Molecular Genetics

What You Must Know:

1. The structure of DNA
2. The knowledge about DNA gained from the work of Griffith; Avery, MacLeod, and McCarty; Hershey and Chase; Wilkins and Franklin; and Watson and Crick
3. Replication is semiconservative and occurs 5’ to 3’
4. The roles of DNA polymerase, ligase, helicase and topoisomerase in replication
5. The general differences between bacterial chromosomes and eukaryotic chromosomes
6. How DNA packaging can affect gene expression
7. How RNA and DNA are similar and different, and how this defines their roles
8. The differences between replication, transcription, and translation and the role of DNA and RNA in each process
9. How eukaryotic cells modify RNA after transcription
10. How genetic material is translated into polypeptides
11. How mutations can change the amino acid sequence of a protein and be able to predict how a mutation can result in changes in gene expression
12. Genes can be activated by inducer molecules, or they can be inhibited by the presence of a repressor as they interact with regulatory proteins or sequences
13. A regulatory gene is a sequence of DNA that codes for a regulatory protein such as a repressor protein
14. How the components of an operon function to regulate gene expression in both repressible and inducible operons
15. How positive and negative control function in gene expression
16. The impact of DNA methylation and histone acetylation on gene expression
17. How timing and coordination of specific events are regulation in normal development, including pattern formation and induction
18. The role of microRNA’s in control of cellular functions
19. The role of gene regulation in embryonic development and cancer
20. The components of a virus
21. The differences between lytic and lysogenic cycles
22. How viruses can introduce genetic variation into host organisms
23. Mechanisms that introduce genetic variation into viral populations
24. The terminology of biotechnology
25. How plasmids are used in bacterial transformation to clone genes
26. The key ideas that make PCR possible and applications of this technology
27. How gel electrophoresis can be used to separate DNA fragments or protein molecules
28. Information that can be determined from DNA gel results, such as fragment sizes and RFLP analysis
29. Discuss ethical implications of some applications of biotechnology
30. How prokaryotic genomes compare to eukaryotic genomes
31. Applications of bioinformatics to medicine, evolution and health
32. The activity and role of transposable elements and retrotransposons in generating genetic diversity
33. The role of homeotic genes and homeoboxes in developmental patterns and sequences

Mendelian Genetics

What You Must Know:

1. The differences between asexual and sexual reproduction
2. Advantages of asexual vs. sexual reproduction
3. The role of meiosis and fertilization in sexually reproducing organisms
4. The importance of homologous chromosomes to meiosis
5. How the chromosome number is reduced from diploid to haploid in meiosis
6. Three events that occur in meiosis but not mitosis
7. The importance of crossing over, independent assortment, and random fertilization to increasing genetic variability
8. Know when a cell goes from diploid to haploid
9. Terms associated with genetics problems: P, F1, F2, dominant, recessive, homozygous, heterozygous, phenotype and genotype
10. How to derive the proper gametes when working a genetics problem
11. The difference between an allele and a gene
12. How to read a pedigree
13. How to use data sets to determine Mendelian patterns of inheritance
14. Know when to use rule of addition and multiplication in genetics
15. How the chromosome theory of inheritance connects the physical movement of chromosomes in meiosis to Mendel’s laws of inheritance
16. The unique pattern of inheritance in sex-linked genes
17. How alteration of chromosome number or structurally altered chromosomes (deletions, duplications, etc.) can cause genetic disorders
18. How genomic imprinting and inheritance of mitochondrial DNA are exception to standard Mendelian inheritance
19. Predict a null hypothesis and calculate a Chi-Square analysis