**Ionotropic receptors (A)**

- **Ligand ion Channel**
  - Ligand ion channel remains closed
  - 1st messenger (NT’s, outside neuron) binds to receptor (ionotopic).
  - Ligand ion channel opens
  - Ion’s move inward or outward depending on the type of channel

This results in a 1-1 ratio of NT to ligand ion channel. So it takes lots of NT’s to open ion channels to make GP’s (depolarization or hyper-polarization). Ligand-ionotopic receptors open fast and close fast! (typically).

Most ions (e.g. Na+, K+, Cl-) do not bind intracellular proteins and thus can not modify their conformation and subsequent function. Only change **membrane potential**!

- **1st messenger** = ○ Positive charged ion = +

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**Metabotropic receptors (B and C)**

- **G-coupled Protein**
  - Metabotropic activates G-coupled protein.
  - Subunit of G-coupled protein disassociates from protein.
  - G-coupled Subunit activates ion-channel to open! Ions move inward or out ward depending on the channel.

This results in a 1-1 ratio of metabotropic receptor activation of ion channel. However, metabotropic receptors can keep ion channels open longer than ionotropic receptors. This results in larger in magnitude GP’s (depolarization or hyper-polarization) that last longer.

Second messengers can open 100s of ions channels! Ions move inward or out ward depending on the channel. This results in larger in magnitude GP’s (depolarization or hyper-polarization) that last longer.

**Second messengers** (always on the inside of neuron) also active intracellular **signal transduction!** (see next slide)
Metabotropic receptors lead to the activation of important intracellular-signaling-intermediate proteins/molecules (mostly Kinases, but not exclusively proteins) via second messengers. Signal-Transduction amplifies metabotropic receptor effects. This sequence of protein-protein interactions between these intermediate molecules that takes place is called signal transduction (cascade of biochemical events). Signal Transduction depends on an “astonishing” number of molecular “players” and “pathways.”