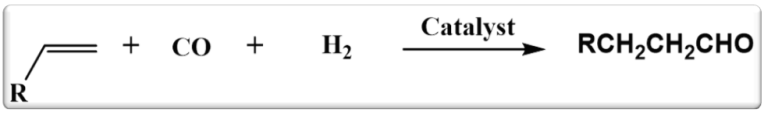
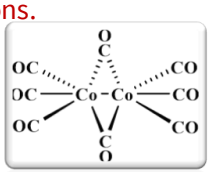
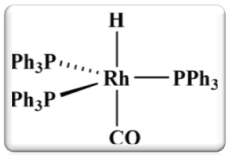
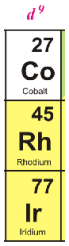
Hydroformylation reaction



- A less common, but more appropriate name is hydrocarbonylation
- Both cobalt and rhodium complexes are used as catalysts.
- Alkene isomerization, alkene hydrogenation and formation of branched aldehydes are the possible side reactions.

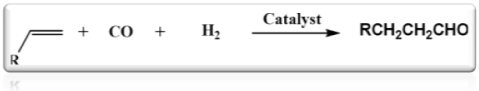


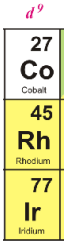




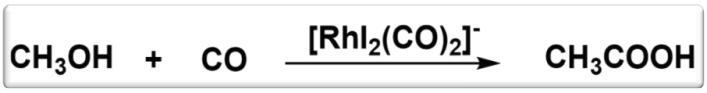
- Cobalt catalysts operate at 150 °C and 250 atm, whereas Rhodium catalysts operate at moderate temperatures and 1 atm.
- Rhodium catalysts promotes the formation of linear aldehydes. Cobalt catalysts do so if modified with alkylphosphine ligands.

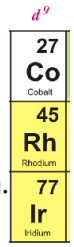
Hydroformylation reaction





Monsanto Acetic Acid Synthesis





- All three members of the group 9 (Co, Rh and Ir) can catalyze this reaction.
- A cobalt complex was initially used, which was replaced with the rhodium complex later on.
- Methanol initially reacts with hydroiodic acid to give methyliodide and H_2O. Methyliodide reacts with the 16e$^-$ catalyst, which is the rate-determining step.

- The final product formed after the catalytic cycle is acetyl iodide, which is hydrolyzed by water to acetic acid and HI.

Monsanto Acetic Acid Synthesis