Foundations of Neural Development 1st edition Breedlove Test Bank

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Test Bank
to accompany
Foundations of Neural Development
S. Marc Breedlove

Chapter 2: Development of a Body Pattern

Multiple choice

1. In humans, the pharyngeal arches develop into the
a. neural crest cells.
b. throat.
c. gills.
d. rhombomeres.
Answer: b
Textbook Reference: 2.1 Darwin Noted That Vertebrate Embryos Start Off Looking Alike, p. 54
Bloom's Level: 1. Remembering

2. Which maternal factor in the *Drosophila* egg accumulates at the end of the embryo that will become the head?
a. Bicoid
b. Nanos
c. Caudal
d. Syncytium
Answer: a
Textbook Reference: 2.2 Mother Knows Best: Maternal Factors Establish a Basic Polarity of the Body, p. 57
Bloom's Level: 1. Remembering

3. If *bicoid* mRNA is injected into the middle of a bicoid-deficient *Drosophila* egg syncytium, the embryo will develop a
a. head at one end, a tail at the other, and another head in the middle.
b. head at one end, a tail at the other, and another tail in the middle.
c. tail at both ends and a head in the middle.
d. head at both ends and a tail in the middle.
Answer: c
Textbook Reference: 2.2 Mother Knows Best: Maternal Factors Establish a Basic Polarity of the Body, p. 58
Bloom's Level: 3. Applying

4. Which class of genes initially establishes the anterior-posterior axis of the body plan?
a. Pair-rule genes
b. Gap genes
c. Maternal polarity genes
d. Hox genes

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Answer: c
Textbook Reference: 2.2 Mother Knows Best: Maternal Factors Establish a Basic Polarity of the Body, p. 58
Bloom's Level: 1. Remembering

5. Which class of genes directly influences the expression of pair-rule genes?
a. Realizator genes
b. Gap genes
c. Maternal polarity genes
d. Hox genes
Answer: b
Textbook Reference: 2.3 A Cascade of Gene Regulatory Proteins Organizes a Body Plan, p. 62
Bloom's Level: 2. Understanding

6. Which is the first class of *Drosophila* regulatory genes to use cell-cell signaling across the membrane?
a. Pair-rule genes
b. Gap genes
c. Maternal polarity genes
d. Segment polarity genes
Answer: d
Textbook Reference: 2.3 A Cascade of Gene Regulatory Proteins Organizes a Body Plan, p. 63
Bloom's Level: 3. Applying

7. 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.
Answer: c
Textbook Reference: 2.4 Some Mutations in *Drosophila* Transform Body Parts Whole, p. 66
Bloom's Level: 2. Understanding

8. Which set of genes shows colinearity?
a. Pair-rule genes
b. Gap genes
c. Hox genes
d. Segment polarity genes
Answer: c
Textbook Reference: 2.4 Some Mutations in *Drosophila* Transform Body Parts Whole, p. 67
Bloom's Level: 1. Remembering

9. Hox genes in *Drosophila* are similar to Hox genes in vertebrates because they _____ in both organisms.
a. are located on one chromosome
b. show colinearity

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c. have two complexes
d. developed by gene duplication and divergence
Answer: b
Textbook Reference: 2.5 Hox Genes are Crucial for Vertebrate Development, Too, p. 67
Bloom's Level: 2. Understanding

10. Which segment in early human brain development contributes to the cerebellum?
a. Telencephalon
b. Rhombencephalon
c. Prosencephalon
d. Mesencephalon
Answer: b
Textbook Reference: 2.6 Hox Genes Direct "Segmentation" in the Mammalian Brain, p. 69
Bloom's Level: 1. Remembering

11. In normal vertebrate development, the hindbrain is distinguished from the forebrain and midbrain by the differential expression of
a. homeobox genes.
b. pair-rule genes.
c. maternal polarity genes.
d. *Wnt1*.
Answer: a
Textbook Reference: 2.6 Hox Genes Direct "Segmentation" in the Mammalian Brain, p. 69
Bloom's Level: 2. Understanding

12. The homeobox gene _____ is only expressed in the posterior portion of the midbrain and marks the boundary between midbrain and hindbrain.
a. *engrailed*
b. *Gbx2*
c. *Wnt1*
d. fibroblast growth factor
Answer: a
Textbook Reference: 2.6 Hox Genes Direct "Segmentation" in the Mammalian Brain, p. 71
Bloom's Level: 2. Understanding

13. If scientists implant an acrylic bead infused with fibroblast growth factor into the middle of a developing chick embryo brain,
a. the brain will form an additional forebrain.
b. the embryo will die.
c. the brain will form an additional midbrain.
d. the brain will develop normally.
Answer: c
Textbook Reference: 2.6 Hox Genes Direct "Segmentation" in the Mammalian Brain, p. 72
Bloom's Level: 3. Applying

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14. As vertebrate development proceeds, the hindbrain becomes segmented into eight swellings called
a. rhombomeres.
b. rhombencephalons.
c. rhombiclips.
d. rhomboids.
Answer: a
Textbook Reference: 2.7 Hindbrain Rhombomere Fates are Directed by Homeobox Genes, p. 75
Bloom's Level: 1. Remembering

15. The structurally distinct swellings in the developing vertebrate hindbrain are demarcated by differential expression of
a. fibroblast growth factor.
b. ephrins.
c. bone morphogenetic protein.
d. retinoic acid.
Answer: b
Textbook Reference: 2.7 Hindbrain Rhombomere Fates are Directed by Homeobox Genes, p. 75
Bloom's Level: 1. Remembering

16. Ephrins are _____ that affect gene expression by _____.
a. transcription factors; binding to DNA
b. proteins; binding to DNA
c. proteins; altering signaling pathways within the cell
d. transcription factors; altering signaling pathways within the cell
Answer: c
Textbook Reference: 2.7 Hindbrain Rhombomere Fates are Directed by Homeobox Genes, p. 75
Bloom's Level: 2. Understanding

17. Exposure to _____ prevents the posterior neural plate cells from becoming epithelial cells by making those cells _____ sensitive to BMP signaling.
a. FGF; less
b. Wnt; less
c. FGF; more
d. Wnt; more
Answer: a
Textbook Reference: 2.8 Several Signals Designate the Caudal End of the Body and Nervous System, p. 78
Bloom's Level: 2. Understanding

18. Which developmental signal is also a powerful teratogen?
a. Fibroblast growth factor
b. Wnt
c. Retinoic acid
d. Bone morphogenetic protein
Answer: c

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Textbook Reference: 2.8 Several Signals Designate the Caudal End of the Body and Nervous System, p. 79
Bloom's Level: 1. Remembering

19. If a vertebrate embryo develops an enlarged posterior nervous system and little or no forebrain, what may have happened in development?
a. The embryo was over-exposed to fibroblast growth factor.
b. The embryo was over-exposed to retinoic acid.
c. The embryo was under-exposed to fibroblast growth factor.
d. The embryo was under-exposed to BMP.
Answer: b
Textbook Reference: 2.8 Several Signals Designate the Caudal End of the Body and Nervous System, p. 80
Bloom's Level: 3. Applying

20. The developmental signal _____ directs the development of the ventral portion of the spinal cord, and _____ directs the development of the dorsal portion of the spinal cord.
a. Sonic hedgehog; bone morphogenetic protein
b. retinoic acid; Sonic hedgehog
c. bone morphogenetic protein; Sonic hedgehog
d. Sonic hedgehog; retinoic acid
Answer: a
Textbook Reference: 2.9 Continued Gradients in BMP Signaling Establish the Dorsal-Ventral Axis in the Nervous System, p. 81, 83
Bloom's Level: 2. Understanding

21. Sonic hedgehog is secreted from the
a. neural tube.
b. ectoderm.
c. notochord.
d. roof plate.
Answer: c
Textbook Reference: 2.9 Continued Gradients in BMP Signaling Establish the Dorsal-Ventral Axis in the Nervous System, p. 81
Bloom's Level: 1. Remembering

22. Bone morphogenetic protein is secreted from the
a. neural tube.
b. ectoderm.
c. notochord.
d. floor plate.
Answer: b
Textbook Reference: 2.9 Continued Gradients in BMP Signaling Establish the Dorsal-Ventral Axis in the Nervous System, p. 83
Bloom's Level: 1. Remembering

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23. An animal can be born with a single telencephalon and a single eye if _____ signaling is disrupted during development.
a. bone morphogenetic protein
b. Sonic hedgehog
c. fibroblast growth factor
d. retinoic acid
Answer: b
Textbook Reference: 2.9 Continued Gradients in BMP Signaling Establish the Dorsal-Ventral Axis in the Nervous System, p. 83
Bloom's Level: 3. Applying

24. If the anterior-posterior axis of the spinal cord is disrupted, what can you conclude happened in development?
a. Sonic hedgehog signaling was blocked
b. Sonic hedgehog signaling was increased
c. Bone morphogenetic protein signaling was increased
d. Homeobox genes were dysfunctional
Answer: d
Textbook Reference: 2.10 Find Out Where You Are to Coordinate Your Fate with That of Your Neighbors, p. 85
Bloom's Level: 4. Analyzing

25. In the evolution of the human brain there were four crucial steps; which event was the first?
a. Social experience began to guide neural development
b. Sensory experience began to guide neural development
c. Cell-cell interactions began to determine cell fate
d. Electrical activity of neurons began to affect the fate of other cells
Answer: c
Textbook Reference: 2.10 Find Out Where You Are to Coordinate Your Fate with That of Your Neighbors, p. 85
Bloom's Level: 5. Evaluating

Short Answer

26. Describe the possible reasons why embryonic structure across species is so similar.
Answer: The similarities in embryonic structures across species: 1) could be evidence of a common ancestor; 2) could be because natural selection favors modifications that happen later in life, and there is no reason for traits that only confer advantages in adults to appear earlier in development; and 3) could be because most modifications of early embryonic events are lethal.
Textbook Reference: 2.1 Darwin Noted That Vertebrate Embryos Start Off Looking Alike, p. 53
Bloom's Level: 5. Evaluating

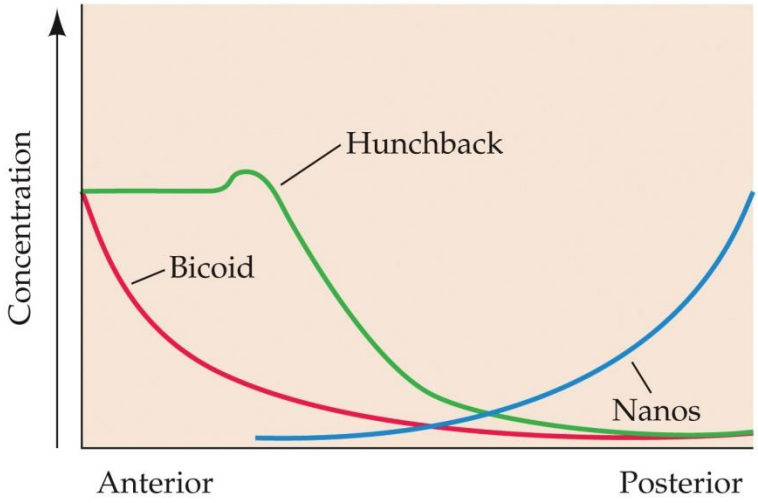
27. In insects, the early embryo consists of a single cell with one continuous cytoplasm containing many nuclei. How can those nuclei become different types of cells if they all started out in the same cytoplasm?

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Answer: The cytoplasm of the syncytium is not homogenous. Transcription factors are distributed in a particular fashion such that each nucleus is differentially affected by its environment.
Textbook Reference: 2.2 Mother Knows Best: Maternal Factors Establish a Basic Polarity of the Body, p. 56
Bloom's Level: 3. Applying

28. Refer to the graph.



Where is the highest concentration of hunchback protein expressed in the *Drosophila* embryo, and how do the antagonistic actions of maternal polarity genes *bicoid* and *nanos* result in sharper boundaries of hunchback gene expression?
Answer: Hunchback protein is mostly expressed in the anterior end of the embryo. Bicoid protein is generated at the anterior end of the embryo and inhibits *nanos* mRNA translation. Nanos protein is generated at the posterior end of the embryo and inhibits *hunchback* gene expression. This antagonistic effect of *bicoid* and *nanos* on hunchback results in more hunchback protein at the anterior end of the embryo with a sharp drop in expression where *bicoid* decreases and *nanos* increases.
Textbook Reference: 2.3 A Cascade of Gene Regulatory Proteins Organizes a Body Plan, pp. 61–62
Bloom's Level: 4. Analyzing

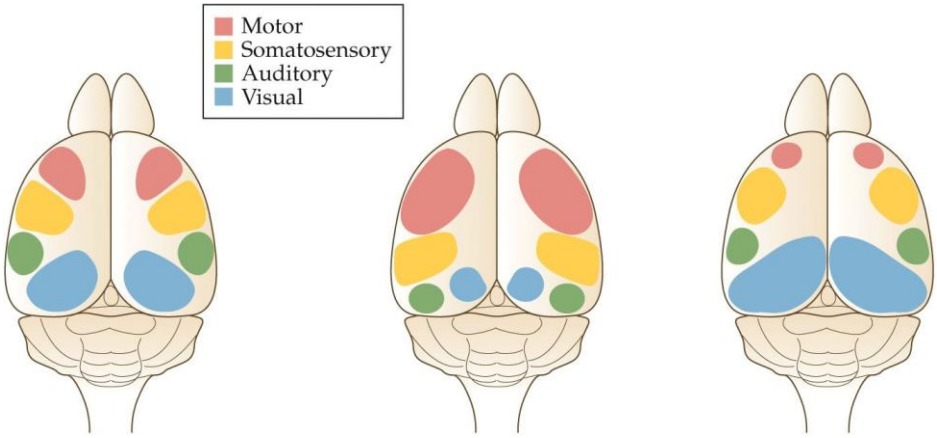
29. What is the relationship between Hox genes and realizator genes? How is their function different?
Answer: Hox genes control the expression of realizator genes. Hox genes are transcription factors that play a role in mapping out the organization of the body. Realizator genes are not transcription factors themselves; instead, they are genes that actually produce the proteins that affect the final structure and function of the cell so it can play its role in building a body part.
Textbook Reference: 2.4 Some Mutations in *Drosophila* Transform Body Parts Whole, p. 66
Bloom's Level: 4. Analyzing

30. What is a potential benefit of a random mutation that leads to a duplication in a gene?

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Answer: The second copy can take on a new role while the other copy continues to take care of whatever its original role was. This can lead to an organism being able to develop more complex structures and functions.
Textbook Reference: 2.5 Hox Genes are Crucial for Vertebrate Development, Too, p. 67
Bloom's Level: 5. Evaluating

31. Refer to the figure.



A normal wild-type mouse is shown in (A), a mutant mouse with enlarged rostral cortex centers is shown in (B), and a mutant mouse with enlarged caudal cortical centers is shown in (C). What specific mutations might (B) and (C) have?
Answer: Mouse (B) has an *Emx2* knockout mutation and mouse (C) has a *Pax6* knockout mutation.
Textbook Reference: 2.6 Hox Genes Direct "Segmentation" in the Mammalian Brain, p. 73
Bloom's Level: 4. Analyzing

32. In vertebrate nervous system development, what system is responsible for sharpening the homeobox gene expression boundaries between rhombomeres? How does this system work with respect to what the key players are, where they are located, how they interact, and how they influence gene expression and rhombomere boundaries? What does this mean for the fate of the cells that make up each rhombomere?
Answer: The ephrin system sharpens the boundaries between rhombomeres. Ephrins bind to ephrin receptors, both of which are membrane-bound, so ephrin signaling requires physical contact between cells, which then triggers second messenger signaling within the cell to indirectly influence gene expression. With this system, cells that are "out of place" in expressing a homeobox gene that its neighbors are not expressing will either stop expressing that gene or migrate to join other cells that are, leading to a sharp boundary in gene expression between rhombomeres. This results in distinct fates for the cells that make up the rhombomeres.
Textbook Reference: 2.7 Hindbrain Rhombomere Fates are Directed by Homeobox Genes, p. 76
Bloom's Level: 2. Understanding

33. What four factors in the vertebrate neurula direct cells to take on a fate appropriate for the caudal end of the animal? What two characteristics do these factors share?

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Answer: Fibroblast growth factor (FGF), Wnt, bone morphogenetic protein (BMP), and retinoic acid (RA) direct the caudal end of nervous system development. These factors are highly concentrated at the posterior end of the neurula, and they all regulate the expression of Hox genes.
Textbook Reference: 2.8 Several Signals Designate the Caudal End of the Body and Nervous System, pp. 78–79
Bloom's Level: 2. Understanding

34. In vertebrate nervous system development, what would happen to the neural tube if the notochord was removed? What would happen if a second notochord was transplanted to another part of the neural tube? What does this suggest about the function of the notochord?
Answer: If the notochord was removed, no floor plate would develop in the neural tube. If another notochord was transplanted to a different part of the neural tube, an additional floor plate would develop. This suggests that something secreted by the notochord directs the development of the floor plate.
Textbook Reference: 2.9 Continued Gradients in BMP Signaling Establish the Dorsal-Ventral Axis in the Nervous System, p. 83
Bloom's Level: 4. Analyzing

35. How is it that the body can randomly assign cells to a particular fate based solely on where they are located, and how is this accomplished?
Answer: Every cell has all of the genes necessary to take on any fate, so it is simply a matter of directing the cell to express the right genes in the right order, which can be accomplished with influences from neighboring cells.
Textbook Reference: 2.10 Find Out Where You Are to Coordinate Your Fate with That of Your Neighbors, p. 85
Bloom's Level: 5. Evaluating

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