Name _____

Matching Choices may be used more than once or not at all.

1-5. Matching

A)	Active transport Pumps	change shape when phosphorylated using ATP	1) _____
B)	Co-/counter- Transporters	are integral transmembrane transporter proteins)	2) _____
C)	Facilitative Transporters	do not change shape (act as simple passageways)	3) _____
D)	Channels (passive)	change shape spontaneously (*aka* carrier proteins)	4) _____
E)	All of these	change shape in presence of ion concentration gradient	5) _____

6-10. Matching.

A)	Are sometimes called "secondary active transporters"	Pumps	6) _____
B)	Are primary active transporters	Channels	7) _____
C)	Are passive transporters	Co-transporters	8) _____
		Counter transporters	9) _____
		Facilitative transporters	10) _____

11-15. Matching

A)	Dialysis	movement in general due to concentration gradient	11) _____
B)	Diffusion	movement of water across a cell membrane due to pressure	12) _____
C)	Osmosis	movement of water across a cell membrane due to concentration	13) _____
D)	Filtration	movement of solute across a cell membrane due to concentration	14) _____
		movement of solvent across a cell membrane due to concentration	15) _____

16-20. Matching.

A)	Osmolarity is normal	Solute concentration is normal	16) _____
B)	Osmolarity is high	Water concentration is high	17) _____
C)	Osmolarity is low	Water concentration is low	18) _____
		Solution is hypertonic	19) _____
		Solution is hypotonic	20) _____

21-25. Matching

A)	Channels (passive)	Function as simple passageways	21) _____
B)	Pumps	Are integral transmembrane proteins	22) _____
C)	A & B	Change shape when phosphorylated using ATP	23) _____
		Allow diffusion of ions from high to low concentration	24) _____
		Force movement of ions from low to high concentration	25) _____

26-30. Matching (major chemical classes of chemical messengers)

A)	Amines	Are short proteins (short chains of amino acids)	26) _____
B)	Steroids	Are synthesized <u>from single</u> amino acids	27) _____
C)	Peptides	Include norepinephrine and epinephrine	28) _____
D)	Amino acids	Are synthesized from cholesterol	29) _____
		Include glycine and glutamate	30) _____

31-35. Matching

A)	Water soluble chemical messenger	Steroids (such as estrogens, cortisol)	31) _____
B)	Lipid soluble chemical messenger	Peptides (such as insulin, glucagon, vasopressin)	32) _____
C)	None of the above	Amino acids (such as glutamate, glycine, GABA)	33) _____
		Thyroid amines (such as thyroxin. triiodothyronin)	34) _____
		Non-thyroid amines (such as norepinephrine, acetylcholine)	35) _____

36-40. Matching

A)	G-protein coupled receptors	Often are ligand-gated channels	36) _____
B)	Enzyme linked receptors	Commonly act via adenylyl cyclase	37) _____
C)	Channel linked receptors	Commonly act via phospholipase C	38) _____
D)	Response elements	Commonly are linked to tyrosine kinase	39) _____
		Usually are part of promoter region of a gene	40) _____

41-45. Place the following events in order for messaging using a G-protein coupled receptor.

A)	G-protein coupled receptor releases G-proteins	first	41) _____
B)	A chemical messenger binds to a G-protein coupled receptor	second	42) _____
C)	G-protein alpha binds to GTP and floats under plasma membrane	third	43) _____
D)	G-protein alpha activates Adenylyl Cyclase	fourth	44) _____
E)	ATP is converted to cAMP	fifth	45) _____

46-50. Place the following events in order for messaging using a G-protein coupled receptor.

A)	G-protein coupled receptor releases G-proteins	first	46) _____
B)	A chemical messenger binds to a G-protein coupled receptor	second	47) _____
C)	G-protein alpha binds to GTP and floats under plasma membrane	third	48) _____
D)	G-protein alpha activates Phospholipase C	fourth	49) _____
E)	PIP2 is converted to IP3 and DAG	fifth	50) _____

51-55. Place the following events in order for messaging using a G-protein coupled receptor.

A)	G-protein coupled receptor releases G-proteins	first	51) _____
B)	A chemical messenger binds to a G-protein coupled receptor	second	52) _____
C)	G-protein beta-gamma floats under plasma membrane	third	53) _____
D)	G-protein beta-gamma binds to potassium channels	fourth	54) _____
E)	Potassium channels open	fifth	55) _____

56-60. Matching (PLC = phospholipase C; IP3 = inositol triphosphate; DAG = diacylglycerol)

A)	G-protein coupled receptors	Are integral transmembrane proteins	56) _____
B)	Channel linked receptors	Function as a receptor and ion channel	57) _____
C)	A and B	Control beta subunit that opens K+ channels	58) _____
		Control alpha subunit that activates PLC to produce IP3 and DAG	59) _____
		Control alpha subunit that activates adenylyl cyclase to produce cAMP	60) _____

61-65. Matching (closest values for most cells at rest)

A)	5 mM	extracellular concentration of Na^+	61) _____
B)	15 mM	intracellular concentration of Na^+	62) _____
C)	105 mM	extracellular concentration of Cl^-	63) _____
D)	140 mM	extracellular concentration of K^+	64) _____
		intracellular concentration of K^+	65) _____

66-70. Matching

A)	When Na^+ channels are open	K^+ diffuses into cell	66) _____
B)	When Cl^- channels are open	Na^+ diffuses into cell	67) _____
C)	When K^+ channels are open	Cl^- diffuses into cell	68) _____
D)	None of the above	K^+ diffuses out of cell	69) _____
		Na^+ diffuses out of cell	70) _____

71-75. Place these events in the order they would occur upon stimulation of a sensory neuron.

A)	Voltage gated Na^+ channels open in the axon and an action potential is generated	first	71) _____
B)	A stimulus opens Na^+ channels of the membrane of the sensory dendrite	second	72) _____
C)	The action potential opens Ca^{2+} channels in the synaptic bulb	third	73) _____
D)	Glutamate is released onto specific neurons in the CNS	fourth	74) _____
E)	The action potential is propagated along the axon	fifth	75) _____

76-80. Matching

A)	Voltage gated channels	Are found in axons	76) _____
B)	Ligand gated channels	Are found in dendrites	77) _____
C)	A and B	Are found in axon hillock	78) _____
		Typically are found in synaptic bulbs	79) _____
		Are found in postsynaptic membranes	80) _____

81-85. Matching (in the context of an action potential)

A)	-75 mV	a typical resting membrane potential	81) _____
B)	-70 mV	the voltage when voltage gated K^+ channels open	82) _____
C)	-55 mV to -60mV	the voltage when voltage gated K^+ channels close	83) _____
D)	+30 mV	the voltage when voltage gated Na^+ channels open	84) _____
		the voltage when voltage gated Na^+ channels close	85) _____

86-90. Place these events in the order they would occur to causes the secretion of a neurotransmitter.

A)	Ca^{2+} binds to synaptotagmin and opens synaptic vesicle	first	86) _____
B)	Neurotransmitter diffuses from synaptic vesicle	second	87) _____
C)	An action potential reaches the synaptic bulb	third	88) _____
D)	Voltage gated Ca^{2+} channels open	fourth	89) _____
E)	Ca^{2+} enters the intracellular fluid	fifth	90) _____

91-95. Matching

A)	Slow EPSPs	Caused by opening ligand gated Cl^- channels	91) _____
B)	Fast EPSPs	Caused by opening ligand gated Na^+ channels	92) _____
C)	Slow IPSPs	Caused by closing K^+ channels that are G-protein coupled	93) _____
D)	Fast IPSPs	Caused by opening K^+ channels that are G-protein coupled	94) _____
		Caused by opening Ca^{2+} channels that are G-protein coupled	95) _____

96-100. Matching

A)	Inhibitory neurotransmitters	Cause excitatory postsynaptic potentials (EPSPs)	96) _____
B)	Excitatory neurotransmitters	Cause inhibitory postsynaptic potentials (IPSPs)	97) _____
		Make intracellular fluid more positive	98) _____
		GABA and glycine are examples	99) _____
		Glutamate is an example	100) _____

101-105. Matching

A)	Primary sensory neuron mechanoreceptors	Taste uses	101) _____
B)	Accessory sensory cell mechanoreceptors	Vision uses	102) _____
C)	Primary sensory neuron thermoreceptors	Hearing uses	103) _____
D)	Accessory sensory cell chemoreceptors	Tactile reception uses	104) _____
E)	Accessory sensory cell photoreceptors	Temperature reception uses	105) _____

106-110. Place these structures in the order that <u>somatosensory signals</u> travel in the PNS and CNS.

A)	Thalamus	first	106) _____
B)	Axons of the sensory neurons	second	107) _____
C)	Primary somatosensory cortex	third	108) _____
D)	Spinal cord or medulla oblongata	fourth	109) _____
E)	Receptors of general sensory neurons	fifth	110) _____

111-115. Matching

A)	Posterior column pathways	Carry signals about touch	111) _____
B)	Spinothalamic pathways	Carry signals about temperature	112) _____
		Carry signals about tissue damage	113) _____
		Primary sensory neurons synapse in spinal cord	114) _____
		Primary sensory neurons synapse in medulla oblongata	115) _____

Fill in

1. In a cell membrane, the _____ _____ of the phospholipids face each other.
2. It is difficult for polar molecules to pass through the center of the phospholipid bilayer because _____ molecules are repelled by _____ molecules.
3. A transmembrane proteins that serves as a passageway for *diffusion* of an ion across a cell membrane is called a _____.
4. Using # 3 above, Na^+ can move from an area of _____ Na^+ concentration to an area of _____ Na^+ concentration.
5. Using # 3 above, water can move from an area of _____ water concentration to an area of _____ water concentration.
6. A transmembrane protein that uses ATP to change shape and transport ions is called a _____.
7. Using # 5 above, Na^+ can move from an area of _____ to an area of _____ concentration.
8. The resting ion concentrations inside and outside of a neuron (or other cell) are produced largely by transmembrane proteins called _____.
9. _____ soluble chemical messengers frequently bind to response element binding proteins in the intracellular fluid.
10. _____ soluble chemical messengers typically bind to channel linked receptors, tyrosine kinase linked receptors, or G-protein coupled receptors.
11. Channel linked receptors that bind to and respond to chemical messengers are frequently called _____ gated channels.
12. _____ binds to and opens ligand gated Cl^- channels.
13. _____ binds to and opens ligand gated Na^+ channels (AMPA receptors).
14. _____ binds to G-protein coupled receptors and opens K^+ channels.
15. _____ is an example of a messenger that binds to GPCRs and opens Ca^{2+} channels
16. _____ gated channels open in response to specific distortion.
17. _____ gated channels open in response to specific voltages.
18. _____ gated channels open in response to specific chemical messengers.
19. _____ is essential for the fusion of the synaptic vesicles to the presynaptic membrane
20. The secretion of _____ and _____ neurotransmitters onto the dendrites of multipolar neurons is the foundation for neural information processing.
21. _____ neurotransmitters can nullify (reverse) the effects of excitatory neurotransmitters.
22. Sensory transduction converts a _____ stimulus into a neural signal.
23. In the posterior (dorsal) column pathways the primary sensory neurons synapse in the _____ _____ (two words).

Name _____

Matching Choices may be used more than once or not at all.

1-5. Matching

A)	Active transport Pumps	change shape when phosphorylated using ATP	1) __A__
B)	Co-/counter- Transporters	are integral transmembrane transporter proteins)	2) __E__
C)	Facilitative Transporters	do not change shape (act as simple passageways)	3) __D__
D)	Channels (passive)	change shape spontaneously (*aka* carrier proteins)	4) __C__
E)	All of these	change shape in presence of ion concentration gradient	5) __B__

6-10. Matching.

A)	Are sometimes called "secondary active transporters"	Pumps	6) __B__
B)	Are primary active transporters	Channels	7) __C__
C)	Are passive transporters	Co-transporters	8) __A__
		Counter transporters	9) __A__
		Facilitative transporters	10) __C__

11-15. Matching

A)	Dialysis	movement in general due to concentration gradient	11) __B__
B)	Diffusion	movement of water across a cell membrane due to pressure	12) __D__
C)	Osmosis	movement of water across a cell membrane due to concentration	13) __C__
D)	Filtration	movement of solute across a cell membrane due to concentration	14) __A__
		movement of solvent across a cell membrane due to concentration	15) __C__

16-20. Matching.

A)	Osmolarity is normal	Solute concentration is normal	16) __A__
B)	Osmolarity is high	Water concentration is high	17) __C__
C)	Osmolarity is low	Water concentration is low	18) __B__
		Solution is hypertonic	19) __B__
		Solution is hypotonic	20) __C__

21-25. Matching

A)	Channels (passive)	Function as simple passageways	21) __A__
B)	Pumps	Are integral transmembrane proteins	22) __C__
C)	A & B	Change shape when phosphorylated using ATP	23) __B__
		Allow diffusion of ions from high to low concentration	24) __A__
		Force movement of ions from low to high concentration	25) __B__

26-30. Matching (major chemical classes of chemical messengers)

A)	Amines	Are short proteins (short chains of amino acids)	26) __C__
B)	Steroids	Are synthesized <u>from single</u> amino acids	27) __A__
C)	Peptides	Include norepinephrine and epinephrine	28) __A__
D)	Amino acids	Are synthesized from cholesterol	29) __B__
		Include glycine and glutamate	30) __D__

31-35. Matching

A)	Water soluble chemical messenger	Steroids (such as estrogens, cortisol)	31) __B__
B)	Lipid soluble chemical messenger	Peptides (such as insulin, glucagon, vasopressin)	32) __A__
C)	None of the above	Amino acids (such as glutamate, glycine, GABA)	33) __A__
		Thyroid amines (such as thyroxin. triiodothyronin)	34) __B__
		Non-thyroid amines (such as norepinephrine, acetylcholine)	35) __A__

36-40. Matching

A)	G-protein coupled receptors	Often are ligand-gated channels	36) __C__
B)	Enzyme linked receptors	Commonly act via adenylyl cyclase	37) __A__
C)	Channel linked receptors	Commonly act via phospholipase C	38) __A__
D)	Response elements	Commonly are linked to tyrosine kinase	39) __B__
		Usually are part of promoter region of a gene	40) __D__

41-45. Place the following events in order for messaging using a G-protein coupled receptor.

A)	G-protein coupled receptor releases G-proteins	first	41) __B__
B)	A chemical messenger binds to a G-protein coupled receptor	second	42) __A__
C)	G-protein alpha binds to GTP and floats under plasma membrane	third	43) __C__
D)	G-protein alpha activates Adenylyl Cyclase	fourth	44) __D__
E)	ATP is converted to cAMP	fifth	45) __E__

46-50. Place the following events in order for messaging using a G-protein coupled receptor.

A)	G-protein coupled receptor releases G-proteins	first	46) __B__
B)	A chemical messenger binds to a G-protein coupled receptor	second	47) __A__
C)	G-protein alpha binds to GTP and floats under plasma membrane	third	48) __C__
D)	G-protein alpha activates Phospholipase C	fourth	49) __D__
E)	PIP2 is converted to IP3 and DAG	fifth	50) __E__

51-55. Place the following events in order for messaging using a G-protein coupled receptor.

A)	G-protein coupled receptor releases G-proteins	first	51) __B__
B)	A chemical messenger binds to a G-protein coupled receptor	second	52) __A__
C)	G-protein beta-gamma floats under plasma membrane	third	53) __C__
D)	G-protein beta-gamma binds to potassium channels	fourth	54) __D__
E)	Potassium channels open	fifth	55) __E__

56-60. Matching (PLC = phospholipase C; IP3 = inositol triphosphate; DAG = diacylglycerol)

A)	G-protein coupled receptors	Are integral transmembrane proteins	56) __C__
B)	Channel linked receptors	Function as a receptor and ion channel	57) __B__
C)	A and B	Control beta subunit that opens K+ channels	58) __A__
		Control alpha subunit that activates PLC to produce IP3 and DAG	59) __A__
		Control alpha subunit that activates adenylyl cyclase to produce cAMP	60) __A__

61-65. Matching (closest values for most cells at rest)

A)	5 mM	extracellular concentration of Na^+	61) __D__
B)	15 mM	intracellular concentration of Na^+	62) __B__
C)	105 mM	extracellular concentration of Cl^-	63) __C__
D)	140 mM	extracellular concentration of K^+	64) __A__
		intracellular concentration of K^+	65) __D__

66-70. Matching

A)	When Na^+ channels are open	K^+ diffuses into cell	66) __D__
B)	When Cl^- channels are open	Na^+ diffuses into cell	67) __A__
C)	When K^+ channels are open	Cl^- diffuses into cell	68) __B__
D)	None of the above	K^+ diffuses out of cell	69) __C__
		Na^+ diffuses out of cell	70) __D__

71-75. Place these events in the order they would occur upon stimulation of a sensory neuron.

A)	Voltage gated Na^+ channels open in the axon and an action potential is generated	first	71) __B__
B)	A stimulus opens Na^+ channels of the membrane of the sensory dendrite	second	72) __A__
C)	The action potential opens Ca^{2+} channels in the synaptic bulb	third	73) __E__
D)	Glutamate is released onto specific neurons in the CNS	fourth	74) __C__
E)	The action potential is propagated along the axon	fifth	75) __D__

76-80. Matching

A)	Voltage gated channels	Are found in axons	76) __A__
B)	Ligand gated channels	Are found in dendrites	77) __B__
C)	A and B	Are found in axon hillock	78) __A__
		Typically are found in synaptic bulbs	79) __C__
		Are found in postsynaptic membranes	80) __B__

81-85. Matching (in the context of an action potential)

A)	-75 mV	a typical resting membrane potential	81) __B__
B)	-70 mV	the voltage when voltage gated K^+ channels open	82) __D__
C)	-55 mV to -60mV	the voltage when voltage gated K^+ channels close	83) __A__
D)	+30 mV	the voltage when voltage gated Na^+ channels open	84) __C__
		the voltage when voltage gated Na^+ channels close	85) __D__

86-90. Place these events in the order they would occur to causes the secretion of a neurotransmitter.

A)	Ca^{2+} binds to synaptotagmin and opens synaptic vesicle	first	86) __C__
B)	Neurotransmitter diffuses from synaptic vesicle	second	87) __D__
C)	An action potential reaches the synaptic bulb	third	88) __E__
D)	Voltage gated Ca^{2+} channels open	fourth	89) __A__
E)	Ca^{2+} enters the intracellular fluid	fifth	90) __B__

91-95. Matching

A)	Slow EPSPs	Caused by opening ligand gated Cl^- channels	91) __D__
B)	Fast EPSPs	Caused by opening ligand gated Na^+ channels	92) __B__
C)	Slow IPSPs	Caused by closing K^+ channels that are G-protein coupled	93) __A__
D)	Fast IPSPs	Caused by opening K^+ channels that are G-protein coupled	94) __C__
		Caused by opening Ca^{2+} channels that are G-protein coupled	95) __A__

96-100. Matching

A)	Inhibitory neurotransmitters	Cause excitatory postsynaptic potentials (EPSPs)	96) __B__
B)	Excitatory neurotransmitters	Cause inhibitory postsynaptic potentials (IPSPs)	97) __A__
		Make intracellular fluid more positive	98) __B__
		GABA and glycine are examples	99) __A__
		Glutamate is an example	100) __B__

101-105. Matching

A)	Primary sensory neuron mechanoreceptors	Taste uses	101) __D__
B)	Accessory sensory cell mechanoreceptors	Vision uses	102) __E__
C)	Primary sensory neuron thermoreceptors	Hearing uses	103) __B__
D)	Accessory sensory cell chemoreceptors	Tactile reception uses	104) __A__
E)	Accessory sensory cell photoreceptors	Temperature reception uses	105) __C__

106-110. Place these structures in the order that <u>somatosensory signals</u> travel in the PNS and CNS.

A)	Thalamus	first	106) __E__
B)	Axons of the sensory neurons	second	107) __B__
C)	Primary somatosensory cortex	third	108) __D__
D)	Spinal cord or medulla oblongata	fourth	109) __A__
E)	Receptors of general sensory neurons	fifth	110) __C__

111-115. Matching

A)	Posterior column pathways	Carry signals about touch	111) __A__
B)	Spinothalamic pathways	Carry signals about temperature	112) __B__
		Carry signals about tissue damage	113) __B__
		Primary sensory neurons synapse in spinal cord	114) __B__
		Primary sensory neurons synapse in medulla oblongata	115) __A__

Fill in

1. In a cell membrane, the __fatty__ __acids__ of the phospholipids face each other.
2. It is difficult for polar molecules to pass through the center of the phospholipid bilayer because __polar__ molecules are repelled by __non-polar__ molecules.
3. A transmembrane proteins that serves as a passageway for *diffusion* of an ion across a cell membrane is called a __channel__.
4. Using # 3 above, Na^+ can move from an area of __high__ Na^+ concentration to an area of __low__ Na^+ concentration.
5. Using # 3 above, water can move from an area of __high__ water concentration to an area of __low__ water concentration.
6. A transmembrane protein that uses ATP to change shape and transport ions is called a __pump__.
7. Using # 6 above, Na^+ can move from an area of __low__ to an area of __high__ concentration.
8. The resting ion concentrations inside and outside of a neuron (or other cell) are produced largely by transmembrane proteins called __pumps__.
9. __Lipid__ soluble chemical messengers frequently bind to response element binding proteins in the intracellular fluid.
10. __Water__ soluble chemical messengers typically bind to channel linked receptors, tyrosine kinase linked receptors, or G-protein coupled receptors.
11. Channel linked receptors that bind to and respond to chemical messengers are frequently called __ligand__ gated channels.
12. __Glycine__ binds to and opens ligand gated Cl^- channels.
13. __Glutamate__ binds to and opens ligand gated Na^+ channels (AMPA receptors).
14. __GABA__ binds to G-protein coupled receptors and opens K^+ channels.
15. __Glutamate__ is an example of a messenger that binds to GPCRs and opens Ca^{2+} channels
16. __Movement__ gated channels open in response to specific distortion.
17. __Voltage__ gated channels open in response to specific membrane potentials.
18. __Ligand__ gated channels open in response to specific chemical messengers.
19. __Calcium__ is essential for the fusion of the synaptic vesicles to the presynaptic membrane
20. The secretion of __excitatory__ and __inhibitory__ neurotransmitters onto the dendrites of multipolar neurons is the foundation for neural information processing.
21. __Inhibitory__ neurotransmitters can nullify (reverse) the effects of excitatory neurotransmitters.
22. Sensory transduction converts a __physical__ stimulus into a neural signal.
23. In the posterior (dorsal) column pathways the primary sensory neurons synapse in the __Medulla__ __oblongata__ (two words).