

Review Sheet Molecular Basis of Inheritance (DNA)

Lester BIOL 150

General things to do to prepare for the exam:

- study the PowerPoints
- write out the answers to the learning objectives found with each PowerPoint
- listen to my lecture recordings

Chapter 16

What did Watson and Crick accomplish? What was Rosalind Franklin's contribution?

Describe Griffith's experiment and what he discovered.

Describe Hershey and Chase's experiment. What did they demonstrate?

Describe the experiments of Meselson and Stahl. How do the results support the semi-conservative model of DNA replication?

What are the 4 nucleotides? How do they base pair with each other? What type of bonds do they use?

Explain what is meant by the two DNA strands are antiparallel.

Describe the process of DNA replication. Include: DNA pol I and III, primase, ligase, helicase, topoisomerase, and DNA binding proteins.

In which direction does DNA polymerase make DNA? Why is one strand synthesized continuously and the other strand synthesized discontinuously?

What are Okazaki fragments?

What is the replisome?

What kind of DNA damage is caused by UV light? How is that damage repaired?

What are telomeres? How do they limit cell life? What is the Hayflick limit?

What is telomerase? In which cells is it found? Why? What are the consequences if a cell has or does not have telomerase?

Sample Test Questions

In his transformation experiments, what phenomenon did Griffith observe?

- A) Mixing a heat-killed pathogenic strain of bacteria with a living nonpathogenic strain can convert some of the living cells into the pathogenic form.
- B) Mixing a heat-killed nonpathogenic strain of bacteria with a living pathogenic strain makes the pathogenic strain nonpathogenic.
- C) Infecting mice with nonpathogenic strains of bacteria makes them resistant to pathogenic strains.
- D) Mice infected with a pathogenic strain of bacteria can spread the infection to other mice.

A heat-killed, phosphorescent (light-emitting) strain of bacteria is mixed with a living, non-phosphorescent strain. Further observations of the mixture show that some of the living cells are now phosphorescent. Which of the following observations would provide the best evidence that the ability to phosphoresce is a heritable trait?

- A) evidence that DNA was passed from the heat-killed strain to the living strain
- B) evidence that protein passed from the heat-killed strain to the living strain
- C) especially bright phosphorescence in the living strain
- D) phosphorescence in descendants of the living cells

Which of the following facts did Hershey and Chase make use of in trying to determine whether DNA or protein is the genetic material?

- A) DNA contains sulfur, whereas protein does not.
- B) DNA contains phosphorus, whereas protein does not.
- C) DNA contains nitrogen, whereas protein does not.
- D) DNA contains purines, whereas protein includes pyrimidines.

Cytosine makes up 42% of the nucleotides in a sample of DNA from an organism. Approximately what percentage of the nucleotides in this sample will be thymine?

- A) 8%
- B) 16%
- C) 42%
- D) 58%

Hershey and Chase set out to determine what molecule served as the unit of inheritance. They completed a series of experiments in which *E. coli* was infected by a T2 virus. Which molecular component of the T2 virus actually ended up inside the cell?

- A) protein
- B) RNA
- C) ribosome
- D) DNA

Which of the following statements accurately describes the differences between DNA replication in prokaryotes and DNA replication in eukaryotes?

- A) Prokaryotic chromosomes have histones, whereas eukaryotic chromosomes do not.
- B) Prokaryotic chromosomes have a single origin of replication, whereas eukaryotic chromosomes have many.
- C) The rate of elongation during DNA replication is slower in prokaryotes than in eukaryotes.
- D) Prokaryotes produce Okazaki fragments during DNA replication, but eukaryotes do not.

What is meant by the description "antiparallel" regarding the two strands that make up the DNA double helix?

- A) The double helix structure of DNA creates nonparallel strands.
- B) The 5' to 3' direction of one strand runs counter to the 5' to 3' direction of the other strand.
- C) Base pairings create unequal spacing between the two DNA strands.
- D) One strand contains only purines and the other contains only pyrimidines.

Suppose you are provided with an actively dividing culture of *E. coli* bacteria to which radioactive thymine has been added. What would happen if a cell replicates once in the presence of this radioactive base?

- A) One of the daughter cells, but not the other, would have radioactive DNA.
- B) Neither of the two daughter cells would be radioactive.
- C) All four bases of the DNA would be radioactive.
- D) DNA in both daughter cells would be radioactive.

In *E. coli*, which enzyme catalyzes the elongation of a new DNA strand in the 5' → 3' direction?

- A) primase
- B) DNA ligase
- C) DNA polymerase III
- D) helicase

In *E. coli*, to repair a thymine dimer by nucleotide excision repair, in which order do the necessary enzymes act?

- A) nuclease, DNA polymerase, RNA primase
- B) helicase, DNA polymerase, DNA ligase
- C) DNA ligase, nuclease, helicase
- D) nuclease, DNA polymerase, DNA ligase

Which of the following statements correctly describes the difference between ATP and the nucleotides used during DNA synthesis?

- A) The nucleotides have the sugar deoxyribose; ATP has the sugar ribose.
- B) The nucleotides have two phosphate groups; ATP has three phosphate groups.
- C) ATP contains three high-energy bonds; the nucleotides have two.
- D) ATP is found only in human cells; the nucleotides are found in all animal and plant cells.

Which of the following statements correctly describes the difference between the leading and the lagging strands of DNA during DNA replication?

- A) The leading strand is synthesized in the same direction as the movement of the replication fork, and the lagging strand is synthesized in the opposite direction.
- B) The leading strand is synthesized by adding nucleotides to the 3' end of the growing strand, and the lagging strand is synthesized by adding nucleotides to the 5' end.
- C) The lagging strand is synthesized continuously, whereas the leading strand is synthesized in short fragments that are ultimately stitched together.
- D) The leading strand is synthesized at twice the rate of the lagging strand.

Why does a new DNA strand elongate only in the 5' to 3' direction during DNA replication?

- A) DNA polymerase begins adding nucleotides at the 5' end of the template.
- B) The polarity of the DNA molecule prevents addition of nucleotides at the 3' end.
- C) Replication must progress toward the replication fork.
- D) DNA polymerase can add nucleotides only to the free 3' end.

What is the function of the enzyme topoisomerase in DNA replication?

- A) relieving strain in the DNA ahead of the replication fork caused by the untwisting of the double helix
- B) elongating new DNA at a replication fork by adding nucleotides to the existing chain
- C) reattaching the hydrogen bonds between the base pairs in the double helix
- D) building RNA primers using the parental DNA strand as a template

Which of the following characteristics would you expect of a eukaryotic organism that lacks the enzyme telomerase?

- A) a high probability of somatic cells becoming cancerous
- B) an inability to produce Okazaki fragments
- C) an inability to repair thymine dimers
- D) a reduction in chromosome length in gametes

Semiconservative replication involves a template. What is the template?

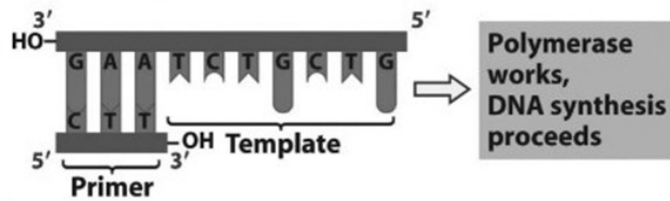
- A) single-stranded binding proteins
- B) DNA polymerase
- C) one strand of the DNA molecule
- D) an RNA molecule

In DNA replication, the resulting daughter molecules contain one strand of the original parental DNA and one new strand. What is the explanation for this phenomenon?

- A) DNA replication is semiconservative.
- B) DNA replication is conservative.
- C) DNA replication is not conservative.
- D) RNA synthesis is conservative.

Use the figure to answer the following question.

Single strand as a template plus 3' end to start DNA synthesis



Referring to the figure, what bases will be added to the primer as DNA replication proceeds?

- A) 5' C, A, G, C, A, G, A 3' B) 3' T, C, T, G, C, T, G 5'
C) 5' A, G, A, C, G, A, C 3' D) 3' G, T, C, G, T, C, T 5'

What are telomeres?

- A) the structures that hold two sister chromatids together
B) enzymes that elongate the DNA strand during replication
C) the sites of origin of DNA replication
D) the ends of linear chromosomes

Which of the following types of cells are affected most by telomere shortening?

- A) only prokaryotic cells B) only eukaryotic cells
C) cells in prokaryotes and eukaryotes D) only animal cells

Which of the following statements accurately describes the structure of a eukaryotic chromosome?

- A) It is composed of a single strand of DNA.
B) It is constructed as a series of nucleosomes wrapped around two DNA molecules.
C) It has different numbers of genes in different cell types of an organism.
D) It is a single linear molecule of double-stranded DNA plus proteins.