

ANSWER KEY WITH EXPLANATIONS FOR CHAPTER 8

Skill Drill Answers

SD 8.1: Neurotransmitter-Function Matching

1. **A** — GABA is the primary inhibitory neurotransmitter
 2. **B** — Glutamate is the primary excitatory neurotransmitter
 3. **D** — Dopamine regulates reward, motivation, and motor control
 4. **C** — Serotonin regulates mood, sleep, and appetite
 5. **E** — Norepinephrine regulates alertness and attention
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SD 8.2: True/False with Correction

1. **F** — Glutamate is the primary **EXCITATORY** neurotransmitter; GABA is inhibitory.
 2. **F** — The BBB has tight junctions that **PREVENT** diffusion between endothelial cells.
 3. **T** — D2 receptors are the primary target of antipsychotics.
 4. **F** — Serotonin is terminated primarily by **REUPTAKE** via SERT, not enzymatic degradation.
 5. **T** — Lipophilic drugs cross the BBB more easily than hydrophilic drugs.
 6. **F** — Antidepressants require 2-4 **WEEKS** for therapeutic effects due to neuroplasticity.
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SD 8.3: Fill in the Blank

1. **tuberoinfundibular**
2. **chloride**
3. **SSRI (selective serotonin reuptake inhibitor)**
4. **out**

5. **nigrostriatal**
 6. **memantine**
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SD 8.4: Receptor Subtype Classification

1. **I** — GABA-A is a ligand-gated ion channel
 2. **M** — GABA-B is a GPCR
 3. **I** — NMDA is a ligand-gated ion channel
 4. **M** — D2 is a GPCR
 5. **I** — 5-HT3 is a ligand-gated ion channel
 6. **M** — 5-HT1A is a GPCR
 7. **I** — AMPA is a ligand-gated ion channel
 8. **M** — mGluR is a metabotropic/GPCR
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SD 8.5: Dopamine Pathway Sorting

1. **C** — Nigrostriatal pathway blockade causes EPS
 2. **A** — Mesolimbic hyperactivity causes positive symptoms
 3. **D** — Tuberoinfundibular blockade causes hyperprolactinemia
 4. **B** — Mesocortical hypoactivity contributes to negative symptoms
 5. **A** — Mesolimbic pathway mediates reward
 6. **C** — Nigrostriatal degeneration causes Parkinson's motor symptoms
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SD 8.6: Rapid Recall

1. **GABA**
2. **Raphe nuclei**
3. **DAT (dopamine transporter)**
4. **Quaternary amine**
5. **GABA-A**
6. **Tryptophan hydroxylase**

SD 8.7: Complete the Sentence

1. **hyperpolarizes**
2. **prefrontal cortex**
3. **do not cross**
4. **excitotoxicity**
5. **Gs**
6. **weeks**

SD 8.8: BBB Permeability Prediction

1. **YES** — Small, lipophilic, uncharged molecules cross easily
2. **NO** — Large proteins cannot cross
3. **NO** — Quaternary amines are charged and cannot cross
4. **NO** — P-gp substrates are pumped out of the brain
5. **YES** — Tertiary amines are uncharged and cross
6. **NO** — Highly polar compounds cannot cross

SD 8.9: Excitatory vs. Inhibitory Sorting

1. **I** — GABA is inhibitory
2. **E** — Glutamate is excitatory
3. **E** — NMDA receptors mediate excitation
4. **I** — GABA-A receptors mediate inhibition
5. **E** — AMPA receptors mediate excitation
6. **I** — Glycine is inhibitory in the spinal cord

SD 8.10: Serotonin Receptor Matching

1. **D** — 5-HT₃ is blocked by ondansetron
2. **A** — 5-HT_{1A} is activated by buspirone

3. **B** — 5-HT_{2A} is blocked by atypical antipsychotics, activated by LSD
 4. **C** — 5-HT_{2C} blockade contributes to weight gain
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SD 8.11: Drug-Neurotransmitter Pairing

1. **A** — SSRIs affect serotonin
 2. **C** — Benzodiazepines enhance GABA
 3. **B** — Antipsychotics block dopamine
 4. **D** — Ketamine blocks glutamate (NMDA)
 5. **B** — Amphetamine releases dopamine
 6. **C** — Barbiturates enhance GABA
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SD 8.12: CNS Disorder-Pathway Connection

1. **A** — Parkinson's involves nigrostriatal dopamine deficiency
2. **C** — Depression involves serotonin deficiency
3. **B** — Positive symptoms involve mesolimbic dopamine excess
4. **D** — Epilepsy involves GABA/glutamate imbalance

Case Study Answers

Case 8.1: Serotonin Syndrome

Question 1. Sertraline blocks SERT, increasing synaptic serotonin. Sumatriptan is a 5-HT₁ agonist that directly stimulates serotonin receptors. The combination produces excessive serotonergic activity at multiple receptor subtypes, causing serotonin syndrome.

Question 2. Classic features include altered mental status (agitation, confusion), autonomic instability (hyperthermia, diaphoresis, tachycardia, hypertension), and neuromuscular abnormalities (tremor, rigidity, hyperreflexia, clonus). These reflect widespread serotonin receptor overstimulation in the CNS and periphery.

Question 3. Serotonin syndrome has rapid onset (hours), hyperreflexia, and clonus; it is caused by serotonergic drugs. NMS has slow onset (days), "lead pipe" rigidity, and bradyreflexia; it is caused by dopamine antagonists (antipsychotics). Both cause hyperthermia.

Question 4. Treatment includes discontinuing serotonergic drugs, supportive care (cooling, IV fluids, benzodiazepines for agitation), and cyproheptadine (serotonin antagonist) in severe cases.

Case 8.2: Understanding Parkinson's Pathophysiology

Question 1. The nigrostriatal pathway degenerates in Parkinson's disease. It normally projects from the substantia nigra to the striatum (basal ganglia) and controls voluntary movement initiation and coordination.

Question 2. Dopamine cannot cross the blood-brain barrier because it is too polar/hydrophilic. L-DOPA crosses via amino acid transporters in the BBB, then is converted to dopamine inside the brain by DOPA decarboxylase.

Question 3. Dopaminergic drugs affect all four pathways. Mesolimbic stimulation may cause psychosis or impulse control disorders. Tuberoinfundibular stimulation may decrease prolactin (actually desired, reducing antipsychotic-induced hyperprolactinemia in some cases).

Question 4. L-DOPA increases dopamine throughout the brain, not just the nigrostriatal pathway. Excessive dopamine in the mesolimbic pathway can cause hallucinations and psychosis—a common complication of Parkinson's treatment.

Diagram/Table Exercise Answers

DT 8.1: Blood-Brain Barrier Structure

1. What type of junctions connect brain endothelial cells? **Tight junctions**
 2. What cell type surrounds brain capillaries with foot processes? **Astrocytes**
 3. What transporter pumps drugs OUT of the brain? **P-glycoprotein (P-gp)**
 4. What property helps drugs cross the BBB by passive diffusion? **Lipophilicity (small size, uncharged)**
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DT 8.2: Dopamine Pathways Diagram

1. Mesolimbic pathway function: **Reward, motivation, pleasure**
2. Mesocortical pathway function: **Cognition, executive function**
3. Nigrostriatal pathway function: **Motor control**
4. Tuberoinfundibular pathway function: **Inhibits prolactin release**

DT 8.3: CNS Neurotransmitter Comparison Table

Neurotransmitter	Primary Function	Main Receptor Types	Transporter
GABA	Primary inhibitory	GABA-A, GABA-B	GAT
Glutamate	Primary excitatory	NMDA, AMPA, kainate, mGluR	EAAT
Serotonin	Mood, sleep, appetite	5-HT1-7	SERT
Dopamine	Reward, motor control	D1-D5	DAT

DT 8.4: Receptor-Second Messenger Table

Receptor	Type	G-Protein/Ion	Effect
GABA-A	Ionotropic	Cl ⁻ channel	Hyperpolarization (inhibition)
GABA-B	Metabotropic	Gi	↓ cAMP, ↑ K ⁺
D1	Metabotropic	Gs	↑ cAMP
D2	Metabotropic	Gi	↓ cAMP
NMDA	Ionotropic	Ca ²⁺ /Na ⁺ channel	Depolarization (excitation)

MULTIPLE-CHOICE QUESTION ANSWERS

Question 1. Answer: C

GABA is the primary inhibitory neurotransmitter in the CNS.

Question 2. Answer: B

Serotonin neurons originate in the raphe nuclei of the brainstem.

Question 3. Answer: B

High lipophilicity allows drugs to cross the BBB by passive diffusion through cell membranes.

Question 4. Answer: B

Antipsychotics primarily target D2 dopamine receptors.

Question 5. Answer: C

GABA-A receptors are chloride channels; opening them hyperpolarizes neurons.

Question 6. Answer: C

The nigrostriatal pathway controls motor function; its degeneration causes Parkinson's disease.

Question 7. Answer: D

The tuberoinfundibular pathway normally inhibits prolactin release; blockade causes hyperprolactinemia.

Question 8. Answer: B

L-DOPA crosses the BBB via amino acid transporters; dopamine is too polar to cross.

Question 9. Answer: C

5-HT₃ is the only serotonin receptor that is a ligand-gated ion channel; all others are GPCRs.

Question 10. Answer: B

Benzodiazepines increase the frequency of GABA-A channel opening (barbiturates increase duration).

Question 11. Answer: B

Excitotoxicity refers to neuronal death caused by excessive glutamate/calcium influx.

Question 12. Answer: B

Sertraline (SSRI) plus tramadol (serotonin reuptake inhibitor and weak opioid) can cause serotonin syndrome.

Question 13. Answer: C

The delay reflects neuroplastic adaptations including autoreceptor desensitization, BDNF upregulation, and synaptic remodeling.

Question 14. Answer: B

P-glycoprotein pumps substrates OUT of the brain, reducing CNS penetration.

Question 15. Answer: B

D2 blockade in the mesolimbic pathway reduces dopaminergic hyperactivity, decreasing hallucinations and delusions.

Question 16. Answer: C

NMDA receptors require both glutamate and glycine (co-agonist) for full activation.