DAYTONA STATE COLLEGE

GENERAL BIOLOGY I
TEST V

REVIEW

TERMS TO KNOW

- Sex linked trait
  - Any gene or allele carried only on the X or Y chromosome
- Monohybrid cross
  - A one gene cross, i.e. flower color
- Dihybrid cross
  - A two gene cross, i.e. eye color
- Dependent assortment (linked genes) vs. independent assortment
  - Genes that are closer on the same chromosome will often cross together in dependent assortment, whereas those farther apart are subject to independent assortment and cross separately
- Barr Bodies (in somatic cells)
  - Inactive X chromosome, more than one x chromosome results in a barr body
- Monosomy
  - Having only one chromosome where normally there are two
- Trisomy
  - Having 3 of the same chromosome i.e. trisomy X (XXX female genotype) and down's syndrome (3 chromosome 21s)

TERMS TO KNOW

- Euploidy
  - Having a normal number of chromosomes
- Aneuploidy
  - Having an abnormal number of chromosomes
- Deletion
  - Removal of a section of a chromosome
- Duplication
  - Repeating a section of a chromosome
- Translocation
  - Moving a segment from one chromosome to a non-homologous one
- Inversion
  - Reversing a section of a chromosome
- Crossing Over
  - In meiosis, the cutting and swapping of genes between homologous chromosomes

TERMS TO KNOW

- Genetic/Linkage Map
  - Constructed using recombination frequencies to demonstrate distance between two genes on a chromosome, recombination frequency is directly proportional to the distance between genes
- Sex-Determining system in humans, grasshoppers, ants/bees, birds
  - Humans: XX(female), XY(male)
  - Grasshoppers: XX(female), X0(male)
  - Ants/bees: Haploid(male), Diploid(female)
  - Birds: ZW(female), ZZ(male)

TERMS TO KNOW

- Anti-parallel (in reference to strands of DNA)
  - The two strands of DNA face opposite directions, one strand is facing the 3' to 5' direction and the other is facing the 5' to 3' direction
- Leading and lagging strand of DNA synthesis
  - Leading Strand: the strand of DNA that copies continuously,
  - Lagging Strand: the strand of DNA that is copied discontinuously, resulting in Okasaki fragments
- What does 5' and 3' mean?
  - 5' is the end of DNA with a phosphate, and 3' is the end with a deoxyribose sugar
- Why is DNA copied in the 5' to 3' direction?
  - New nucleotides can only be added to the 3' end of DNA
- Okasaki fragment
  - Short, newly synthesized DNA fragments
  - Found on the lagging template strand of DNA,
- Primase and primer
  - Primase is the enzyme that creates a primer, which is a short piece of RNA that is used to begin copying DNA
- Transcription
  - Copying of DNA to RNA
- Translation
  - The process by which a ribosome uses an mRNA template and makes a protein

TERMS TO KNOW

- DNA replication
  - The process of duplicating DNA to make two complete copies from a single copy of DNA
- mRNA
  - Messenger RNA, used as a template for protein synthesis
- tRNA
  - Transfer RNA, ferries amino acids to ribosomes
- Initiator tRNA
  - Has an anticodon for the "start" codon of mRNA
- rRNA
  - Ribosomal RNA, ribosomes are made of rRNA and some proteins
- snRNA
  - Small Nuclear RNA, snRNA is often combines with proteins to produce snRNPs "snurps" which assist in the processing of pre-mRNA
- Amino-Acid tRNA Synthase
  - Aminoacyl tRNA synthetase attaches amino acids to tRNA
- The Genetic Code is:
  - Universal: All domains and kingdoms use DNA as the genetic material
  - Degenerate: There are 64 different codons for only 20 amino acids
  - Non-overlapping: Each nucleotide is used only once
  - Comma-less: There are no "spaces" or unused nucleotides between codons

TERMS TO KNOW

- Codon
  - 3 nucleotides together make up a codon which codes or a single amino acid
- Termination codon
  - The "stop" codon, signals the end of translation
- Anticodon
  - On tRNA, this is a sequence of 3 nucleotides that matches up with a codon, i.e. if the codon is ACG, the anticodon would be UGC
- Promoter
  - Where transcription begins on a strand of DNA
  - A site in a DNA molecule at which RNA polymerase and transcription factors bind to initiate transcription of mRNA.
- RNA polymerase
  - Enzyme that makes RNA
- 5' cap (with G)
  - Modified guanine added to 5' end of mRNA
- Poly A tail
  - 50-250 Adenines added to 3' end of mRNA
- Introns
  - Non-coding parts of mRNA
- Exons
  - Coding parts of mRNA
- Spliceosome
  - snRNA and proteins that splice out introns, also called snRNPs or "snurps"

TERMS TO KNOW

- A site, P site, E site of a Ribosome
  - A Site: Aminoacyl tRNA binding site, where tRNA molecules bind to mRNA
  - P Site: Peptidyl tRNA binding site, where the peptide bond forms between the two amino acids carried by the tRNA molecules
  - E Site: Exit site, where the tRNA exits the ribosome after detaching from its amino acid
- Point mutation
  - Change in one base of DNA (silent mutation changes DNA but not amino acid sequence)
- Frame shift mutation
  - Insertion or deletion of 1 or 2 nucleotides, changes multiple amino acids
- Missense mutation
  - One DNA base change changes only one amino acid
- Nonsense mutation
  - Makes a premature stop codon

CONCEPT QUESTIONS

- If two genes have a 5% recombination frequency and another two genes have a 10% frequency, which genes are closer: the 5% or 10%?
  - 5%
- Is protein or DNA the hereditary material?
  - DNA
- What was the Beadle and Tatum definition of a gene?
  - A sequence of DNA that codes for an enzyme
- What is a more comprehensive definition of a gene?
  - A sequence of DNA that codes for any protein or functional RNA (like tRNA or rRNA)

CONCEPT QUESTIONS

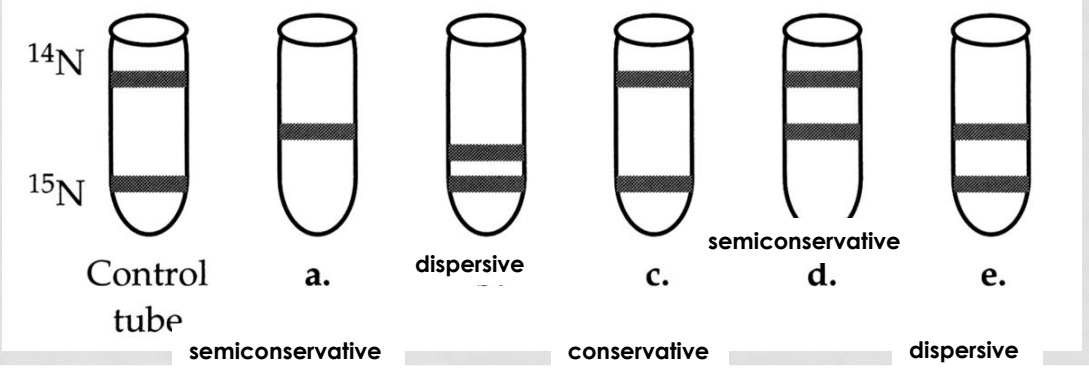
- What was the Avery, McCleod, and McCarty experiment and what did it show?
  - It expanded upon the Griffith experiment by heat-killing the transforming S material and treating it with protease, but it still transformed R cells into S cells, proving that protein was NOT the hereditary material
- What was the Hershey-Chase experiment, what did it show, and what was labeled P^{32} and S^{35}?
  - The Hershey-Chase experiment took a T2 bacteriophage which was composed only of DNA and protein, separately labeled the DNA with P^{32} and the proteins with S^{35} to see which was passed on to bacteria in infection. The radioactive phages were mixed with bacteria and then centrifuged to see where the radioactive particles ended up. In the phages with radioactive proteins, the liquid was radioactive, indication that protein had not passed into the cell. In phages with radioactive DNA, the pellet was radioactive, indicating that the DNA was passed on, and proving that DNA was the hereditary material.

CONCEPT QUESTIONS

- DNA and RNA base pairs
  - Which bases of DNA hydrogen bond to which bases of DNA?
- A pairs with __T__ with __2__ hydrogen bonds.
- G pairs with __C__ with __3__ hydrogen bonds
  - Which bases of DNA hydrogen bond to which bases of RNA?
- A with __U__; T with __A__; G with __C__; C with __G__
  - Which bases of RNA hydrogen bond to which bases of RNA?
- A pairs with __U__ with __2__ hydrogen bonds.
- G pairs with __C__ with __3__ hydrogen bonds
  - If adenine is 40% of the DNA, then what is the percentage of T, C and G?
    - T: 40%
    - C: 10%
    - G: 10%

CONCEPT QUESTIONS

- How did the Messelson-Stahl experiment with N_{14} and N_{15} prove that **DNA replicates semi-conservatively** and **not** conservatively or dispersively?
  - Bacteria that were cultivated in N_{15} and then transferred to N_{14} culture and had their DNA centrifuged after 20 minutes and then 40 minutes to allow one and then two replications. The heavier N_{15} was mixed with the lighter N_{14} instead of separating after the first replication, and after the second, it was separated, showing that neither conservative or dispersive replication occurred.
- What are the expected results from semi-conservative replication, conservative replication and dispersive replication? Be able to identify figures representing semi-conservative, conservative and dispersive replication.



CONCEPT QUESTIONS

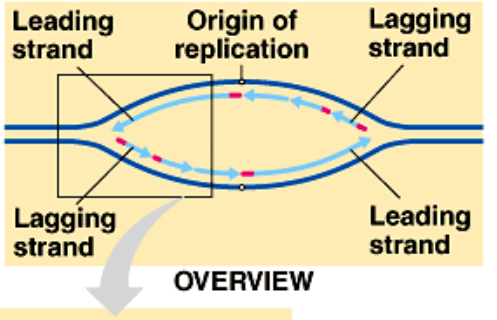
- What are the functions of:
  - Helicase
    - Unzips the double helix
  - Ligase
    - Binds the Okazaki fragments together
  - DNA polymerase
    - Makes new DNA
  - Primase
    - Makes an RNA primer
  - Single Stranded DNA Binding Protein
    - Keeps DNA strands separated until DNA polymerase synthesizes a new strand
  - Gyrase
    - Keeps the DNA form getting too tightly wound

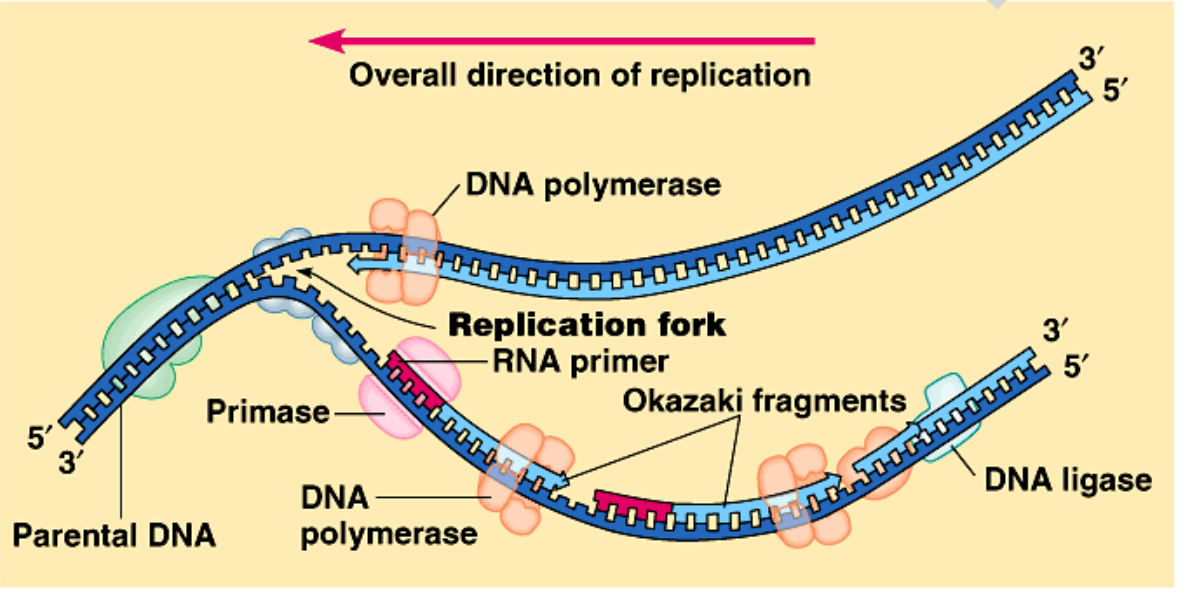
CONCEPT QUESTION

Summarize DNA replication for the leading and lagging strands

Leading Strand: helicase unwinds DNA, primase creates and RNA primer, and DNA polymerase synthesizes continuously

Lagging Strand: helicase unwinds DNA, primase creates an RNA primer, DNA polymerase is synthesized discontinuously, with RNA polymerase making new primers. DNA polymerase removes the RNA primers and ligase replaces them with DNA





FILL IN THE BLANK

PROBLEM	SOLUTION
DNA Polymerase makes DNA only in the 5' to 3', but DNA is anti-parallel	
Okasaki Fragments must be joined together to make longer pieces of DNA	
DNA polymerase cannot add the FIRST base	
RNA doesn't belong in DNA	
How to break open hydrogen bonds of DNA to open the strands of DNA (helix)?	
How to keep the DNA that has been opened from re-hybridizing	

FILL IN THE BLANK

PROBLEM	SOLUTION
DNA Polymerase makes DNA only in the 5' to 3', but DNA is anti-parallel	Synthesize one strand continuously and the other discontinuously
Okasaki Fragments must be joined together to make longer pieces of DNA	Ligase joins Okazaki fragments together
DNA polymerase cannot add the FIRST base	RNA polymerase (Primase) makes an RNA primer
RNA doesn't belong in DNA	DNA Polymerase removes the RNA primer and Ligase inserts DNA
How to break open hydrogen bonds of DNA to open the strands of DNA (helix)?	Helicase "unzips" DNA
How to keep the DNA that has been opened from re-hybridizing	Single Stranded DNA Binding Proteins

CONCEPT QUESTIONS

- How does the telomerase solve the problem of replicating linear DNA?
  - It elongates the ends of DNA with "junk" nucleotides in order to not lose information when DNA is copied
- What would happen to DNA if the DNA telomerase did not function?
  - DNA would continue to get shorter and shorter and would lose genes from the ends, leading to mutations
- What are the main steps of initiation, elongation, and termination of protein synthesis (translation)? Where does the release factor bind?
  - Anticodon on tRNA binds to codon on mRNA
  - Ribosome forms a covalent (peptide) bond between amino acids in P site and A site
  - Ribosome moves down the mRNA 3 codons, continues until it reaches stop codon, release factor binds to A site and stop codon
- What are the main steps of initiation, elongation, and termination of RNA synthesis (transcription)?
  - At the promoter sequence, transcription factors help RNA polymerase bind to DNA
  - RNA polymerase unwinds DNA and copies as it moves along the strand
  - At the terminator, RNA polymerase detaches from DNA and the new mRNA detaches from it
- What are the three steps of processing eukaryotic mRNA to the mature form (any order)?
  - Introns are removed and exons are spliced together, 5' cap and poly A tail are added,

CONCEPT QUESTIONS

- How many nucleotides would be necessary to code for one amino acid?
  - 3
- How many nucleotides would be necessary to code for a polypeptide that is 500 amino acids long?
  - 1500
- If the genetic code were only two nucleotides long and comprised four different nucleotides (A, G, C, U) how many amino acids could be coded for precisely?
  - 16
- How does the signal peptide and signal recognition particle help target proteins to the RER?
  - Signal peptide at the end of mRNA binds to signal recognition particle, which binds to ribosome on the RER

DAYTONA STATE COLLEGE

Questions

Prepared by

K. Martin (Peer Tutor) & D. Leonard (Learning Specialist)
The Academic Support Center @ Daytona State College
http://www.daytonastate.edu/asc/ascsciencehandouts.html