

Classification of Elements and Periodicity in Properties

one table, and the four trends that explain the rest of chemistry

How the table was arrived at

- **Dobereiner's triads** : in a set of three similar elements the middle atomic mass is close to the mean of the other two, which worked for a handful of sets and no further
- **Newlands' law of octaves** : arranged by increasing mass, every eighth element repeats the properties of the first. It held only up to calcium
- **Mendeleev** : arranged by atomic MASS into groups and periods, left gaps for undiscovered elements and predicted their properties, which is what made the table convincing when eka aluminium turned up as gallium
- his anomalies (argon before potassium, tellurium before iodine) were the clue that mass was the wrong ordering variable

The modern periodic law, and what changed

- **Moseley**, from X ray spectra, showed the fundamental property is the **atomic number**, not the mass
- the modern periodic law : the properties of elements are a periodic function of their atomic numbers
- that one swap fixes every anomaly at once, because Ar (18) genuinely precedes K (19) and Te (52) precedes I (53)
- periodicity itself has a cause: the outer electronic configuration repeats, and elements with the same outer configuration behave alike

The shape of the table

- 7 periods and 18 groups ; the period number is the highest principal quantum number occupied, so period 3 means the outermost electrons are in $n = 3$
- period lengths run 2, 8, 8, 18, 18, 32, 32, and each length is simply how many electrons the subshells filling in that period can hold
- **s block** groups 1 and 2, **p block** groups 13 to 18, **d block** groups 3 to 12, **f block** the two rows set below
- the **lanthanoids and actinoids** are printed separately only to keep the table on a page: they belong inside periods 6 and 7



the 18 columns and 7 rows every element is placed into, with group 1 banded down the left

The four blocks, and what each one is like *

Block	Filling	General configuration	Character
s	ns	ns^{1-2}	soft reactive metals, strong reducing agents
p	np	$ns^2 np^{1-6}$	metals, non metals and every metalloid
d	$(n-1)d$	$(n-1)d^{1-10} ns^{0-2}$	hard metals, variable oxidation states, coloured ions
f	$(n-2)f$	$(n-2)f^{1-14} (n-1)d^{0-1} ns^2$	inner transition, very similar to one another

helium sits in group 18 with the noble gases on behaviour, not in group 2 where its $1s^2$ configuration would put it