

1. Which of the following correctly describes a prokaryotic cell?
- All prokaryotic cells are the same size as eukaryotic cells, but lack a nucleus.
 - All prokaryotic cells exist as single-celled organisms.
 - All prokaryotic cells have a flagellum, but no nucleus.
 - All prokaryotic cells have a cell wall, but no nucleus.
2. A graduate student has been asked to visualize the effect of Mycalamide B, a ribosome inhibitor, on cancer cells. Which of the following techniques should she use?
- DNA Microarray.
 - PCR.
 - Genome Sequencing.
 - 2D Gel Electrophoresis.
3. In cells treated with α -amanitin, an RNA Polymerase II inhibitor, which of the following would NOT be affected?
- The Proteome.
 - The Transcriptome.
 - Tryptophan operon expression in the absence of tryptophan.
 - Genome expression.
4. Which of the following statements concerning genome expression is correct?
- All of the cells in your body contain the same DNA, and therefore all have the same proteins.
 - Different cell types with the same DNA will express none of the same proteins.
 - Cells with the same DNA will express different proteins depending on extracellular stimuli.
 - Larger cells must have a greater number of genes being expressed.
5. Which of the following conditions will cause the highest expression of β -galactosidase in the *E. coli* *Lac* operon?
- Low glucose and high lactose.
 - High glucose and high lactose.
 - High glucose and low lactose.
 - Low glucose and low lactose.
6. Which of the following is a positive regulator of gene expression and is removed from DNA upon ligand binding?
- Lac repressor.
 - Trp repressor.
 - CAP.
 - None of the above.

7. Which of the following correctly describes molecular events inside *E. coli* under conditions of high glucose and low lactose?
- a. Low lactose levels produce high allolactose levels. Allolactose binds to the lac repressor. The activated lac repressor prevents *Lac* operon transcription.
 - b. High glucose levels produce high cAMP levels. cAMP binds to the CAP protein. The inactivated CAP protein does not bind to the CAP-binding site.
 - c. High glucose levels produce low cAMP levels. cAMP does not bind to the CAP protein. The inactivated CAP protein does not bind to the CAP-binding site.
 - d. Low lactose levels produce low allolactose levels. Allolactose does not bind to the lac repressor. The inactivated lac repressor allows *Lac* operon transcription.
8. A graduate student wishes to isolate the five *E. coli* enzymes required for tryptophan biosynthesis. Which of the following methods will allow him to create *E. coli* with high levels of these enzymes?
- a. Mutating the helix-turn-helix motif of the tryptophan repressor in *E. coli*.
 - b. Inserting gene activators of RNA polymerase II into *E. coli*.
 - c. Growing *E. coli* with high concentrations of tryptophan.
 - d. None of the above.
9. Which of the following will NOT facilitate the bacteriophage lambda switch from prophage to lytic pathway?
- a. DNA damage
 - b. Cro blocking the synthesis of the Lambda repressor.
 - c. Cro allowing its own synthesis.
 - d. Inhibition of most bacteriophage DNA transcription.
10. Which of the following can be directly mediated by histone chaperones?
- a. Deacetylation of histones.
 - b. Phosphorylation of histones.
 - c. Methylation of histones.
 - d. Removal of histones.
11. Which of the following will occur in *Drosophila* cells kept in the dark?
- a. Per will permanently inhibit Tim and Per gene expression because Tim is not degraded.
 - b. Tim and Per gene expression will oscillate because Per inhibits its own gene expression in a delayed negative feedback loop.
 - c. Tim and Per heterodimer formation will not occur because Tim will be constantly degraded.
 - d. Tim and Per will be permanently localized in the nucleus.

12. "The represillator" has been modified so that the repressor B coding sequence has been replaced with a Green Fluorescent Protein (GFP) sequence. Which of the following will be observed in bacteria grown for a long period of time with this new system?

- a. The bacteria will always be fluorescent.
- b. The bacteria will never be fluorescent.
- c. The bacteria will have oscillating fluorescence.
- d. Approximately half the bacteria will be fluorescent at any given time.

13. Which of the following is a reasonable research project?

- a. Comparing prokaryotic and eukaryotic regulatory elements located within introns.
- b. Comparing prokaryotic and eukaryotic regulatory elements that participate in DNA looping.
- c. Comparing prokaryotic and eukaryotic siRNA sequences.
- d. Comparing prokaryotic and eukaryotic histone chaperones.

14. You are studying the human interferon gene promoter and find a type of cell in which H3K14 is always acetylated. Which other modification(s) will always be present?

- a. H3S10 phosphorylation.
- b. H4K8 acetylation, H3K9 acetylation, and H3S10 phosphorylation.
- c. H4K8 acetylation.
- d. H4K8 acetylation and H3K9 acetylation.

15. Which of the following statements concerning *Drosophila* sex determination is correct?

- a. Functional Dsx protein is produced whether or not its mRNA is spliced.
- b. If pre-mRNA splicing does not occur, functional proteins are not produced.
- c. Sxl protein functions as a splicing activator.
- d. Tra protein functions as a splicing repressor.

16. Which of the following will NOT be observable in female *Drosophila*?

- a. Two X chromosomes and 2 autosomes.
- b. Two X chromosomes, one Y chromosome, and two autosomes.
- c. Spliced Sxl RNA.
- d. Sxl protein.

17. Which of the following statements concerning RNA transport from the nucleus is NOT correct?

- a. The majority of RNA leaves the nucleus.
- b. mRNAs without cap binding complexes do not leave the nucleus.
- c. mRNAs without exon junction complexes do not leave the nucleus.
- d. mRNAs with snRNPs do not leave the nucleus.

18. A drug company may have identified a chemical that inhibits the HIV Rev protein. Which of the following results should be observed if the chemical is indeed a Rev inhibitor?
- a. HIV-infected cells treated with the chemical should have unspliced RNAs, whereas untreated HIV-infected cells will not.
 - b. HIV-infected cells treated with the chemical should have no viral RNAs in the cytosol when compared to untreated HIV-infected cells.
 - c. HIV-infected cells treated with the chemical should have more unspliced RNAs in the nucleus when compared to untreated HIV-infected cells.
 - d. HIV-infected cells treated with the chemical should have more viral RNAs in the cytosol when compared to untreated HIV-infected cells.

19. Which of the following modifications will decrease the stability of transferrin receptor RNA?

- a. Increased cellular deadenylase concentration.
- b. Decreased expression of miRNAs complementary to transferrin receptor RNA.
- c. Increased poly-A tail length.
- d. Decreased cellular iron concentration.

20. Which of the following can be observed in eukaryotes?

- a. mRNAs with stop codons at the very 3' end of the molecule.
- b. Pairing of broken mRNAs with tmRNAs.
- c. RNA molecules binding to complementary RNA molecules.
- d. mRNA molecules that do not change in length.

21. Which of the following will decrease the variation provided by the genome?

- a. Removing the stop codons present in introns.
- b. Decreasing the expression of Upf proteins.
- c. Removing cytosolic exon junction complexes.
- d. None of the above.

22. Which of the following correctly completes the sentence below?

“The maturation of miRNAs requires _____ in the nucleus and _____ in the cytosol.”

- a. dicing; cropping
- b. cropping; dicing
- c. splicing; dicing
- d. splicing; cropping

23. Which of the following is NEVER used to regulate prokaryotic translation?

- a. Translational repressor proteins.
- b. Temperature regulated 5'-UTR structures.
- c. miRNAs complementary to Shine-Dalgarno sequences.
- d. 5'-UTR riboswitches.

24. Which of the following correctly describes a mechanism of eukaryotic translational regulation?

- a. eIF2B phosphorylates eIF2-GDP to produce eIF2-GTP for translation initiation.
- b. eIF2B is phosphorylated by eIF2-GTP, leaving behind eIF2-GDP.
- c. eIF2-GDP phosphorylation decreases the amount of eIF2-GTP.
- d. eIF2-GTP sequesters eIF2B.

25. Which of the following statements concerning cytosolic aconitase is correct?

- a. Cytosolic aconitase releases the 5' untranslated region of ferritin mRNA when cellular iron is high, allowing ferritin mRNA translation.
- b. Cytosolic aconitase binds to the 3' untranslated region of ferritin mRNA when cellular iron is low, preventing ferritin mRNA translation.
- c. Cytosolic aconitase binds to the 5' untranslated region of transferrin receptor mRNA when cellular iron is low, allowing transferrin receptor protein to be made.
- d. Cytosolic aconitase releases the 3' untranslated region of transferrin receptor mRNA when cellular iron is low, causing mRNA degradation.

26. A RISC complementary to the mRNA of the GroES cap (which functions with chaperonin) will produce which of the following effects?

- a. Accelerate protein folding.
- b. Increase protein degradation.
- c. Decrease ubiquitin ligase activity.
- d. Increase allosteric transitions.

27. A transcriptional repressor of ubiquitin will produce which of the following effects?

- a. Decelerate chaperonin function.
- b. Increase protein degradation.
- c. Increase ubiquitin ligase activity.
- d. Increase protein aggregates.

28. Which of the following statements concerning RNA is correct?

- a. mRNA molecules begin with AUG at their 5' ends.
- b. All RNA molecules except rRNA and tRNA contain protein coding sequences.
- c. After mRNA splicing, all non-coding sequences except the 5' CAP and poly-A tail are removed.
- d. RNA molecules containing a poly-A tail do not necessarily code for protein.

29. Which of the following will occur after adrenaline activates its receptor on skeletal muscle cells?

- a. Adenylyl cyclase will be inactivated.
- b. Protein kinase A will phosphorylate glycogen phosphorylase kinase.
- c. cAMP will be converted into ATP.
- d. CRE sequences will be removed.

30. Which of the following best describes the complete interactome map?

- a. A diagram illustrating the interactions between DNA and all gene regulators.
- b. A diagram illustrating all the ubiquitin ligase interactions.
- c. A diagram illustrating the interactions between each protein in an organism.
- d. A diagram illustrating the interactions between RNA and translational regulators.

31. Which of the following proteins would be unaffected by a GTP hydrolysis inhibitor?

- a. Ran
- b. Dynamin
- c. Hsp70
- d. Sar1

32. Which of the following correctly describes the role of Ran-GTP in nuclear transport?

- a. Ran-GTP allows for the nuclear export of cargo proteins and the nuclear import of nuclear import receptors.
- b. Ran-GTP binding allows for the nuclear import of nuclear export receptors.
- c. Ran-GTP is at higher concentrations in the cytosol than in the nucleus, and therefore maintains the concentration gradient required for transport.
- d. Ran-GTP facilitates guanine nucleotide exchange by binding to proteins such as Ran-GEF and eIF2B.

33. A scientist has recently discovered that protein kinase A can act on NFAT. Which of the following observations should he observe when he increases adenylyl cyclase gene expression in T cells?

- a. NFAT phosphate removal, calcineurin binding, and nuclear import.
- b. NTF2 phosphorylation, calcineurin binding, and nuclear export.
- c. NFAT phosphorylation, nuclear export signal exposure, and nuclear export.
- d. NFAT polyubiquitylation and subsequent proteasome degradation.

34. Which of the following is most likely a multi-pass endoplasmic reticulum transmembrane protein with its C-terminus facing the cytosol?
- a. A protein with an internal start transfer signal sequence and more positively charged amino acids at the C-terminal side of this sequence.
 - b. A protein with an N-terminal start transfer signal sequence.
 - c. A protein with an N-terminal start transfer signal sequence and an internal stop transfer signal sequence.
 - d. A protein with four transmembrane domains, with its N-terminus facing the cytosol.
35. Which of the following can be observed in cells with deficient glucosyl transferase?
- a. Increased UDP-glucose.
 - b. Increased protein retention in the endoplasmic reticulum.
 - c. Increased glucose on N-linked oligosaccharides.
 - d. Increased protein folding.
36. Which of the following best describes a protein with its N-terminus facing the cytosol?
- a. NH₂-terminal start transfer signal sequence-COOH
 - b. NH₂-internal start transfer signal sequence-positively charged amino acids-COOH
 - c. NH₂-terminal start transfer signal sequence-stop transfer signal sequence-COOH
 - d. NH₂-positively charged amino acids-internal start transfer signal sequence-stop transfer signal sequence-COOH
37. Which of the following most commonly requires COPII-coated vesicle formation?
- a. Transport from the golgi apparatus to the plasma membrane.
 - b. Transport between different golgi cisternae.
 - c. Transport from the endoplasmic reticulum to the golgi apparatus.
 - d. Transport from the golgi apparatus to the endosome.
38. Which of the following is a function of vesicular protein coats?
- a. To remain associated with vesicles, protecting them throughout transport.
 - b. To help select cargo for transport.
 - c. To help induce membrane flip-flopping during vesicle fusion.
 - d. To help direct vesicles towards organelles such as plastids.

39. Scientists have discovered “protein X”, which binds to KKXX protein sequences and prevents normal KKXX interactions. Which of the following processes will be the most affected by “protein x”?

- a. KDEL receptor binding to soluble ER resident proteins.
- b. KDEL receptor binding to the COPI coat.
- c. KDEL receptor release of soluble ER resident proteins.
- d. KDEL receptor binding to the clathrin coat.

40. Which of the following correctly describes the cisternal maturation model?

- a. COPI-coated transport vesicles move proteins back and forth between different cisternae.
- b. Each golgi cisterna becomes the next one, moving from *cis* to *trans*.
- c. COPI-coated transport vesicles indicate forward movement in the golgi apparatus, from *cis* to *trans*.
- d. COPII-coated transport vesicles indicate forward movement in the golgi apparatus, from *cis* to *trans*.

41. Which of the following correctly completes the statement below?

“The _____ receptor releases its cargo in the _____ due to the more acidic environment in this organelle.”

- a. KDEL; early endosome
- b. KDEL; golgi apparatus
- c. mannose-6-phosphate; early endosome
- d. mannose-6-phosphate; golgi apparatus

THE END