

Answer key will be posted by Feb 27, 2003

Biology 202 Midterm 2

Instructor: Dr. McGuire

Date: November 15, 2001

Name: _____

Lab Section: _____

Part 1: For the following multiple choice questions, enter the best single answer onto a scantron 882-ES using a #2 pencil. (2 points each)

1. What is the sequence of DNA that is complementary to the following sequence?
5' AATTGCATTCCGCGATAACGTTTCC3'
 - a. 5'AATTGCATTCCGCGATAACGTTTCC3'
 - b. 5'GGAAACGTTATCGCGGAATGCAATT3'
 - c. 5'TTAACGTAAGGCGCTATTGCAAAGG3'
 - d. none of the above

2. Meiosis differs from mitosis in that:
 - a. the chromosomes align on an equatorial plate during metaphase.
 - b. sister chromatids separate to different daughter cells.
 - c. the homologous pairs associate with one another in prophase I.
 - d. all of the above.

3. Homologous recombination
 - a. occurs when sister chromatids form chiasmata, or "cross-over", in the bivalent structure.
 - b. only takes place during mitosis.
 - c. results in non-disjunction, which is the unequal distribution of DNA in daughter cells.
 - d. explains recombinant phenotypes in the inheritance of independently assorting traits.

4. Apoptosis and necrosis differ from one another in which of the following ways:
 - a. only one of them induces inflammation and harm to surrounding "innocent bystander" cells.
 - b. only one of them results in cell death.
 - c. only one of them is triggered by conditions outside the cell.
 - d. none of the above.

5. Two genes are linked on the same chromosome. When two truebreeding plants, one dominant, one recessive, are crossed, 10 recombinant phenotype plants were observed in the F₂ population out of a total of 600 progeny. How many map units apart are the two genes?
 - a. 0.017
 - b. 0.17
 - c. 1.70
 - d. 17.0

6. A hypothetical human trait, called furry toes, is seen rarely in human families. Individuals afflicted by this trait have excess hair growth on their toes. By studying four generations of a single family, the following pedigree was established. Known affected individuals are indicated as having the gene and carriers are indicated when they can be inferred.

Which inheritance pattern best explains this pedigree?

- a. recessive X-linked gene.
- b. dominant X-linked gene.
- c. recessive autosomal gene.
- d. dominant autosomal gene.

7. Which of the following statement(s) is/are **true**?

- a. Penetrance is the percent of individuals carrying an allele that display the associated trait.
- b. Hemizygosity is extremely rare because it only occurs in individuals that have lost a chromosome.
- c. Phenotype always reflects genotype.
- d. none of the above.

8. The leading strand of DNA synthesis is synthesized

- a. as one strand from a single RNA primer located at the 5' end of the new strand.
- b. as Okasaki fragments and requires DNA ligase to put the pieces together.
- c. from 3' to 5' while the lagging strand is synthesized 5' to 3'.
- d. all of the above.

9. The lagging strand of DNA synthesis is synthesized

- a. as one strand from a single RNA primer located at the 5' end of the new strand.
- b. as Okasaki fragments and requires DNA ligase to put the pieces together.
- c. from 3' to 5' while the leading strand is synthesized 5' to 3'.
- d. all of the above.

10. What is the significance that DNA polymerase can "proof-read"?

- a. It reduces the error rate in DNA synthesis by 1000-fold.
- b. It maintains the integrity of DNA during mitosis and meiosis.
- c. It lowers the chance that mutations will be passed to new generations and to new cells.
- d. all of the above.

11. Which of the following statement(s) about DNA synthesis is/are **false**?
- RNA polymerases can start synthesis *de novo* but DNA polymerases can not.
 - The start of DNA replication always occurs at origins of replication.
 - A primer is required only for the synthesis of the lagging strand.
 - none of the above.
12. The Hershey-Chase experiment demonstrated
- that DNA replicates semi-conservatively.
 - that DNA, not protein, is the genetic material for most organisms.
 - the universality of the universal genetic code.
 - that DNA was a double helix.
13. RNA is similar to DNA in that they
- are both always in the nucleus of a eukaryotic cell.
 - are both synthesized in the 5' to 3' direction by polymerases.
 - both are made up of deoxynucleotides.
 - are both single stranded.
14. The aminoacyl-tRNA-synthetase enzymes
- are responsible for the specificity of codons for amino acids.
 - are specific for a single amino acid.
 - are specific for a limited number of tRNAs determined by the anti-codon sequence.
 - all of the above.
15. Transcription
- is the process by which the cell makes protein.
 - is the process by which the cell makes RNA.
 - is the process by which the cell synthesizes new DNA.
 - all of the above.
16. Translation
- is the process by which the cell makes protein.
 - is the process by which the cell makes RNA.
 - is the process by which the cell synthesizes new DNA.
 - all of the above.
17. The P site on the large ribosomal subunit
- is the exit site of the ribosome where empty tRNAs leave the complex.
 - contains a tRNA with the growing polypeptide chain.
 - accepts the incoming tRNA which is bringing in the next amino acid for the growing polypeptide chain.
 - holds the release factor when the ribosome reaches a stop or termination codon.

18. What are differences that can be found between proteins that will be secreted or in the plasma membrane versus proteins found in the cytoplasm?
- They contain a stretch of hydrophobic amino acids at the N terminus called a signal sequence.
 - They are translated into the lumen of the rough endoplasmic reticulum.
 - They interact with the signal recognition particle which binds to a receptor on the ER.
 - all of the above.
19. The open reading frame (called ORF) of an mRNA
- starts with the first base in the message and goes through to the end of the mRNA.
 - is found in reading frame 1 of every mRNA, no matter what protein it encodes.
 - is the reading frame of the RNA that encodes the protein and it always begins with AUG.
 - does not exist because ORFs are only found in rRNAs and tRNAs.
20. The three main processing events that precursor RNAs destined to be translated go through are
- recombination, replication and splicing.
 - replication, capping and polyadenylation.
 - polyadenylation, splicing and recombination.
 - capping, polyadenylation and splicing.
21. The spliceosome is responsible for
- transport of the rRNAs from the nucleus to the cytoplasm where they can be assembled into ribosomes.
 - the removal of introns from the precursor RNA to make the mature mRNA.
 - the removal of exons from the precursor RNA to make the mature mRNA.
 - the attachment of the amino acid to the tRNA for protein synthesis.
22. RNA polymerase II is responsible for the transcription of which type of RNA?
- mRNAs
 - tRNAs
 - rRNAs
 - all of the above.
23. Which of the following statements about polyadenylation is/are **true**?
- Polyadenylation is the addition of ~200-600 A residues at the end of an mRNA.
 - Polyadenylation occurs at a specific sequence, AAUAAA, in the 3'UT of an pre-mRNA.
 - Polyadenylation is required for mRNA stability.
 - all of the above.
24. Pseudogenes
- are just like regular genes because they encode proteins.
 - always have intron like sequences just like real genes.
 - often have intron sequences removed, leading to the theory that they arose from mRNAs.
 - are not found in the human genome.

25. Which of the following statements concerning telomers is/are **true**?
- a. Telomers are made up of a repetitive DNA sequence, 5'TTAGGG3', that is repeated hundreds of times at the end of each chromosome.
 - b. Telomers protect us from losing vital chromosomal DNA during DNA replication.
 - c. Telomers are lost in cells that don't express telomerase, limiting the number of cell divisions a cell can undergo.
 - d. all of the above.

Part 2: For the following true-false questions, enter (A) for true and (B) for false onto a scantron 882-ES using a #2 pencil. (1 point each)

26. The synapse is a physical association of the two chromosomes in a homologous pair during meiosis.
27. Mitosis maintains genetic material while meiosis promotes genetic diversity.
28. Apoptosis is programmed cell death in which the cell degrades its DNA and signals phagocytes to remove it by phagocytosis.
29. The definition of epistasis is that the trait caused by a single gene can be influenced by the alleles present at other loci.
30. The ABO blood group system contains multiple alleles, two co-dominant and one recessive.
31. DNA polymerase reads the template strand 3' to 5' to synthesize the new DNA strand 5' to 3'.
32. Mismatch repair is a mechanism in which several base pairs of DNA are removed from one strand and replaced with the correct nucleotides reading the other strand.
33. Point mutations always result in the substitution of amino acids in the final protein product of a gene.
34. Alu sequences, a moderately repetitive DNA sequence, may function as the origin of replication in human DNA.
35. A somatic mutation is passed on to the next generation due to the fact that it took place in cells giving rise to eggs and/or sperm.

Part 3: Answer the following questions as indicated. 10 points each.

36. Draw the lac operon from E. coli and clearly indicate how lactose regulates expression from this operon. How does glucose regulate expression from this operon?

37. The given sequence of DNA is a hypothetical gene with no introns that encodes a very small protein. Provide the information requested:

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5' GGCTAAATGCTTAAAAGCTACGGGCGCGAGGAATAGGAG 3'  
3' CCGATTTACGAATTTTCGATGCCC GCGCTCCTTATCCTC 5'
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Which is the template strand? (Write out the sequence and label the 5' and 3' ends)

What is the sequence of the mRNA? (Write out the sequence and label the 5' and 3' ends)

What is the amino acid sequence of the translated polypeptide? (Use the attached universal genetic code and use three letter code.)

38. In the mouse, there are three hypothetical independent loci (encoded by three different autosomes); *Mc*, *Ke* and *Ms* (*Mc* for mottled coat vs. *mc* for white coat, *Ke* for kinked ears vs. *ke* for smooth ears, and *Ms* for musty scent vs. *ms* for nonmusty scent). An F1 mouse from a cross between two inbred strains, one carrying all dominant traits and one carrying all recessive traits, is back-crossed to a recessive strain mouse. Show the genotypes of the two mice in the backcross, show the gametes each makes, and give the possible genotypes and phenotypes for the progeny, with the ratios expected.

39. What are the five components of the replication fork and what is the function of each of those components?