One drop: blood red

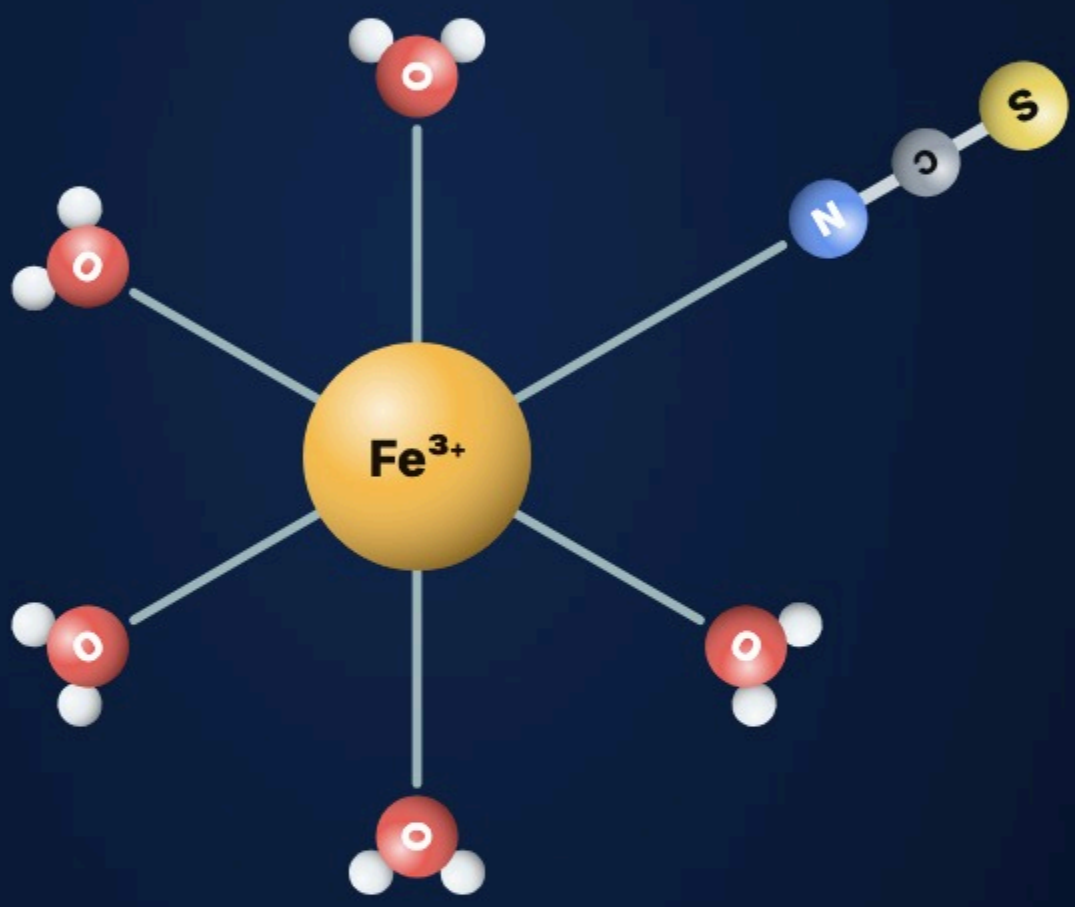


$Fe^{3+}(aq)$ + KSCN

$Fe^{3+}(aq)$ is pale yellow. One drop of KSCN → blood-red $[Fe(SCN)(H_2O)_5]^{2+}$.

A new species has formed: a **complex**.

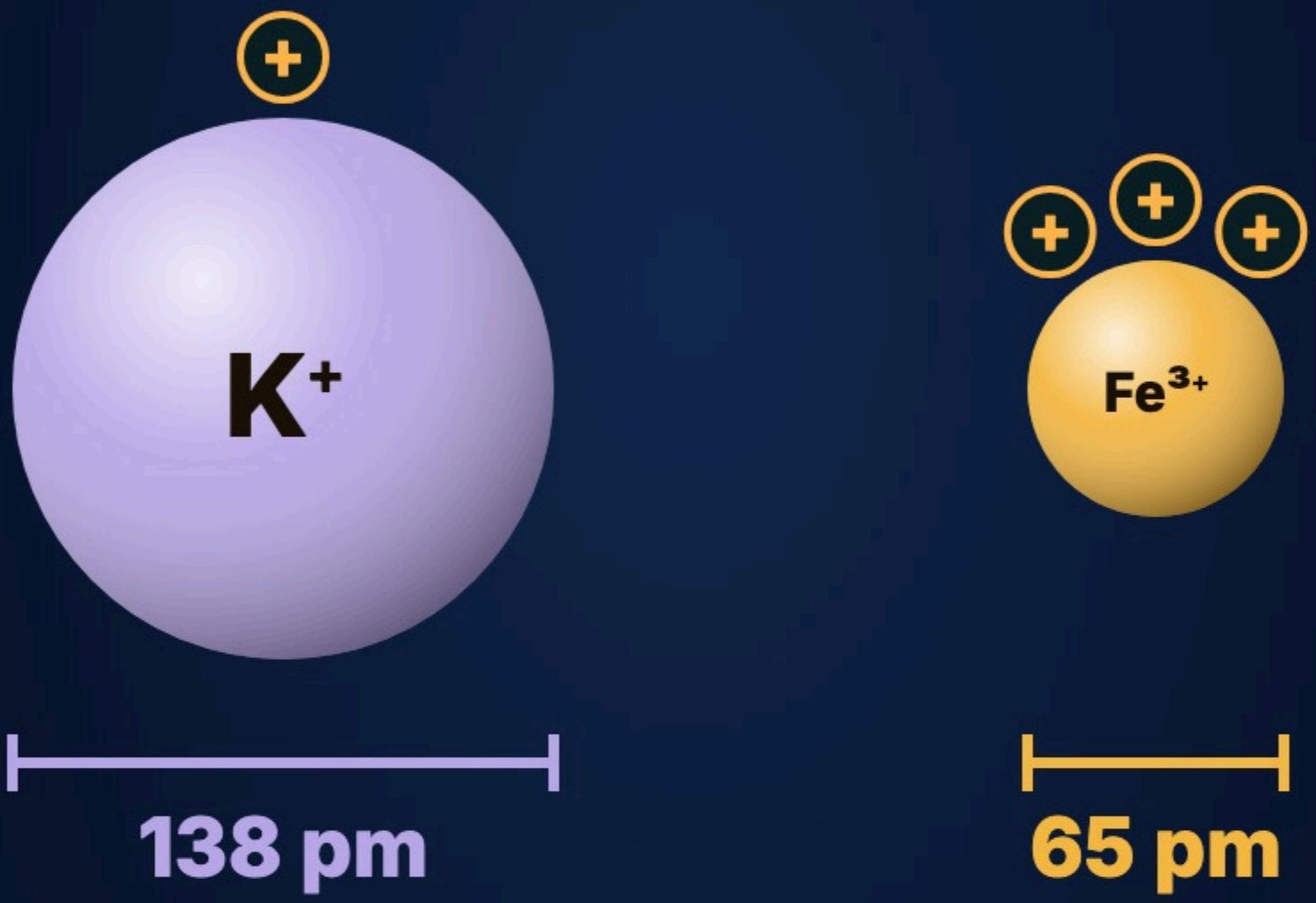
What is a complex?



A **central metal ion** bonded to a number of anions or neutral molecules: the **ligands**.

NCERT examples: $[Fe(CN)_6]^{3-}$, $[Fe(CN)_6]^{4-}$, $[Cu(NH_3)_4]^{2+}$, $[PtCl_4]^{2-}$.

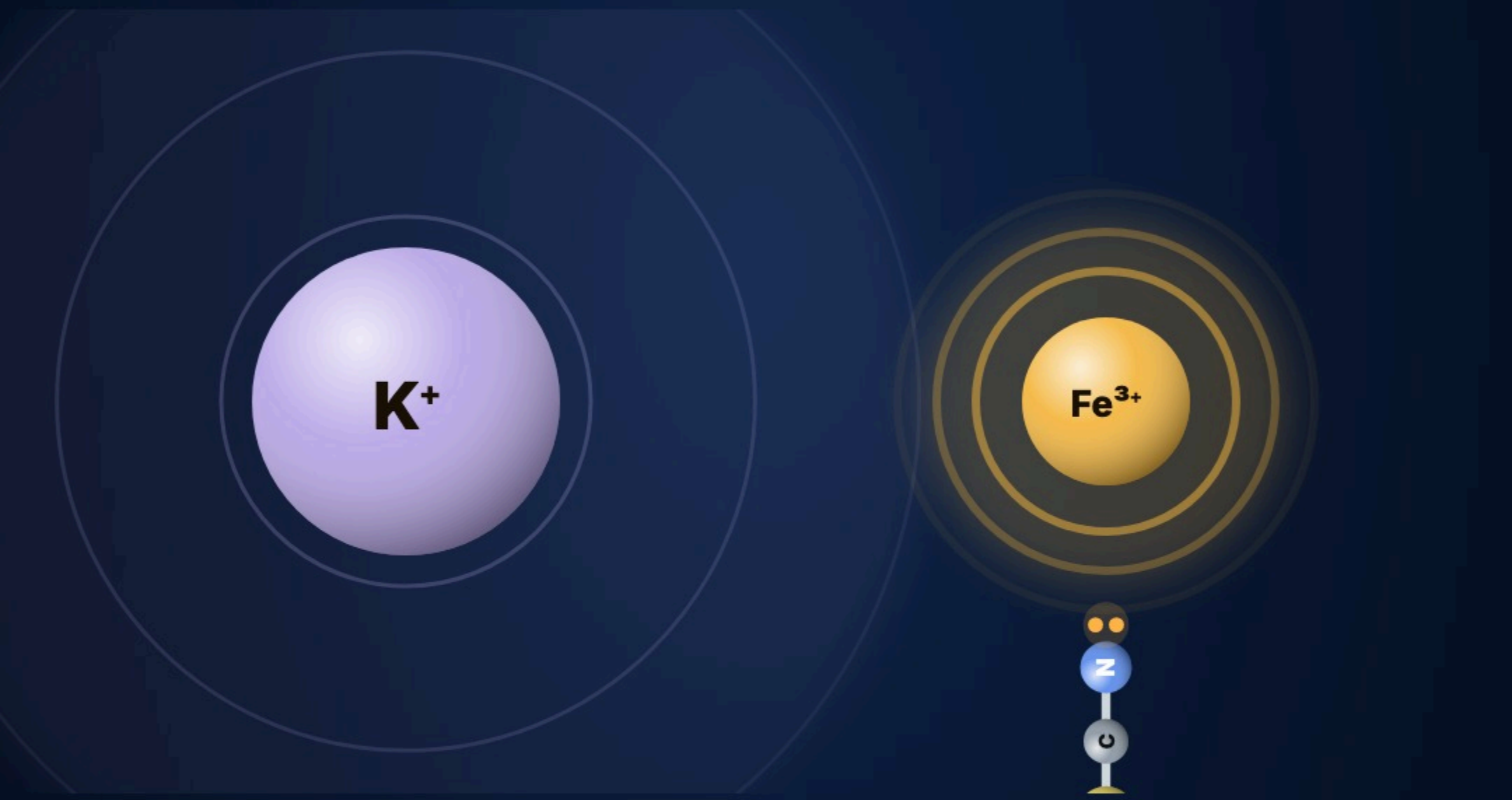
Same drop, but K^+ grabs nothing



K^+: big (138 pm), charge +1. Fe^{3+}: small (65 pm), charge +3.

Radii drawn to scale.

Small + highly charged = strong grip



Three times the charge in less than half the size: charge ÷ radius is about **6×** that of K^+.

So Fe^{3+} pulls hard on a ligand's **lone pair**.

The coordinate bond



ligand → metal: both electrons from the ligand

The ligand brings a **lone pair** (2 electrons).

The ion has **d orbitals available for bonding** and accepts the pair: a **coordinate bond**.

Why transition metals? (NCERT 4.3.11)



+3

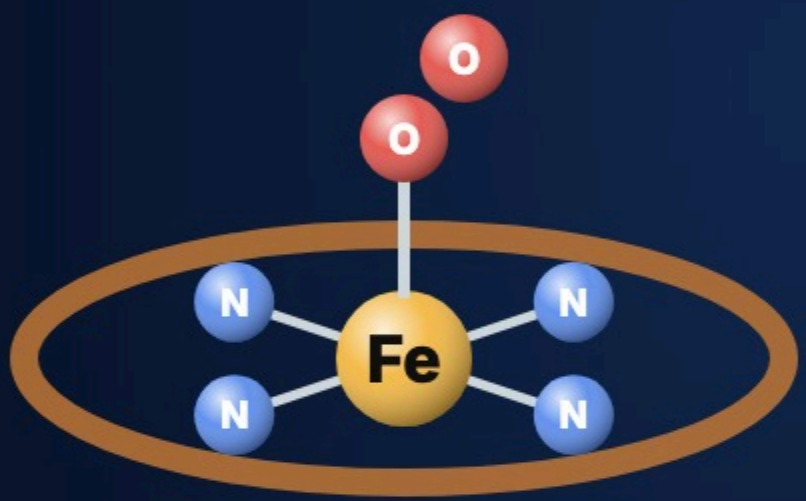


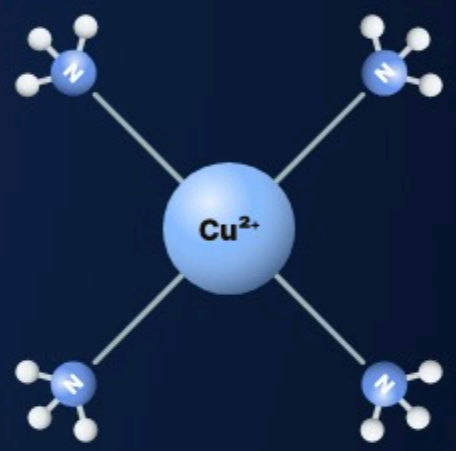
small size high charge d orbitals

Comparatively **smaller ions**, **high ionic charge**, and **d orbitals available** for bond formation.

So they form far more complexes than ions like K^+ or Na^+.

Complexes in life





haem: Fe holds O_2 $[Cu(NH_3)_4]^{2+}$ deep blue

Haemoglobin carries O_2 on iron. **Cisplatin**, a Pt complex, is an anticancer drug.

SCN^- turning a solution blood red is the lab test for Fe^{3+}.

Remember

small size + high charge
+ d orbitals for bonding
= many complexes

coordinate bond: both electrons from the ligand

Your turn: why does Zn^{2+} form complexes easily but K^{+} hardly does?