

Practice questions:

1. The paraxial mesoderm gives rise to somites. The structure of the somite
 - a) is a loose mesenchymal sheet that will migrate toward the notochord.
 - b) is an epithelial rosette with tight junctions and adhesive molecules.
 - c) varies across developmental time (e.g., somites formed early [(e.g., 21 days post-conception) vs late (25 days post-conception)]).
 - d) is epithelial at the cranial end vs the thoracic region.
2. Segmentation of peripheral nerves in the trunk is
 - a) independent on the somites.
 - b) dependent on the differences in chemical signals from the cranial vs caudal half of each somites.
 - c) has a completely different mechanism from the segmentation of the dorsal root ganglia.
 - d) dependent on brain segmentation.
3. A derivative of the somites is the vertebral column. The first step in the formation of the segments of the vertebral column is
 - a) for the somites to return to the somitomere state.
 - b) for the somites to undergo an epithelial to endodermal transition.
 - c) for the caudal half of one somite and cranial of the next somite to migrate, forming the vertebrae .
 - d) for both the medial and lateral aspects of the somite to migrate and contribute equally the vertebrae.
4. It is difficult to determine the precise number of somite pairs, particularly in the human, because
 - a) humans do not form tight, epithelial somites.
 - b) the transition time from epithelial rosette to migratory mesenchyme is rapid.
 - c) Only somitomeres are formed.
 - d) Addition of somites is very slow.
5. The developmental fates of the cells of the somite vary by their location within the somite. Those cells that give rise to the segmental muscles and skeletal muscles of the limbs arise from the myotome. Which of the following statements are true concerning the myotome?
 - a) The cells found (for the most part) in the more lateral aspect of the somite.
 - b) These cells delaminate from the epithelial somite after those of the sclerotome.
 - c) The myotome divides into the epimere and hypomere each of which gives rise to anatomically distinct muscle groups.
 - d) All of the above.

6. Within the somite there are cells set aside which will give rise to
 - a) endothelia of blood vessels.
 - b) hair cells of the skin.
 - c) joint surfaces.
 - d) All of the above.

7. The formation of somites per se is
 - a) cell autonomous.
 - b) dependent on the notochord.
 - c) dependent on the spinal cord.
 - d) dependent on the intermediate mesoderm.
 - e) None of the above.

8. Somite pairs are formed sequentially. To accomplish this orderly pattern
 - a) There is the expression of genes known collectively as the molecular oscillator.
 - b) To start the clock “ticking” the paraxial mesoderm responds to the “competition” between signaling molecules including retinoic acid and fibroblast growth factor 8.
 - c) The initiation of expression of segmental genes is dependent on Notch signaling.
 - d) All of the above.

9. What makes one somite different from another? Somite identity is determined, at least in part, to the
 - a) overlapping expression of HOX genes.
 - b) location of pre-somitic mesoderm along the rostral-caudal axis.
 - c) “a” above has been established by naturally occurring or induced alterations in the exposure of embryos to substances that suppress or enhance a particular HOX gene’s expression.
 - d) “b” above has been established by experiments involving tissue transplantation.
 - e) All of the above.

10. Activation of Notch signaling
 - a) requires two proteolytic cleavages of the original transmembrane Notch.
 - b) is ligand independent.
 - c) requires ion channel modulation.
 - d) insertion of the peptide following Notch cleave into the plasma membrane.

11. The mammalian kidney arises from the following embryonic tissues;
 - a) metanephric mesenchyme
 - b) ciliated epithelium
 - c) ureteric bud
 - d) a and c
 - e) a, b, & c

12. Which of the following are true of urinary tract malformations?

They are often asymptomatic

- a) They involve both the ureter and the kidney.
- b) They involve either the ureter or the kidney but never both.
- c) a and b
- d) a and c

13. Which of the following are true of urinary tract malformations?

- a) They are the most common cause of pediatric kidney failure.
- b) They are always symptomatic.
- c) They can be asymmetric.
- d) a and c

14. Children with bilateral renal agenesis die due to complications involving the following organ(s):

- a) heart
- b) lung
- c) liver
- d) pancreas
- e) all of the above

15. Which of the following are true of inheritance pattern of autosomal dominant polycystic kidney disease?

- a) Male children of affected males have a 50% chance of inheriting the disease gene.
- b) Female siblings of affected males have a 25% chance of being affected.
- c) There is no female to male transmission.
- d) Males are more frequently affected than females.
- e) a and b

16. Which of the following are true about human urinary tract malformations?

- a) Renal dysplasia can be associated with cysts.
- b) Patients with renal hypoplasia have small, narrow ureters.
- c) Unilateral renal agenesis can be asymptomatic.
- d) a and c
- e) a, b and c

17. Which of the following are true about vesicoureteral reflux?

- a) It requires immediate surgical correction.
- b) It is commonly associated with polycystic kidney disease.
- c) It is associated with backflow of the ureteric bud into the metanephric mesenchyme.
- d) It predisposes to urinary tract infections.
- e) a and d

18. Which of the following are true about dysplastic kidney?
- a) It can be associated with vesicoureteral reflux.
 - b) It can be caused by mutations in the PAX2 gene.
 - c) It can be caused by mutations in the PKD1 gene.
 - d) a and b
 - e) a, b and c
19. Which of the following are true about polycystic kidney disease?
- a) Cysts can develop in the liver and cardiac tissue.
 - b) Virtually all affected individuals progress to kidney failure.
 - c) Hemorrhage into cysts produce characteristic itching sensation.
 - d) The recessive type is the most common genetic kidney disease in humans.
 - e) b and d
20. Which of the following are true about human urinary tract malformations?
- a) Most of the disease genes have been identified.
 - b) Many of the genes implicated to date participate in a common molecular pathway.
 - c) Most cases are syndromic.
 - d) Most cases are caused by chromosomal abnormalities.
 - e) b and d
21. Many of the genes mutated in cystic kidney diseases encode proteins that localize to
- a) propulsive flagella
 - b) primary cilia
 - c) golgi apparatus
 - d) solute transporters
 - e) b and d
22. Which one of the following statements about Spemann's Organizer is TRUE?
- a) If transplanted to an ectopic position, it will develop into a secondary neural tube.
 - b) If transplanted to an ectopic position, it will induce adjacent tissue to form a secondary neural tube.
 - c) When isolated from an embryo and cultured, it will give rise to neural tissue.
 - d) Is ectodermally-derived.
23. Which of the following families of secreted molecules is NOT associated with patterning neuronal identities?
- a) FGF
 - b) SHH
 - c) BMP
 - d) SLIT

24. Defects in SHH signaling are often associated with
- holoprosencephaly
 - lissencephaly
 - spina bifida
 - anencephaly
25. Astrocytes are derived from progenitors in the:
- ventricular layer
 - mantle layer
 - cortical plate
 - pre-plate
26. Glutamatergic neurons migrate to their final position in the cortex along:
- the rostral migratory stream
 - astrocytes
 - radial glia
 - pre-plate
27. Which of the following is NOT a diffusible signal involved in axon guidance?
- ephrin
 - netrin
 - slit
 - laminin
28. Axons expressing an EphB tyrosine kinase receptor would be:
- attracted to a high concentration of EphrinBs.
 - repelled by a high concentration of EphrinBs.
 - attracted to a high concentration of EphrinAs.
 - repelled by a high concentration of EphrinAs.
29. Which of the following statements about the role of apoptosis in normal CNS development is TRUE?
- is limited to specific nuclei/regions.
 - is influenced by target innervations.
 - occurs at roughly equal rates across the developing neural tube.
 - is limited to the postnatal period in rodents.
30. In rodents, the most dramatic increase in synaptic formation is observed:
- during gestation.
 - in the first two postnatal weeks.
 - in the second and third postnatal weeks.
 - after one month of age.

31. Saethre-Chotzen syndrome (SCS) patients display a range of morphological defects in their limbs. These can include syndactyly, and bifid or triphalangeal big toes. The molecular defect in SCS is known to occur in a transcription factor called TWIST1. Which of the following processes do you think it is likely that TWIST1 modulates?

- a) proximodistal patterning
- b) anteroposterior patterning
- c) programmed cell death
- d) a and b
- e) b and c

32. The activity of which molecular pathway(s) are likely to be altered in SCS limbs?

Shh

- a) BMP
- b) Wnt
- c) a and b
- d) b and c

33. If you removed the ectoderm from a right forelimb bud after outgrowth had started, rotated it across the dorsoventral axis, and transplanted it onto another right forelimb of the same developmental age, which axis or axes would you expect to see altered after the resulting limb had grown out?

- a) dorsoventral
- b) proximodistal
- c) anteroposterior
- d) none of the above

34. If you did the same experiment as in Q5, but transplanted the ectoderm to a right hindlimb of the same age, what would be changed?

- a) dorsoventral patterning
- b) proximodistal patterning
- c) anteroposterior patterning
- d) forelimb vs hindlimb identity
- e) none of the above

35. If you transplanted the ectoderm in Q5 onto a younger right hindlimb bud, but did not rotate the ectoderm around the DV axis, what would be altered?

- a) dorsoventral patterning
- b) proximodistal patterning
- c) anteroposterior patterning
- d) forelimb vs hindlimb identity
- e) none of the above

36. The ureteric bud gives rise to:
- Nephrons
 - The renal interstitium
 - The collecting duct system
 - The loop of Henle
 - The distal convoluted tubule
37. Which is NOT TRUE about branching morphogenesis:
- Branching morphogenesis depends on signals from nephron progenitors
 - Branching morphogenesis involves formation of an ampula at the ureteric bud tip.
 - Branching morphogenesis is a transient process that does not continue into adult life.
 - Branching morphogenesis forms the collecting duct system of the kidney.
 - Branching morphogenesis depends on expression of Gdnf in the ureteric bud.
38. The urothelium:
- lines the surface of the kidney, ureter and bladder.
 - expresses uroplakins.
 - is specialized for water absorption.
 - is specialized for salt absorption.
 - contains villi that secrete enzymes.
39. What is NOT TRUE about ureteral peristalsis
- It is mediated by specialized neural crest cells residing in the ureteral muscle similar to what occurs in the gut.
 - It is required for propelling urine from the kidney to the bladder.
 - It can be observed in vitro.
 - It is important for preventing functional obstruction.
 - It is mediated by ureteral muscle.
40. Transposition of the ureter from the Wolffian duct to the bladder depends on:
- Apoptosis of the bladder at the site where the ureter will insert.
 - Chemotaxis which induces the ureter to migrate from the Wolffian duct to the bladder.
 - Apoptosis of the common nephric duct.
 - Proliferation of the ureter.
 - Ascent of the kidney which pulls the ureter away from the Wolffian duct and allows it to fused with the bladder.

The End