

Molecular Biology

Midterm Exam 5

1. The Sevenless pathway regulates the development of the R7 cell during Drosophila eye development. What kind of molecule is Sevenless?

- A. A tethered ligand.
- B. A receptor tyrosine kinase
- C. A cytoplasmic kinase
- D. A nuclear transcription factor.

2. What would happen if the kinase activity of the Sevenless protein were to be eliminated by a missense mutation?

- A. The non-neuronal cone cells will be transformed into R7 cells.
- B. The R7 cell will be transformed into outer R1-6 type of photoreceptor
- C. The R7 cell will fail to form.
- D. Development of the R7 cell would not be affected.

3. What would happen if a constitutively activated version of the Sevenless protein were to be expressed in all four developing cone cells?

- A. The cone cells will be transformed into R7 cells.
- B. The cone cells will be transformed into the outer R1-6 type of photoreceptor.
- C. The cone cells will fail to form.
- D. Development of the cone cells will not be affected.

4. Which of the following is a false statement regarding receptor tyrosine kinases?

- A. Upon ligand binding receptor tyrosine kinases dimerize.
- B. Dimerization of receptor tyrosine kinases leads to phosphorylation of the kinase domains.
- C. The phosphorylation of the kinase domain leads to activation of the Ras cytoplasmic kinase.
- D. The cytoplasmic or intracellular domain of receptor tyrosine kinases translocates to the nucleus where it binds to transcription factors.

5. What role does the ERK/MAPK protein play in regulating receptor tyrosine kinase pathways?

- A. ERK/MAPK phosphorylates transcription factors within the nucleus
- B. ERK/MAPK binds to DNA binding proteins and aids in the repression of target genes.
- C. ERK/MAPK cleaves the intracellular portion of the receptor tyrosine kinase away from the transmembrane segment of the protein.
- D. ERK/MAPK binds to DNA binding proteins and aids in the activation of target genes.

6. The Notch pathway plays a critical role in the neuronal vs. epidermal cell fate decision. What would happen if the Notch receptor were eliminated in all cells?

- A. All cells will adopt a neuronal fate.
- B. All cells will adopt an epidermal fate
- C. Both neuronal and epidermal cells will fail to develop.
- D. Development of the neuronal and epidermal cell fates will not be affected.

7. What would happen if the Notch pathway were activated in all cells?

- A. All cells will adopt a neuronal fate.
- B. All cells will adopt an epidermal fate
- C. Both neuronal and epidermal cells will fail to develop.
- D. Development of the neuronal and epidermal cell fates will not be affected.

8. What would happen if the Su(H) DNA binding protein were unable to bind to the transcriptional co-repressors Hairless, Groucho and CtBP?

- A. All cells will adopt a neuronal fate.
- B. All cells will adopt an epidermal fate
- C. Both neuronal and epidermal cells will fail to develop.
- D. Development of the neuronal and epidermal cell fates will not be affected.

9. What would happen if the Delta ligand were unable to bind to the Notch receptor?

- A. All cells will adopt a neuronal fate.
- B. All cells will adopt an epidermal fate
- C. Both neuronal and epidermal cells will fail to develop.
- D. Development of the neuronal and epidermal cell fates will not be affected.

10. Which of the following is a true statement regarding the Notch receptor?

- A. Upon ligand binding the bound Notch receptors dimerize.
- B. The Notch receptor is phosphorylated within the cytoplasmic kinase domain.
- C. Activation of the receptor leads to the translocation of ERK/MAPK into the nucleus and the modulation of transcription of target genes.
- D. Upon binding of a ligand to the Notch receptor, the intracellular domain (ICD) will translocate to the nucleus, binds to a DNA binding protein and aids in the activation of target genes.

11. Many genes such as D-Pax2 are activated in particular cell types in response to a combination of signaling inputs. In the Drosophila retina D-Pax2 activation is critical to the formation of the cone cells. Based on your knowledge of how the D-Pax2 cone cell enhancer is regulated which of the following proteins is not required for the activation of D-Pax2 expression?

- A. Lozenge (Lz)
- B. Pointed (Pnt)
- C. Suppressor of Hairless (Su[H])
- D. Eyeless (Ey)

12. Based on your knowledge of the combinatorial code that exists for retinal cell fate specification what type of cell would you specify if the Lz and Pnt proteins were the only factors bound to the D-Pax2 enhancer?

- A. Undifferentiated Cells
- B. R3/R4
- C. R7
- D. Cone Cells

13. Which cell type would you specify if the Pnt protein was the only factor to bind to the D-Pax2 enhancer?

- A. Undifferentiated Cells
- B. R3/R4
- C. R7
- D. Cone Cells

14. What cell type would you specify if the Lz, Pnt and Su(H) proteins were all expressed in all cells within the developing eye?

- A. Undifferentiated Cells
- B. R3/R4
- C. R7
- D. Cone Cells

15. What is the effect of mutating Lz binding sites that are located within the D-Pax2 enhancer.

- A. The R3/R4 cell pair will fail to form.
- B. The R7 cells will fail to form.
- C. The cone cells will fail to form.
- D. There is no effect on cell specification.

16. Which of the following processes is regulated by microRNAs?

- A. Transcription
- B. RNA splicing
- C. DNA replication
- D. Translation

17. Which of the following members of the microRNA pathway cleave the mature 70nt pre-microRNA into the 21-25nt double-stranded mature microRNA?

- A. Drosha and Pasha
- B. Exportin-5
- C. Dicer
- D. Argonaut

18. Which of the following members of the microRNA pathway is a member of RISC and aids in the matching of microRNAs to complementary sequences within the 3' UTR of mRNAs?

- A. RNA Polymerase II
- B. Drosha and Pasha
- C. Loquacious
- D. Argonaut

19. What would happen if a microRNA that can form complementary base pairing with the 3' UTR of the eyeless mRNA is expressed throughout all tissues in Drosophila.

- A. The compound eye will be eliminated due to the block in translation of the eyeless RNA
- B. Ectopic eyes will form in the antenna, legs, wings and halteres due to an increase in transcription of the eyeless gene in these tissues.
- C. The eyeless mRNA will be translated at higher levels within the developing eye alone.
- D. There will be no effect on the development of the fly.

20. What would happen to a bacterial cell if you over-expressed the pri-microRNA that is predicted to bind to the 3' UTR of the RNA Polymerase mRNA?

- A. Transcription levels would be reduced due to a block in the translation of the bacterial RNA polymerase mRNA.
- B. Transcriptional levels would be reduced as the pri-microRNA will target the promoter of bacterial RNA polymerase and block its transcription.
- C. The pri-microRNA will target and increase translation of the bacterial RNA Polymerase mRNA. This in turn will result in overall higher levels of transcription.
- D. There will be no effect on transcription levels because bacterial cells lack the machinery to process pri-microRNAs.

21. The *Drosophila* eye can be used to identify genes that are required for growth. The assay involves comparing the size of a patch of tissue that is mutant for a random gene to tissue that is wild type for the same gene. The wild type tissue is red in color and the mutant tissue is white in color. If a mutation is made in a tumor suppressor gene then which of the following tissues will comprise the larger portion of the adult eye.

- A. Mutant (white)
- B. Wild type (red)
- C. Both mutant and wild type tissue will be the same size.

22. The Hippo signaling pathway is responsible for regulating cell proliferation in all animal cells. Based on your knowledge of this pathway which of the following best describes the effect that loss of function hippo (*hpo*) mutations have on tissues such as the head, eye and haltere?

- A. These tissues will be larger than wild type due to increased cell proliferation levels.
- B. Each of these tissues will undergo homeotic transformations and assume a new identity.
- C. These tissues will be smaller than wild type due to decreased cell proliferation rates.
- D. In each tissue a subset of cells will be transformed into ectopic eye tissue.

23. Which of the following best explains the phenotypic effect that mutants of the Hippo pathway have on tissue growth?

- A. The number of cells stays the same but each cell is larger than normal.
- B. The number of cells increases but each cell remains the same size as wild type cells.
- C. The number of cells and the size of each cell both increases.
- D. None of the above.

24. Which of the following best describes the effect that loss of function *yorki* (*yki*) mutations have on developing tissues such as the head, eye and haltere?

- A. These tissues will be larger than wild type due to increased cell proliferation levels.
- B. Each of these tissues will undergo homeotic transformations and assume a new identity.
- C. These tissues will be smaller than wild type due to decreased cell proliferation rates.
- D. In each tissue a subset of cells will be transformed into ectopic eye tissue.

25. Which of the following best describes how the Hippo pathway regulates the activity of the Yorkie transcription factor?

- A. The Hippo pathway directly activates the transcription of the Yki gene.
- B. The Yki protein is phosphorylated by the Hippo pathway and this in turn regulates the localization of Yki in either the cytoplasm or the nucleus.
- C. The Hippo pathway regulates the splicing of the Yki mRNA.
- D. The Hippo pathway activates the expression of a microRNA that can target and block the translation of the yki mRNA.

26. The *bantam* microRNA regulates the size of tissues. Which of the following is a true statement regarding the mechanism by which *bantam* regulates tissue size?

- A. *bantam* binds to and promotes translation of the *yorki* (*yki*) mRNA.
- B. *bantam* binds to and suppresses translation of the *hippo* (*hpo*) mRNA.
- C. *bantam* binds to and suppresses translation of the head involution defective (*hid*) mRNA.
- D. *bantam* binds to and promotes translation of several mRNAs that encode effector caspases.

27. Based on your knowledge of the relationship between the Hippo pathway and the bantam microRNA, which of the following clones will be the largest?

- A. Clones that are mutant for the bantam.
- B. Clones over-expressing yorki (yki).
- C. Clones that are wild type for all genes
- D. Clones that are mutant for the bantam microRNA and simultaneously over-expressing yorki (yki).

28. Expression of the head involution defective (hid) gene in the eye results in an increase in programmed cell death and a strong reduction (but not complete) of the developing retina. What would happen if you then removed the genes that code for the effector caspases?

- A. Cell death levels will increase and the eye will be completely eliminated.
- B. There will be no effect on cell death levels but the eye will be completely eliminated because effector caspases function downstream of the cell proliferation activator yorki (yki).
- C. Cell death levels will decrease and the structure of the eye will be restored.
- D. There will be no effect on cell death levels or eye structure since hid functions genetically downstream of the effector caspases.

29. Which of the following systems use temperature to determine the sex of their offspring?

- A. Humans and Mice
- B. Fruit flies
- C. Turtles and Alligators
- D. Birds

30. Which of the following best describes the ratio of the sex chromosomes to autosomes in female fruit flies?

- A. 1:1
- B. 1:2
- C. 2:1
- D. 4:1

31 Which of the following best describes the ratio of transcriptional activators to repressors in female fruit flies.

- A. 1:1
- B. 1:2
- C. 2:1
- D. 4:1

32. The Sex-lethal gene contains two promoters. One is called the early promoter (Pe) and the other is called the maintenance promoter (Pm). Which one of these promoters is under the control of the Sis-A and Sis-B activators as well as the Dpn repressor?

- A. Pe
- B. Pm
- C. Both A and B.
- D. None of the above.

33. Which of these two promoters directs the production of a mRNA transcript that requires Sxl protein for proper splicing?

- A. Pe
- B. Pm
- C. Both A and B.
- D. None of the above.

34. Transcription from the Pe promoter occurs in which of the following?

- A. Males
- B. Females
- C. Both A and B.
- D. None of the above

35. How would the ratio of male to female flies be affected if the Dpn gene were deleted?

- A. All flies would be male.
- B. All flies would be female.
- C. All flies will be both male and female.
- D. There will be no change to the population.

36. How would the ratio of male to female flies be affected if the SisA gene were deleted?

- A. All flies would be male.
- B. All flies would be female.
- C. All flies will be both male and female.
- D. There will be no change to the population.

37. How would the ratio of male to female flies be affected if an extra copy of the Sis-A gene were translocated to the Y chromosome?

- A. All flies would be male.
- B. All flies would be female.
- C. All flies will be both male and female.
- D. There will be no change to the population.

38. Some cells can outcompete others depending upon their genetic make-up. Levels of the myc gene have been shown to be important for conferring super-competitor status on cells. Imagine that one group of cells contains 2 copies of the myc gene while one group of cells contains 4 copies of the myc gene. Which of the two populations will function as a super-competitor cell type?

- A. The cell with two copies of myc.
- B. The cell with four copies of myc.
- C. Both cells will die out.
- D. Both cells will grow equally.

39. Based on the known requirements for cell competition which of the following are important?

- A. Myc levels
- B. Protein biogenesis
- C. Cell death
- D. All of the above.

40. Under which circumstance will a genetically compromised cell survive within an epithelium?

- A. The compromised cell will survive if it is surrounded by cells that also contain the same mutation.
- B. The compromised cell will always be eliminated by programmed cell death.
- C. The compromised cell will survive if it is surrounded by wild type cells.
- D. None of the above.

EXAM 5 ANSWER KEY

1. B
2. C
3. A
4. D
5. A
6. A
7. B
8. D
9. A
10. D
11. D.
12. C
13. B
14. D
15. C
16. D
17. C
18. D
19. A
20. D
21. A
22. A
23. B
24. C
25. B
26. C
27. B
28. C
29. C
30. A
31. C
32. A
33. A
34. B
35. B
36. A
37. B
38. B
39. D
40. A