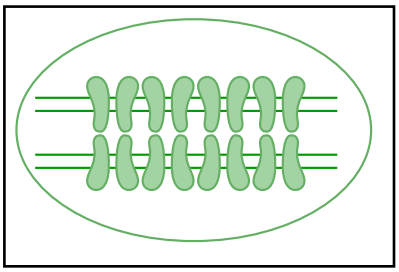
HST 131/Neuro 200
Exam I Solutions , Sept 24, 2003

1) A,C,D 2) A 3) A,C,F 4) A,E

5)

A	Originates from a specialized segment from the cell body
AD	Unmyelinated
D or AD	Contains ER or ribosomes
A	Cylindrical in shape
___	Does not branch
AD	Can contain presynaptic release sites
AD	Contains voltage-gated ion channels



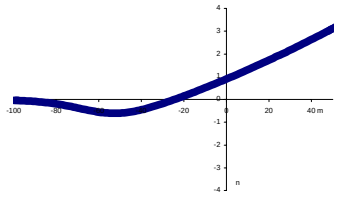
6) dynein, microtubules, 0,5 days at ~200mm/day, herpes, polio, rabies

7) A: spine B: dendrite C: soma/cell body D: nucleus E: axon hillock F: axon/initial segment G: myelin
J: presynaptic terminal K: vescicle L: clathrin-coated membrane[1] M: synaptic cleft N: Active zone
O: postsynaptic terminal
CNS: (many)
PNS: ACh

8) (in mV)

1.	voltage-gated potassium channel	-70 to -95
2.	voltage-gated sodium channel	+50 to +70
3.	voltage-gated calcium channel	+100 to +250
4.	ACh receptor channel	-20 to +20
5.	NMDA receptor channel	-20 to +20
6.	$GABA_A$ receptor channel	-70 to -20

9)



10) b 11) d

12) Absolute refractory period: *2pts* Impossible to fire an action potential.
Relative refractory period: *2pts* Can fire an AP with added stimulus.

13 a) Note: in the answer, the words "hyperpolarized" and "depolarized" are important.
-You block 25% of the cell's sodium channels with a small amount of TTX.
1.5pts Depolarized: A more depolarized potential would need to be reached for action potential initiation because you have less sodium current will be available to initiate the cascade.
-You apply a drug that shifts the Vmid for opening of potassium channels to a 50mV more depolarized.
1.5pts
Either:
Hyperpolarized: Less K channels will be open to counter the AP, making it easier, and thus the threshold will occur at a low (hyperpolarized) potential.
Or
No change: V-gated K channels are so slow that their voltage dependence would have an effect on the repolariztion of an AP, but not its initiation.
b) -You slow potassium channel opening by a factor of 4. *Increase*
-A mutation causes sodium channels to inactivate with a time constant 3 times faster than normal. *Decrease*

14) resistance (or thickness), capacitance

15) a) B b) C c) vagal nerve stimulation, surgery, ketogenic diet

16) Synaptobrevin - Vesicle
Syntaxin - Active Zone/Plasma Membrane
SNAP-25 - Active Zone/Plasma Membrane (0.7 for each correct one, up to 2.0)

17) Both cleave SNARES, blocking vesicular release.
The toxins differ in their tropism/affinity for uptake into different neurons:
*Tetanus - selective uptake into inhibitory interneurons in the spinal cord, thus disinhibiting motor neurons (rigid paralysis). Tetanus cleaves VAMP. (1.5)
*Botulism - selectively targets motor neurons, and thus release at the NMJ. thus, no excitation of muscles (flaccid paralysis). Various types of Botulinum toxins (Bot A-G) cleave VAMP, Syntaxin, or SNAP-25. (1.5)

Partial credit for knowing the mechanism of action (cleavage of SNARES) without explaning the difference.

[1] Since Dr. Corey announced that L referred to the cage-like structure, endosome was not a sufficient answer unless accompanied by further explanation, and nor was transmitter.

18) Required conditions for NMDA to open:
a) Glutamate (agonist) binding (1.0)
b) Glycine (co-agonist) binding (1.0)
c) Cell depolarized to relieve Mg+2 block (1.0)

19) Properties (any of a number of correct answers acceptable; 1.0 for each):
Ionic permeability (especially Ca+2) (NMDA yes, AMPA not if edited GluR2 subunit is included)
Glutamate affinity (NMDA high, AMPA low)
Channel opening timecourse (NMDA slow, AMPA fast)
Channel closing timecourse (NMDA slow, AMPA very fast)
Desensitization (AMPA)

Molecular Mechanisms to Produce the Variation (0.7 for each, up to 2.0):
RNA editing (GluR2 Q to R)
RNA splice variation (FLIP/FLOP, but also GluR2 vs GluR2L, etc.)
Subunit composition/heteromultimerization (Tetrameric channels)

20) A, D (0.4 for each correct answer; 0.4 for not circling wrong answer)
21) A, D (0.5 for each correct answer; 0.5 for not circling wrong answer)
22a) no change (1pt), b) increase (1pt), c) none (1pt) d) none (1pt)

23a) ACh, b) muscarinic AChR, c) K+, open, inward rectifier/ Kir3.1, 3.2 24) A,B,E

25) V = Vo*e^(-x/lamda)
V = 20*e^(-300/200)
V = 4.46 mV

26) A, B, D 27) A,E 28) D 29) B,D 30) B, C 31)C,D 32) D,E