Cheat Sheet

Chapter 18 Questions

1. **What is *Anableps anableps*?**
2. **What is feedback inhibition?**
3. **What is a transcription unit?**
4. **What are genes that can be controlled together by a single on/off switch (adj.)?**
5. **What is an operator?**
6. **What is the combination of the operator, the promoter, and genes they control?**
7. **How do repressors work?**
8. **What is a corepressor?**
9. **Explain the lac gene and trp gene regulation pathways in *E. coli*.**
10. **What is the difference between a repressible and an inducible operon?**
11. **What is the equivalent of a corepressor in an inducible operon?**
12. **What are repressible and inducible enzymes?**
13. **What is the difference between positive and negative gene regulation?**
14. **When does *E. coli* use glucose?**
15. **What is the expression of different genes by cells with the same genomes called?**
16. **What is histone acetylation?**
17. **The addition of what group to histones leads to the condensation of chromatin?**
18. **What is DNA methylation?**
19. **What is epigenetic inheritance?**
20. **What are control elements?**
21. **What is the difference between general and specific transcription factors?**
22. **What are control elements that are located close to the promoter called?**
23. **What are control elements that are distant from the promoter called?**
24. **What is MyoD?**
25. **What are the two types of structural domains in activator proteins?**
26. **What are mediator proteins?**
27. **What is silencing?**
28. **What is albumin?**
29. **How does expression of genes that must be turned on/off together differ in prokaryotes and eukaryotes?**
30. **What techniques allow researchers to cross-link/identify regions of chromosomes that associate with each other during interphase?**
31. **What are transcription factories?**
32. **How does the location of expressed and not-expressed genes differ?**
33. **What is alternative RNA splicing?**
34. **How is gene expression regulated during translation?**
35. **What is the precursor for insulin?**
36. **What is ubiquitin?**
37. **What percent of the human genome is protein-coding DNA?**
38. **What is transcribed, nontranslated RNA called?**

39. **What are microRNAs (miRNAs)?**
40. **What are small interfering RNAs?**
41. **How do ncRNAs play a role in the remodeling of chromatin structure?**
42. **What are piwi-interacting RNas (piRNAs)?**
43. **How do long noncoding RNAs (lncRNAs) play a role in the deactivation of the X chromosome?**
44. **What is differentiation?**
45. **What is morphogenesis?**
46. **What are cytoplasmic determinants?**
47. **What is induction?**
48. **What is determination?**
49. **What are proteins found only in a specific cell type called?**
50. **What are myoblasts?**
51. **What is MyoD?**
52. **What is a body plan?**
53. **What is pattern formation?**
54. **What are the three body axes?**
55. **What is the structure of the *Drosophila melanogaster* ovary?**
56. **What are homeotic genes?**
57. **What are embryonic lethals?**
58. **What is a maternal effect genes?**
59. **What are genes that control the orientation of egg called?**
60. **What is the *bicoid* gene?**
61. **What is the morphogen gradient hypothesis?**
62. **What are cancer-causing genes called?**
63. **What are normal versions of cancer-causing genes called?**
64. **What are genes that code for products that inhibit cell division called?**
65. **What is the *ras* gene?**
66. **What is the p53 gene?**
67. **Why do elephants have a lower cancer rate than other mammals?**
68. **What is colorectal cancer?**
69. **What is the second most common form of cancer?**
70. **What is adenomatous polyposis coli (APC)?**
71. **Name virus related cancers.**

Chapter 18 Answers

1. Freshwater fish, upper half of eyes for aerial vision, lower for aquatic (“cuatro ojos”)
2. Activity of first enzyme in pathway is inhibited by pathway’s end product
3. A set of clustered genes and their promoter
4. Coordinately controlled
5. On-off switch, segment of DNA, positioned within promoter or between promoter and genes, controls access of RNA pol to genes
6. The operon
7. Repressor = allosteric protein that binds to operator and blocks attachment of RNA pol to promoter, prevents transcription of genes, specific to operator, encoded by regulatory gene that are expressed continuously at low rate, active when substrate binds, may dissociate or associate when active
8. Small molecule that cooperates with repressor protein to switch operon off
9. Lac gene (*lacZ* that codes for ß-galactosidase that breaks lactose into galactose and glucose + *lacY* for permease + *lacA* for transacetylase (all for using lactose)), repressor (regulatory gene = *lacI*) dissociates when allolactose (isomer of lactose formed in small amounts when lactose enters cell) binds to it. Trp gene codes for enzymes that produce trp, repressor associates when trp binds to it (regulatory gene = *trpR*)
10. Transcription usually on, can be inhibited; Transcription usually off, can be stimulated
11. inducer
12. synthesis blocked by end corepressor (functions in anabolic pathways), synthesis stimulated by chemical signal (functions in catabolic pathways)
13. Regulatory protein interacts with genome to turn on transcription, prot binding turns off
14. When glucose is present (preferred over lactose). cAMP accumulates when glucose is scarce, binds cAMP receptor protein (CRP). CRP is activator, protein that binds to DNA to stimulate transcription of gene. With cAMP bound, CRP active can attached to site upstream of lac promoter, increasing affinity of RNA pol for lac promoter, may affect expression of over 100 genes in *E. coli*
15. Differential gene expression
16. Addition of acetyl group (-$COCH_3$) to amino acid of histone tail (N terminus of protein), appears to promote transcription by opening up chromatin structure.
17. Methyl
18. Addition of methyl, usually to cytosine, occurs in most plants, animals, fungi, generally deactivate DNA, enzymes methylate correct daughter strand after each round of DNA replication (accounts for genomic imprinting)
19. Inheritance of traits transmitted by mechanisms not involving nucleotide sequence itself
20. Segments of noncoding DNA where transcription factors bind
21. Required for transcription of all protein-coding genes (may bind to DNA sequence or other proteins)
    Allow for high levels of transcription at appropriate time and place
22. Proximal control elements

23. Distal control elements, groupings of them are enhancers (can be upstream/downstream of gene or in intron), each gene may have multiple enhancers, each enhancer specific to one gene
24. Transcriptional activator protein, 2 polypeptide subunits (mostly α helix, each has DNA-binding domain and activation domain (includes binding sites for proteins), involved in muscle development in vertebrate embryos
25. 1 DNA-binding domain, part of protein's three dimensional structure that binds to DNA
    1 or more activation domains, bind other regulatory proteins or components of transcription machinery
26. DNA bends to touch activators to them, and they interact with general transcription factors at the promoter to help assemble and position initiation complex
27. Phenomenon where repressors recruit proteins that remove acetyl groups from histones to reduce transcription, most common mechanism of repression
28. A blood protein
29. Coordinately controlled genes clustered into operon, regulated by single promoter

    Genes scattered over different chromosomes, each gene has same specific combination of control elements
30. Chromosome conformation capture(3C)
31. Areas rich in RNA polymerases and other transcription-associated proteins where loops of chromosomes congregate
32. In interior region of nucleus, in outer edges of nucleus
33. Different mRNA molecules produced depending on which RNA segments are treated as exons/introns, regulatory proteins bind to regulatory sequences to control intron-exon choices
34. Regulatory proteins bind to specific structures within UTR to prevent attachment of ribosomes or protein factors required for initiation of translation are deactivated or mRNAs are degraded (quickly or slowly)
35. Polypeptide pro-insulin cleaved to form active hormone
36. Small protein attached to protein to mark it the protein for destruction (proteasomes, giant protein complexes, recognize ubiquitin-tagged proteins and degrade them)
37. 1.5%
38. Non-coding RNAs (ncRNAs)
39. 22 nucleotide-long, single-stranded RNA molecules, produced from longer RNA precursor, forms complex with one or more proteins, allows complex to bind mRNA, complex degrades target mRNA or blocks translation
40. Similar size/function as miRNAs, precursor different (usually double-stranded in both cases), blocking of gene expression by siRNAs called RNA interference (RNAi)
41. In S phase of cell cycle, centromeric regions of DNA must be loosened and re-condensed. siRNAs produced in some yeasts required to reform heterochromatin at centromeres (interacts with other ncRNAs and with chromatin-modifying enzymes to condense centromere chromatin)

42. Induce formation of heterochromatin, block expression of transposons (parasitic DNA elements), 24-31 nucleotides in length, processed from longer, single-strand RNA precursor, establish appropriate methylation patterns in germ cells
43. lncRNAs (200 to hundreds of thousands of nucleotides in length) are produced by XIST gene, bind back to and coat chromosome, condensing entire chromosome to heterochromatin
44. Process by which cells become specialized in structure/function
45. Development of form of organism and its structure
46. Maternal substances in egg that influence course of early development
47. Signals conveyed to embryonic cells from other nearby embryonic cells causing changes in target cells
48. Point at which embryonic cell is irreversibly committed to becoming particular cell type
49. tissue-specific proteins
50. Cells that have been determined to become part of muscle cells
51. Protein coded by master regulatory gene, capable of changing some fully differentiated nonmuscle cells (e.g. fat/liver cells) into muscle cells, transcription factor that binds to specific control elements in enhancers of various target genes and stimulates expression, stimulates *myoD* gene (positive feedback)
52. Overall three-dimensional arrangement
53. Development of spatial organization in which tissues and organs are all in characteristic places, controlled by molecular cues called positional information
54. Anterior-posterior(head-to-tail), dorsal-ventral (back-to-belly), right-left
55. Egg adjacent to nurse cells, all surrounded by follicle cells
56. Regulatory genes that control pattern formation
57. Mutations with phenotypes causing death at embryonic or larval stage
58. Genes that when mutant in mother results in mutant phenotype in offspring regardless of offspring's genotype
59. egg-polarity genes
60. Two mutants of gene results in posterior structures at both ends of larva, product concentrated at anterior of egg, likely determines anterior end
61. Gradients of morphogens establish embryo's axes and other features of its form
62. oncogenes
63. proto-oncogenes
64. tumor-supressor genes
65. Named for rat sarcoma (connective tissue cancer), mutation occurs in 30% of human cancers, codes Ras protein (G protein that relays signal from growth factor receptor on plasma membrane to cascade of protein kinases. Certain mutations in ras gene cause Ras protein that triggers kinase cascade without growth factor
66. Tumor-suppressor gene, 50% of cancers have mutation in gene, protein product has 53,000 dalton molecular weight, protein is specific transcription factor that promotes synthesis of cell cycle-inhibiting protein, often activates p21 gene whose product halts cell cycle by binding Cdks, activates expression of miRNAs that inhibit cell cycle, can turn on repair genes and suicide genes

67. Have 20 copies of p53 genes compared to 1 copy of other mammals
68. Cancer that affects colon/rectum, 140,000 cases each year in US, 50,000 deaths per year, develops gradually (begins as polyp, small benign growth in colon lining)
69. Breast cancer, first among women, strikes over 230,000 women, kills 40,000, BRCA1 and BRCA 2 considered tumor-supressor genes (repair genes), mutations may cause cancer, estrogen receptor alpha (ERα, steroid receptor), progesterone receptor (PR, steroid receptor), HER2 (type of RTK) are involved in regulating cell growth
    Luminal A: ERα+++, PR++, HER2-, 40% of breast cancers, best prognosis
    Luminal B: ERα++, PR++, HER2- or HER2++, 15-20% of breast cancers, poorer prognosis than A, A and B can be treated by tamoxifen
    Basal-like: ERα-, PR-, HER2-, 15-20%, aggressive, poorest prognosis, often has mutation in tumor repressor BRCA1, treated with cytotoxic chemotherapy that targets fast growing cells
    HER2: ERα-, PR-, HER2++, 10-15%, poorer prognosis than A, treated with Herceptin (antibody protein that inactivates HER2)
70. Tumor suppressor gene that is mutated in 60% of colorectal cancers, regulates cell migration and adhesion
71. Tumor viruses are viruses that cause cancer, Burkitt's lymphoma related to Epstein-Barr virus, papillomaviruses associated with cervix cancer, HTLV-1 causes adult leukemia, viruses play role in 15% of cancer in humans