Developmental Neurobiology Assessment (DNA)

Instructions: Please answer the following questions to the best of your ability.

1. Neural Crest Cells (NCC) are derived from what location?
   a. Dorsal neural tube
   b. Somites
   c. Notochord
   d. Ventral neural tube

2. As a physician, you encounter a child with craniofacial abnormalities, microcephaly, and micrognathia. Genetic analysis reveals a chromosome abnormality. Based on the phenotype observed, which NCC derivative is likely to be affected?
   a. Vagal
   b. Cranial
   c. Trunk
   d. Sacral

3. You perform additional tests, and your analysis demonstrates that NCCs fail to be induced at an early stage. What is most likely the cause of this failed induction?
   a. Sonic hedgehog signaling pathway defects
   b. Increased BMP
   c. Decreased BMP
   d. None of the above

4. As vertebrate development proceeds, the hindbrain becomes segmented into eight regions called:
   a. Rhombomeres
   b. Rhombencephalons
   c. Rhombiclips
   d. Rhomboids

5. You are a researcher, and you think you might have found a new gene associated with NCCs. When this gene is present, cell adhesion is high. However, when the gene is absent, cells lose adhesion and migrate away. What do you believe the role of the gene is, and how would that affect E-cadherin expression?
   a. Activation of the notch signaling pathway; induction of EMT
   b. Induction of EMT; decrease in E-cadherin expression
   c. Induction of EMT; increase in E-cadherin expression
   d. Production of cadherdase; decrease in E-cadherin expression

6. Activation of the gene, snail:
   a. Increases E-cadherin
   b. Decreases E-cadherin
   c. Coincides with activation of WNT signaling
   d. Both A and C
   e. Both B and C

7. You are a researcher and you have discovered a transcription factor that decreases NCC survival. How would you determine whether deletion of the gene affects cell survival?
   a. TUNEL assay

b. Determine cadherin expression
c. Use live imaging to track cell fate
d. None of the above

8. In humans, the pharyngeal arches develop into the:
a. Neural crest
b. Mandible
c. Gills
d. Rhombomeres

9. As a physician, you diagnose a patient with peripheral nerves defects, abnormal heart development, abnormal craniofacial development, and defects in enteric neuron function. Given these diagnoses, which stage of NCC development was most likely impacted (i.e., disrupted in order for these outcomes to have occurred)?
a. Induction
b. Neural tube closure
c. Neural crest migration
d. Neural crest differentiation
e. Both A and C are equally likely

10. Which statement regarding homeobox and Hox genes is true?
a. Every homeobox gene is a Hox gene
b. Every transcription factor is a homeobox gene
c. Every Hox gene is a homeobox gene
d. Every transcription factor is a Hox gene