In-Class Activity

- what type of ligand is O^{2-}?
- Draw a diagram showing metal dAOs and O^{2-} FOs interacting (ie the MOs).
  - O has 4p valence electrons and can interact with filled dAOs on a TM, because of the electronegativity of O the MOs formed are dominated by the O contribution, and the electrons can be formally considered to reside on the O ligand (O-> O^{2-}) while M is oxidised (M->M^{2+}), **Figure 1**.
  - It is also possible for a TM with no d electrons to interact with O^{2-} which has 6p valence electrons, **Figure 1**. We can also think of these two options as resonance structures both contributing to the real bonding situation.

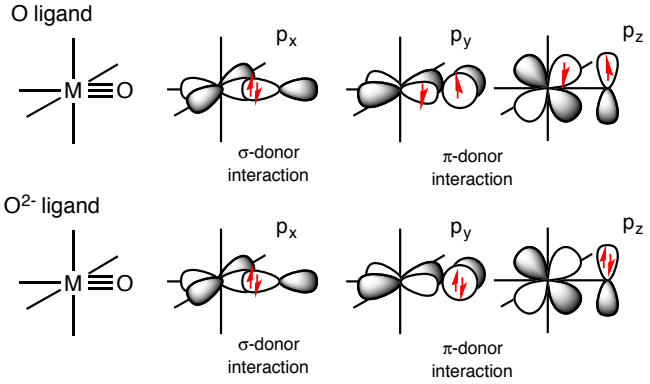

Figure 1 Diagram showing the orbital interactions for O and O^{2-}

  - O^{2-} is a strong π-donor ligand because the pAOs can donate into empty dAOs. O^{2-} is a weak σ-donor because the high electronegativity of oxygen means that the bonding σ-MO is strongly dominated by the s-FO contribution. O^{2-} cannot be a π-acceptor because there are no π* FOs in this ligand
- If a complex has only σ-donor ligands how is Δ_{oct} increased?
  - add a ligand which has higher energy FOs that will form a strong antibonding interaction with the metal dAOs and hence strongly raise the antibonding "e_g" MOs increasing Δ_{oct}, **Figure 2a**

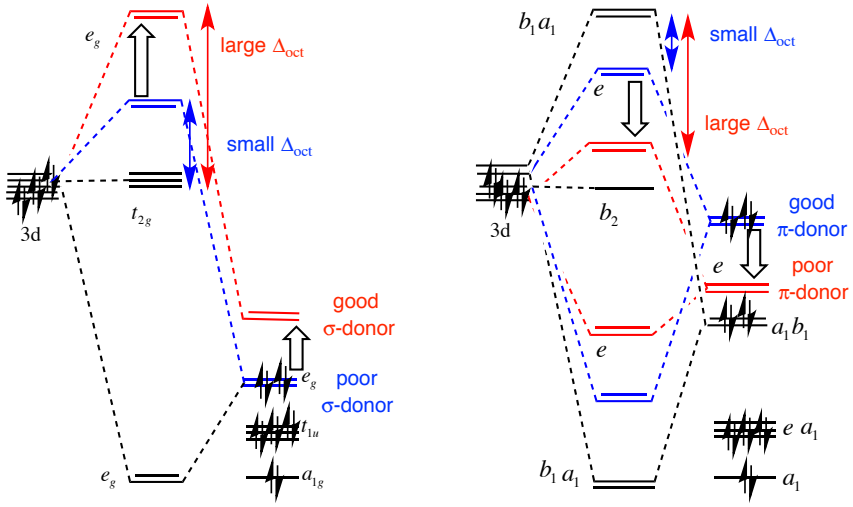

Figure 2 Diagram showing changes to Δ_{oct}

- If a complex contains a π-donor ligand how is Δ_{oct} maximised?

add a small electronegative π-donor ligand which has lower energy FOs that will form a weak antibonding interaction with the metal dAOs raising only slightly some of the "t_{2g}" MOs thus maximising Δ_{oct}, **Figure 2b**