Corrosion

- Unwanted dissolution of a metal in a solution, resulting in continued degradation → may elicit an adverse biological host reaction and reduce structural integrity of material or prosthesis.

- Usually an electrochemical reaction with n-valence electrons being lost from metal by an oxidation reaction resulting in a positive charged metal ion (anode)
  - Metal → metal ion + electrons (e.g. Fe → Fe$^{2+}$ + 2e$^{-}$)
  - OILRIG – oxidation is loss, reduction is gain (of electrons)
  - These electrons then flow and are transferred to another chemical species (cathode) which will become negatively charged

- Passivity – formation of a thin passive oxide film which is adherent to the metal prosthesis, and serves as a protective barrier to further corrosion

- Galvanic corrosion– two dissimilar metals with different surface potentials. The more active metal/alloy becomes anodic and the more noble metal cathodic.
  - Anodic metal is lost / sacrificed
  - A galvanic series exists which is a list of metals/alloys in order of nobility. Allows prediction of galvanic relationships and unsuitable combinations

- Crevice corrosion – narrow cavity where fluid can enter but then is limited in terms of flow back to main solution. Micro-environment created where oxygen levels reduced and H$^{+}$ and Cl$^{-}$ ions build up, resulting in damage to the passive layer of the metal
  - Metal within crevice becomes anodic.
  - Electrons however can escape from the crevice and make rest of surface cathodic (protected)
  - Thus perpetuates the localisation of corrosion within the crevice

- Fretting corrosion – synergistic combination of wear and crevice corrosion of two materials in contact, where micro-motion disrupts protective passivity film.
  - Exposed metal then oxidises into ionic form (dissolution) but will also gradually re-passivate.
  - Further movement disrupts passive film again, so there is a steady loss / dissolution

- Pitting Corrosion – a form of localised galvanic corrosion that again is localised.
  - Small holes form in a vertical direction upon a horizontal surface
  - Usually arise in breaks in the passivation film or voids in the alloy/metal
  - Insidious – little material loss until failure occurs, but substantial ionisation
  - Self-sustaining and grow.

- Stress corrosion (fatigue or cracking) – base of crevice acts as a stress concentration factor for propagation of a crack and subsequent implant failure.