

SYNAPTIC TRANSMISSION AND NEUROTRANSMITTERS

The Synapse: the axon terminal, the dendrite and the tiny space between them (the synaptic cleft)

1. Action potentials arrival at the axon terminal opens Ca^{2+} channels, rather than Na^{+} channels.
2. Ca^{2+} rushes in, stimulates exocytosis of synaptic vesicles. Exocytosis=fusion with the membrane and release of neurotransmitters into synaptic cleft.
3. Neurotransmitters (NTs) diffuse across the synaptic cleft and bind to postsynaptic receptors.
4. Binding of neurotransmitters causes Na^{+} or K^{+} channels to open in the dendrite.
5. If Na^{+} channels are opened, the graded potential moves the membrane closer to threshold; this is an **excitatory post-synaptic membrane potential (EPSP)**. If K^{+} channels are opened, the graded potential moves the membrane farther from threshold; this is an **inhibitory post-synaptic membrane potential (IPSP)**.
6. Degradation of NTs by enzymes ends synaptic transmission; fragments are endocytosed (**reuptaken**) by axon terminal and recycled. The NTs never remain very long on the receptors; and they do not enter the postsynaptic cell.

Graded Potentials increase or decrease the likelihood of AP occurring at the axon hillock.

6 Cool Neurotransmitters and their receptors

1. **Acetylcholine (ACh)** binds to cholinergic receptors. **Cholinergic receptors can be either muscarinic or nicotinic**
 - responsible for skeletal muscle contraction (via nicotinic receptors)
 - numerous effects in brain
 - released from parasympathetic neurons, causing rest and digest effects in the body (typically muscarinic receptors)
2. **Norepinephrine (NE)** binds to adrenergic receptors. **Adrenergic receptors are either alpha or beta**
 - "Feel Good NT", some stimulatory drugs increase release of this neurotransmitter
 - released from sympathetic neurons, causing fight or flight effects in the body.
 - reuptake of NE blocked by cocaine
3. **Dopamine**
 - "Feel Good NT", some stimulatory drugs increase release of this neurotransmitter
 - Involved in smooth/fine motor skills, especially in the substantia nigra, a nucleus in the cerebral peduncle of the midbrain.
 - Reuptake blocked by cocaine
 - Released by methamphetamines
 - Deficient in Parkinson's disease (causing motor coordination problems and depression)
4. **Serotonin**
 - Mood regulation
 - Reuptake blocked by anti-depressants
5. **GABA**
 - inhibits most brain functions
 - release stimulated by alcohol and Valium
6. **Glutamate**
 - involved with neurons for learning and memory
 - implicated in the development of drug addiction (in which the pleasure of the drug is "learned/remembered")