Quiz Answers:
1. T/F: Taking a little bit more drug that has a high therapeutic index is safe?
2. A) agonist = a drug that blocks reuptake
3. Routes of Administration: intraperitoneal, subcutaneous, sublingual, inhalation, etc.
4. GABA = neurotransmitter that is inhibitory

**Acetylcholine**

- **Synthesis:**

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COA (mitochondria) → Acetyl-COA → Acetate (vinegar) → Choline (Lipids and Food) → ACh (CoA)
```

- **Found where:**
  - Pons (REM Sleep)
  - Basal forebrain
  - Medial spectrum
  - Peripheral nervous system

- **Receptors:** Mostly excitatory
  - Nicotinic, stimulated by nicotine
  - Muscarinic (membrane-bound proteins)

- **Psychopharmacology:** 1\(^\text{st}\) neurons discovered
  - ACh is involved in muscle contraction
  - In the parasympathetic system: digestion, decrease heart rate
  - Botulinum toxin: blocks ACh release, produced by bacteria, extremely poisonous, occur naturally
  - Black- widow spider venom: promotes ACh release
  - Neostigmine: reduces myasthenia gravis symptoms
  - Atropine: blocks muscarinic receptors, response to nerve gas
  - Curare: blocks nicotinic receptors
Synthesis of ACh

Mono Amines: Catecholamine’s

Dopamine

Def: helps control the brains reward and pleasure centers. Regulates movement and emotional responses

- Synthesis: Tyrosine (high protein foods) $\rightarrow$ L-Dopa $\rightarrow$ Dopamine
- Found Where:
  - Substantia Nigra
    - Projects to basal ganglia (movement)
  - Ventral Tegmental area
    - Projects limbic cortex
    - Projects prefuntuntal cortex
- Receptors: Excitatory and Inhibitory
- Psychopharmacology: Pleasure system, positive reinforcement, drug addiction
  - Parkinson’s disease (low level DA)
  - Schizophrenia (high level DA)
  - AMPt blocks enzyme (tyrosine-> L-Dopa)
  - Monoamine oxidase: destroys excessive monoamines, found naturally in blood. Too much links depression
**Catecholamines**

**Def:** hormones that are released by the adrenal glands in situations of stress

**Steps:** 1. Tyrosine 2. L-Dopa 3. Dopamine 4. Noradrenaline 5. Adrenaline

![Chemical Reaction Diagram]

**Nor/Epinephrine (NE/E)**

**Def:** a chemical released from the sympathetic nervous system in response to stress

- **Synthesis:** tyrosine $\rightarrow$ L-dopa $\rightarrow$ dopamine $\rightarrow$ norepinephrine
- **Found Where:** - locus coeruleus
  - Epinephrine (hormone) produced in adrenal medulla (gland above kidneys)
  - Wide projections through brain
- **Receptors:** excitatory or inhibitory
- **Psychopharmacology:** > vigilance and attention
  - Fusaric acid blocks synthesis NE from dopamine
  - Reserpine prevents storage of monoamines vesicles
  - Idazoxan blocks auto receptors

**Serotonin (5-HT)**

**Def:** important chemical transmitter that is responsible for maintaining mood balance

- **Synthesis:** Tryptophan (food) $\rightarrow$ 5-HTTP $\rightarrow$ 5-HT
- **Found Where:** - mainly: midbrain
  - Released at axonal varicosities (diffuse release)
- **Receptors:** excitatory or inhibitory
- **Psychopharmacology:** mood, eating (vomit), sleep (dream), pain
  - PCPA blocks tryptophan, 5-HTTP reaction
  - Fluoxetine (Prozac) inhabits 5-HT reuptake
  - Fenfluramine inhabits 5-TP reuptake
  - LSD (acid) is a hallucinogenic, multiple site of action 5-HT
  - MDMA (ectosy) invert reuptake transporters direction. Long term memory deficit
**Synthesis of Serotonin (Steps)**

Def: small protein molecules used by neurons to communicate with each other

- **Synthesis:**
  - in the soma from many amino acids
  - 100 kinds
  - transmitters= endogenous opioids

- **Found Where:**
  - in many regions of CNS and PNS
  - Released at synaptic boutons (leaking) by volume transmission
  - Co released with other transmitters
  - Deactivated by enzymes (no reuptake/ recycle)

- **Receptors:** usually inhibitory

- **Psychopharmacology:**
  - opium morphine, heroine= bind to/open opide receptors
  - Codeine= cough suppressant (liver→morphine) binds to opale receptors.
  - Naloxone= competitive blocker of or (prevents overdoes)
  - Angiotensin= PNS: constrid blood vessels CNS: thirst

*the pain decreases and the mood increases

**Lipids**

Def: a thin, protective, 2 layer membrane that forms around cells

- **Synthesis:** anandamide
- **Found where:** non-local, produced on demand, not stored in vesicles
- **Receptors:** excitatory or inhibitory
- **Psychopharmacology:** complex synaptic effects. THC agonists for CB1 and CB2
- Good- THC (marijuana, hashish): sedative, appetitive enhancer, reduce nausea, blocks (vomiting)
- Bad- THC: interferes with attention, distort perception (time and space), impares learning and memory, may be addictive to some individuals

**Nucleosides**

- **Synthesis:** sugar molecule bound to other compounds
- **Found where:** > non-local
  - Adenosine: released by astrocytes
- **Receptors:** > There are many
  - 3 types: Inhibitory through a metabotropic K+ channel. Triggered by low energy. Low oxygen signals
- **Psychopharmacology:** physiological: high blood flow

**Caffeine**

- **Synthesis:** > nitric oxide (NO) within neurons, no storage
  - Carbon monoxide (CO)
- **Found where:** non-local → no brain area
- **Receptors:** >none. Diffuse directly neighboring neurons
  - Trigger 2nd messenger’s cascades
- **Psychopharmacology:** > modulates intestine function (relaxes)
  - Stimulates erection
  - Involved in learning and memory

**Soluble Gases**

- **Synthesis:** > nitric oxide (NO) within neurons, no storage
  - Carbon monoxide (CO)
- **Found where:** non-local → no brain area
- **Receptors:** >none. Diffuse directly neighboring neurons
  - Trigger 2nd messenger’s cascades
- **Psychopharmacology:** > modulates intestine function (relaxes)
  - Stimulates erection
  - Involved in learning and memory

**Summary: Agonist and Antagonists Game**