

Name _____ **KEY** _____

**Nsci 4100: Development of the Nervous System
2018 Examination 1**

Write your name on this page! On your scantron answer sheet, enter your name (last name, space, first name), internet ID (X.500 name) and student number. Please do it now!!!

Class 2 & 3 neuro 101

1. Neurons can receive synaptic input on all parts of the cell EXCEPT the ...
 - A. axon.
 - B. dendrite.
 - C. soma.
 - D. None of the above is correct.
 - E. More than one of the above are correct.

2. The cell bodies of which of the following cell types can be found in the peripheral nervous system?
 - A. neuron
 - B. oligodendrocyte
 - C. astrocyte
 - D. schwann cell
 - AD E. More than one of the above are correct.

3. The typical flow of information in a motor neuron is ...
 - A. soma > axon > synapse > dendrite
 - B. dendrite > soma > axon > synapse
 - C. axon > soma > dendrite > synapse
 - D. soma > axon > dendrite > synapse
 - E. soma > dendrite > axon > synapse

4. What is the main function of spines found on the dendrites of some neurons?
 - A. postsynaptic sites
 - B. presynaptic sites
 - C. for protection
 - D. sites where action potentials are initiated
 - E. More than one of the above are correct.

5. A neuron that is said to be at rest has a higher concentration of which ion inside the cell than is present outside the cell?
 - A. sodium (Na⁺)
 - B. potassium (K⁺)
 - C. chloride (Cl⁻)
 - D. calcium (Ca⁺⁺)
 - E. More than one of the above are correct.

6. What effect does excitatory synaptic activity have on a neuron?
- A. hyperpolarizes the cell (i.e. the membrane potential becomes more negative)
 - B. hyperpolarizes the cell (i.e. the membrane potential becomes more positive)
 - C. depolarizes the cell (i.e. the membrane potential becomes more negative)
 - D. depolarizes the cell (i.e. the membrane potential becomes more positive)
7. What cell type has 'endfeet' that surround capillaries in the central nervous system?
- A. neuron
 - B. oligodendrocyte
 - C. astrocyte
 - D. schwann cell
 - E. More than one of the above are correct.
8. What cell type forms the myelin wrapping around some axons?
- A. pericyte
 - B. oligodendrocyte
 - C. astrocyte
 - D. schwann cell
 - BD E. More than one of the above are correct.
9. Which of the following statements regarding the autonomic (visceral) motor system is NOT true?
- A. The soma of the neurons that synapse with glands, blood vessels, and smooth muscle are in ganglia.
 - B. The soma of some neurons that are part of this system and that have axons in the peripheral nervous system are in the brain or spinal cord.
 - C. Sympathetics and parasympathetics are both divisions of the autonomic nervous system.
 - D. Very little of the autonomic nervous system is under conscious control.
 - E. All of the above are true, and none is false.
10. What cell type has axons that run in the optic nerve?
- A. lateral geniculate nucleus neuron
 - B. retinal amacrine cell
 - C. retinal ganglion cell
 - D. retinal photoreceptor cell (also known as rod and cone cells)
 - E. More than one of the above are correct.

Class 4 & 5 embryology

11. How many cell layers compose the embryonic disk in the blastula stage embryo?
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 5

12. Incomplete closure of the anterior neuropore results in ...

- A. spina bifida.
- B. hydrocephaly .
- C. anencephaly.
- D. neurulation.
- E. formation of the 4th ventricle.

13. The retina develops from an out-pocketing of the ...

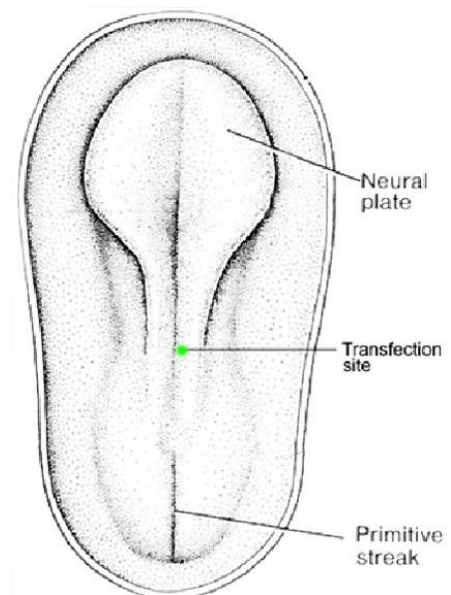
- A. midbrain.
- B. forebrain.
- C. epidermis.
- D. somites.
- E. notochord.

14. Imagine that you stably transfected a small group of cells just off the midline of the caudal neural plate as indicated in the figure. You transfected the cells with a constitutively expressed reporter gene such as green fluorescent protein (GFP). All cells generated by division of the transfected cells would carry the GFP gene and express GFP. Thus, you can follow the lineage of the cells that you originally transfected. Which of the following cell types would you think most likely to express GFP in the adult?

- A. motor neurons in the spinal cord
- B. neurons in the dorsal horn of the spinal cord
- C. neurons in dorsal root ganglia
- D. neurons in the vestibular nuclei
- E. More than one of the above are correct.

15. Which of the following cell types could have developed from cells in the lateral margins of the neural plate?

- A. motor neurons
- B. sympathetic ganglia neurons
- C. oligodendrocytes
- D. Schwann cells
- BD E. More than one of the above are correct.



Class 6 induction

16. Which of the following is true regarding Spemann's organizer?

- A. It later becomes epidermis.
- B. It later becomes axial mesoderm.
- C. It induces neural tissue in the underlying endoderm.
- D. It only exists in avian embryos.
- E. None of the above is correct.

17. What would be the cell fate of animal cap cells harvested from a late blastula stage frog embryo, dissociated and maintained in culture at low cell density?
- A. epidermis
 - B. neurons
 - C. notochord
 - D. muscle
 - E. The cells would remain undifferentiated (i.e. have no obvious fate).
18. What effect does BMP4 have on ectoderm cells in the gastrula stage embryo?
- A. inactivates Smads
 - B. promotes expression of Zic1
 - C. represses expression of Sox2
 - D. activates the Erk/MAPK pathway
 - E. More than one of the above are correct.

Class 7 & 8 regionalization (from Dr. Nakagawa)

Everyone received credit for question 19.

19. Which statement is NOT true about Wnt signaling during regionalization?
- A. Frizzled and LRP6 are the co-receptor for Wnts.
 - B. Without Wnt binding to the receptors, β -catenin is targeted for degradation.
 - C. Soluble Wnt inhibitors are expressed in the rostral neural plate.
 - D. Injecting both Noggin and Wnt mRNAs into *Xenopus* embryos induces caudal neural tissue.
 - E. All of the above statements are true.

Everyone received credit for question 20.

20. The rostral end of the line that abuts the alar plate and basal plates is located within:
- A. thalamus
 - B. hypothalamus
 - C. midbrain
 - D. hippocampus
 - E. None of the above is correct.

21. Which of the following is NOT true about homeotic mutations?
- A. A mutation in which even numbered body segments are missing is called a homeotic mutation.
 - B. A mutation in which there are two pairs of wings instead of one pair is called a homeotic mutation.
 - C. Mutations in homeobox genes or their abnormal expression are responsible for homeotic mutations.
 - D. Homeobox genes in the mouse genome are all clustered on a chromosome so that their expression along the anterior-posterior axis of the embryo corresponds to their order on the chromosome.
 - AD E. More than one statement are NOT true.

22. The early regionalization results in distinct expression of two transcription factors Gbx2 and Otx2. Which two structures form rostral and caudal to their expression boundaries?
- A. diencephalon and midbrain
 - B. midbrain and hindbrain
 - C. hindbrain and spinal cord
 - D. cerebral cortex and hypothalamus
 - E. None of the above is correct.

23. Which of the following statements is NOT true regarding regionalization?
- A. Many signaling pathways involved in regionalization of the vertebrate nervous system were initially discovered with *Drosophila* genetics.
 - B. Regionalization establishes the identity of neural progenitor cells that is appropriate for their location within the embryo.
 - C. Mechanisms of regionalization is similar between vertebrate species.
 - D. Early regionalization rostralizes the neural tissue that is initially formed with a caudal identity.
 - E. All of the above statements are true.
24. What is the similarity between primary (Spemann's) and secondary organizers?
- A. Both induce neural tissue from undifferentiated ectoderm
 - B. Both secrete BMP inhibitors
 - C. Both are located within the mesodermal tissue
 - D. Upon transplantation, both induce an ectopic fate in the host tissue.
 - E. More than one of the above are similar between primary and secondary organizers.

Class 9 & 10 cell division

25. Asymmetric neurogenic cell divisions are required for the exponential expansion of the cell population in the early developing neural tube. True or false?
- A. true
 - B. false
26. Which of the following statements regarding the neuroepithelial cells in the early neural tube is NOT true?
- A. Neighboring cells are linked together at their apical ends by adherens junctions.
 - B. Cells have a cilium that projects into the lumen of the tube.
 - C. Cells have endfeet in contact with the basal lamina that lines the ventricle.
 - D. Cells undergo M-phase near the ventricular surface.
 - E. More than one of the above are NOT true.
27. Primates, including humans, have a progenitor cell population in the developing cortex that is rarely found in rodents. In what layer are these dividing cell typically found?
- A. cortical plate
 - B. subventricular zone
 - C. outer subventricular zone
 - D. ventricular layer
28. In the developing nervous system, which phase of the cell cycle is most likely to vary in length?
- A. G1
 - B. G2
 - C. G3
 - D. S
 - E. M

29. The laboratory technique, in situ hybridization, is used to detect what type of molecule? (Indicate the best answer.)

- A. DNAs (genes)
- B. mRNAs
- C. proteins
- D. proteins, glycoproteins and some lipids

30. Which of the following statements is true regarding retinoblastoma protein (Rb)?

- A. Rb is dephosphorylated by cyclins during G1-phase of the cell cycle.
- B. Active Rb binds E2F factors.
- C. Active Rb promotes expression of DNA polymerase.
- D. Mutations in the Rb gene have been associated with reduced cell division.
- E. More than one of the above are correct.

Class 12 & 13 cell fate

31. Notch ...

- A. is a secreted factor.
- B. is a cell surface ligand for its receptor.
- C. is cleaved when activated, and a fragment of Notch functions in the nucleus.
- D. is a receptor tyrosine kinase.
- E. More than one of the above are correct.

32. What effect would you expect if you experimentally misexpressed Neuregulin-1 (Nrg1) in sclerotome cells on one side of an early chick embryo compared to the contralateral (control) side?

- A. Crest cells that give rise to the peripheral nervous system would migrate dorsolaterally.
- B. Fewer melanocytes would migrate into the skin.
- C. Dorsal root ganglia would fail to form, or if they did form, they would have fewer neurons and more glia.
- D. Dorsal root ganglia would develop, but would have more neurons and fewer glia.
- E. More than one of the above are correct.

33. Sonic Hedgehog deactivates the integral membrane protein Patched. True or false?

- A. true
- B. false

34. At the time of birth in the rodent retina, most rod cells and Muller glia are being generated. Imagine that a drug was administered to a newborn rodent that exclusively killed all the retinal ganglion cells. What effect would you expect this to have on cell genesis in the retina that animal?

- A. Retinal ganglion cells would be generated again.
- B. A reduced number of rods and Muller cells would be generated.
- C. More rods and Muller cells would be generated.
- D. There would be minimal change in the cell types generated.
- E. More than one of the above are correct.

35. bHLH proneural factors typically ...

- A. bind the E-box of certain genes involved in neuronal differentiation.
- B. block differentiation and maintain progenitor cells in a division mode.
- C. are each linked to generation of specific cell fates within a domain of the nervous system.
- D. block expression of Delta.

→AC E. More than one of the above are correct.

36. Lineage tracing studies in developing retina showed that a single progenitor cell can generate ...

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- A. all types of retinal neurons and glia.
 - B. all types of retinal neurons or glia, but never both.
 - C. early produced retinal cell types including ganglion cells and cones, or late produced cell types including rods and Muller glia, but never both.
 - D. only a single type of retinal neuron or glial cell, and very seldom multiple cell types.

37. Which of the following statements regarding mechanisms that determine cell fate in the developing cerebral cortex is true?

- A. Activation of Notch in progenitor cells is required for cells to be responsive to Cardiotrophin-1 (Ct-1).
- B. Cardiotrophin-1 represses glial genesis.
- C. Activated Stat3 is a transcription factor that promotes expression of glial-specific genes.
- D. Platelet derived growth factor (PDGF) promotes generation of astrocytes.

→AC E. More than one of the above is correct.

Class 14 discussion

38. In the early developing vertebrate spinal cord, what secreted factor promotes expression of cyclin D?

- A. Wnt
- B. Shh
- C. Notch
- D. EGF

→ABD E. More than one of the above are correct.

Class 15 research (from Dr. Lanier)

39. What was the most important factor in getting medium spiny neurons in culture to have normal looking dendritic arbors?

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- A. co-culture medium spiny neurons with cortical cells
 - B. co-culture medium spiny neurons with substantia nigra cells
 - C. add dopamine to the medium in the cultures of medium spiny neurons
 - D. add glutamate to the medium in the cultures of medium spiny neurons
 - E. maintain the medium spiny neurons in culture at least 14 days

Class 16 research (from Dr. Nakagawa)

40. Which statement is true regarding layer 4 neurons in the primary somatosensory cortex of a rodent?

- A. They are the main recipients of the thalamic input.
- B. Their number is reduced in mice lacking thalamocortical projections.
- C. Their number is controlled by microglia.
- D. Each of their “barrel-patterned” aggregates is a functional unit corresponding to a whisker pad on the face.
- all E. More than one of the above are true.

The End!

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