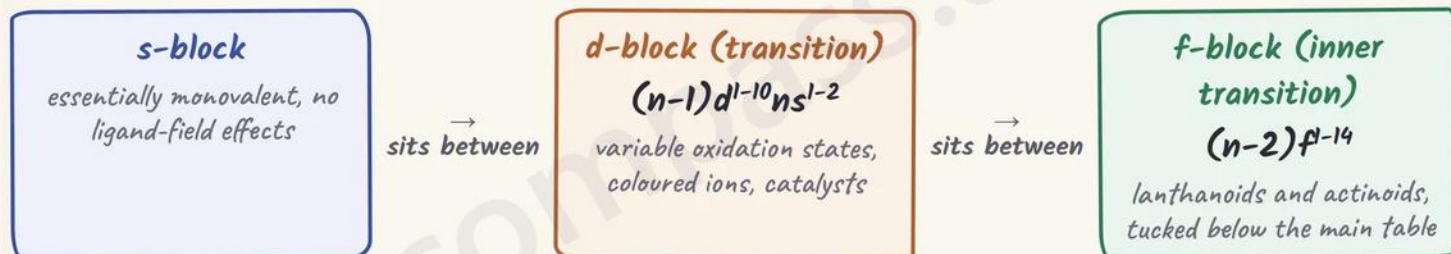


Transition and Inner Transition Elements

the d-block's variable valency and colour, the f-block's contraction, and the blast furnace that turns ore into iron



and back: IUPAC defines a transition element as one whose ATOM or CATION has an incomplete d-subshell, which is exactly why Zn, Cd, Hg are excluded but Cu ($3d^9$ as Cu^{2+}) is included

Electronic Configuration and the Cr/Cu Exceptions

- 3d series: Sc(21) to Zn(30); general configuration $[Ar]3d^{1-10}4s^2$
- Zn's 3d is FULLY filled in both the atom and Zn^{2+} ($3d^{10}$)
- so Zn is excluded from the transition series
- Cr is $[Ar]3d^54s^1$, not the expected $3d^44s^2$
- Cu is $[Ar]3d^{10}4s^1$, not the expected $3d^94s^2$
- both swaps buy stability from a HALF- or FULLY-FILLED d subshell
- on ionisation, 4s empties BEFORE 3d
- regardless of the ground-state order they were filled in
- oxidation states shown track unpaired d electrons
- Sc (1 unpaired) shows just one: +3
- Mn (5 unpaired, mid-series) shows the most: +2 to +7

Q. Why is copper classed as a transition element but zinc is not, even though both end their atomic configuration in $3d^{10}$?

- IUPAC's test is about the d-subshell of the ATOM OR ITS IONS, not just the neutral atom
- Cu atom is $3d^{10}4s^1$ (filled d)
- but its common ion Cu^{2+} is $3d^9$: an INCOMPLETE d-subshell
- Zn atom is $3d^{10}4s^2$, and its only common ion Zn^{2+} is also $3d^{10}$, always complete

Answer

Cu qualifies through Cu^{2+} ($3d^9$); Zn never has an incomplete d-subshell in any common oxidation state