NEUROTRANSMITTERS

Norepinephrine

- Produced in locus coeruleus
- In sympathetic nervous system
- Released from adrenal glands during stress
- For alertness and arousal
- PTSD
  - Drugs affect norepinephrine
    - Blood-pressure medication prazosin
    - Beta-blocker propranolol
- Major depression
- In SWS: low acetylcholine and norepinephrine
- In arousal systems
  - During REM: low norepinephrine and high acetylcholine
  - When awake: high acetylcholine and norepinephrine

Endocannabinoids

- Concentrated in hippocampus
  - Cannabinoid receptors
- Coordinate movements
  - Natural form of THC = anandamide
- Suppress neurotransmitter release
- Neuromodulators
- Cannabis-like
- Mimicked by marijuana, or THC

GABA

- Antiepileptic agents such as gabapentin
- Metabotropic receptors
  - K+
- Ionotropic receptors
  - Cl-
- Anxiety disorders
- Most common brain inhibitory neurotransmitter
- VLPO release galanin and GABA
  - Suppress arousal systems
- Benzodiazepines (e.g., diazepam, or Valium) boost levels
- Huntington's disease
  - Loss of inhibitory GABAergic neurons in basal ganglia
    - Random involuntary movements
- REM behaviour disorder
  - Benzodiazepine drug clonazepam enhance GABA

Endorphins

- Released from periaqueductal gray matter
- Concentrated in the spinal cord
  - Opioid receptors
- Pain perception
- Natural opiods
- Euphoria
- Act like the analgesic morphine

Prostaglandins

- Increase pain sensitivity
- Produced by cyclooxygenase
  - Inhibited by NSAIDs like aspirin
- Lipids

Dopamine

- Mesolimbic pathway
  - Reward and motivation
- Too little dopamine
  - ADHD
  - Depression
  - Parkinson's disease → Substantia nigra neurons
- Too much dopamine → Schizophrenia
  - Addiction
- Lateral habenula
  - Encode punishment by inhibiting dopamine
    - Linked to inappropriate aggression
- Monoamine neurotransmitter
- Catecholamine
- Psychostimulants
  - Flood the reward system with dopamine
- Motor control
- Produced by basal ganglia
- Nicotine stimulates its relase
  - Creates a buzz of pleasure and energy

Acetylcholine

- Involved in learning and memory
  - Deficit in Alzheimer's disease
    - Cholinesterase inhibitors: donepezil, galantamine, and rivastigmine
- Main neurotransmitter at neuromuscular junction
- Acetylcholinesterase breaks down acetylcholine
- Receptors destroyed in myasthenia gravis
- In arousal systems
  - Keeps awake (arousal)
- Mimicked by nicotine
  - Binds to nicotinic acetylcholine receptors
  - Varenicline mimics nicotine
    - Treats nicotine addiction

Glutamate

- Learning and memory
- Non-traditional target for antidepressants
- Neurotoxic
- Most common brain excitatory NT
- Released by gliomas
  - Can destroy nerve cells
- ALS
  - Riluzole decreases glutamate levels
- Ketamine alters its signaling
- Too much causes epilepsy
- AMPA and NMDA receptors
  - Blocked by ethanol
  - Na+ Fast and brief → High [Ca2+] → Kinases → LTP
  - Na+ and Ca2+ Slow, long-lasting Blocked by Mg2+ → Low [Ca2+] → Phosphatases → LTD

Histamine

- Produced by hypothalamic neurons
- Cause itch
  - Involved in skin irritation, bug bites, and allergies
- Increase arousal
- Promotes wakefulness

Serotonin

- Emotions
- Monoamine neurotransmitter
- Selective serotonin reuptake inhibitors (SSRIs) raise serotonin levels
- Major depression
- Anxiety disorders
- PTSD
- Low concentration
- Boosts levels of serotonin
  - Ecstasy
- Produced in raphe nuclei
- In arousal systems
  - Keeps awake (arousal)

Orexin

- Prevent a sudden transition to sleep
- Narcolepsy
- Orexin-producing neurons located in hypothalamus
- Exert excitatory effects on arousal systems

BIOLYMPIADS