of about 15.999.



► **Categorising Elements**

Elements in the periodic table can be categorised in two main ways:

- I. **Groups**
- II. **Periods**

I- Groups

- Elements with similar chemical behaviours are organised within the same group (vertical columns).

C1: Atomic Structure

And periodic table

ASM Tuition Academy

- ▶ Some groups have specific names; for example, group 7, containing elements like fluorine and chlorine, is known as the halogens.

II- Periods

- ▶ The seven horizontal rows are called periods, and this organization is based on the elements' electronic configurations, which indicates the number of electron shells occupied by electrons.
- ▶ In other words, the organization is based on the elements' atomic numbers (the number of protons they have).
- ▶ For example, iron (Fe), cobalt (Co) and nickel (Ni) have atomic numbers of 26, 27 and 28 respectively, and are placed in the same period because they have electrons in four different energy levels or electron shells.

C1: Atomic Structure And periodic table

ASM Tuition Academy

PERIODS

VERSUS

GROUPS

Visit www.PEDIAA.com

PERIODS	GROUPS
Periods are horizontal rows in the periodic table	Groups are vertical columns in the periodic table
Elements within a period have the same highest principal energy level	Elements within a group share the same number of valence electrons
Typically have a variable number of elements, with the first period having only 2 elements and subsequent periods having up to 32 elements	Generally have a more consistent number of elements (usually 8 or 18)
Has 7 periods	Has 18 groups
Properties of elements gradually change when moving from left to right across a period	Elements within the same group have similar chemical and physical properties