

1. How many hydrogen bonds does adenine form?

- a 1
- b 2
- c 3
- d 4
- e none

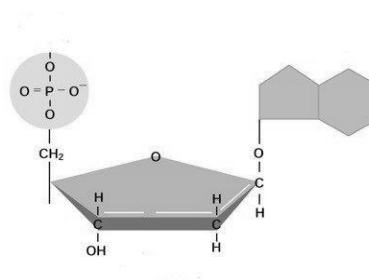
Sample	G	A	T
I	34	16	16
II	16	34	34
III	16	16	34
IV	34	34	16

2. A sample of animal DNA had 34% cytosine. Which sample(s) below likely came from an animal of the same species?

- a samples I and IV
- b sample I only
- c samples I and II
- d sample II only
- e sample III only

3. What generalized structure does the following diagram represent?

- a chromosome
- b nucleic acid
- c nucleotide
- d gene
- e nitrogen-containing base



4. Which statement is **false**?

- a DNA is a double stranded nucleic acid and RNA is single stranded nucleic acid
- b both DNA and RNA have a 3' end and a 5' end
- c both DNA and RNA contain phosphate, a sugar and a nitrogen base in a nucleotide
- d DNA has a sugar-phosphate "backbone" and RNA does not
- e DNA is different from RNA because it has deoxyribose sugar instead of ribose sugar

5. What is the nucleotide sequence for the start codon in the genetic code?
- a ACG
 - b CAG
 - c AUG
 - d UAG
 - e GGC
6. Which process is explained by the triplet hypothesis?
- a the three-stage process of DNA transcription, translation, and regulation
 - b the mechanisms by which proteins unwind DNA and copy its sense strand
 - c the creation of mRNA by removing introns during the processing of pre-mRNA transcripts in the nucleus
 - d the possible grouping of nucleotides that code for one amino acid during protein synthesis
 - e the combination of RNA, DNA, and ribosomes required to generate a single polypeptide chain
7. During DNA replication, one of the new strands of DNA is synthesized continuously, while the other is synthesized as a number of separate fragments of DNA that are subsequently linked by DNA ligase. This is because
- a replication starts at many points on the chromosome
 - b RNA primers only join to one of the parental strands of DNA
 - c DNA polymerase III only synthesizes new DNA in the 3' - 5' direction
 - d one of the parental strands is unwound slower than the other by helicase
 - e DNA polymerase III only synthesizes new DNA in the 5' - 3' direction
8. The 'Central Dogma' states that the flow of genetic information is in the direction
- a protein, RNA, protein
 - b RNA, DNA, RNA
 - c protein, RNA, DNA
 - d RNA, DNA, protein
 - e DNA, RNA, protein

9. What is the DNA **template** for the mRNA sequence **5' UAACGGAGCCUAAUC 3'**?
- a 5' AUUGCCUCGGAUUAG 3'
 - . .
 - b 5' GAUUAGGCUCCGUUA 3'
 - . .
 - c 5' ATTGCCTCGGATTAG 3'
 - . .
 - d **5' GATTAGGCTCCGTTA 3'**
 - . .
 - e 5' TAACGGAGCCTAATC 3'
 - . .
10. What happens in the process of transcription?
- a Double stranded RNA is formed.
 - . .
 - b Amino acids are added to a new polypeptide chain.
 - . .
 - c Transfer RNA brings amino acids to the peptide bonding site.
 - . .
 - d **mRNA is assembled using a DNA template.**
 - . .
 - e DNA polymerase creates a new DNA molecule.
 - . .
11. What is meant by the term “universality,” in reference to the genetic code?
- a All organisms read DNA as a long series of 3 letter codons without spaces or overlap.
 - . .
 - b **A codon triplet codes for the same amino acid in almost all species of organisms.**
 - . .
 - c Although the code is always a group of three nucleotides, each species has evolved different triplets for each amino acid.
 - . .
 - d A segment of DNA produces different polypeptides, depending on the organism in which it is placed.
 - . .
 - e all of the above
 - . .
12. What is affected by errors in transcription?
- a the inheritance of traits by future generations
 - . .

- b new cells formed during mitosis
- .
- c polypeptides formed during translation
- .
- d the ability of a cell to create new RNA
- .
- e the ability of a cell to reproduce
- .

13. What are nucleosomes?

- a structural units of DNA that consist of about 200 bases wrapped around a group of histones
- b regions of the bacterial cytoplasm, where the bacterial chromosome may be found
- c Positions on the bacterial cell membrane that the chromosome may bind to
- d pieces of circular DNA that are commonly found in the cytoplasm of some bacterial cells
- e a system of tubes and fibers that assist the movement of chromosomes during anaphase in mitosis

Short Answer

1.a) Make a chart showing 3 differences between transcription and translation.

-occurs in nucleus
 -creates mRNA
 -starting molecule template DNA strand
 -uses RNA polymerase

-occurs in cytoplasm
 - creates polypeptide
 -starting molecule in mRNA
 -uses ribosome to assemble

b) In what three ways are the processes of transcription and translation the same?

-transcription
 -(creates) mRNA
 -needs post processing (splicing)
 mRNA has 5' and 3' ends

translation.
 -(uses) mRNA
 -needs post processing (folding)
 mRNA has 5' and 3' ends

2. After transcription pre-mRNA must be modified before translation occurs. Name and describe in detail **three** types of processing of pre-mRNA that occur before the mRNA leaves the nucleus.

5' cap- many Guanine added to 5' end of mRNA

3' tail- 200+ adenine added to 3' end

splicing- removing introns. using ligase to anneal exons

4. Describe the three important features of the Central Dogma.

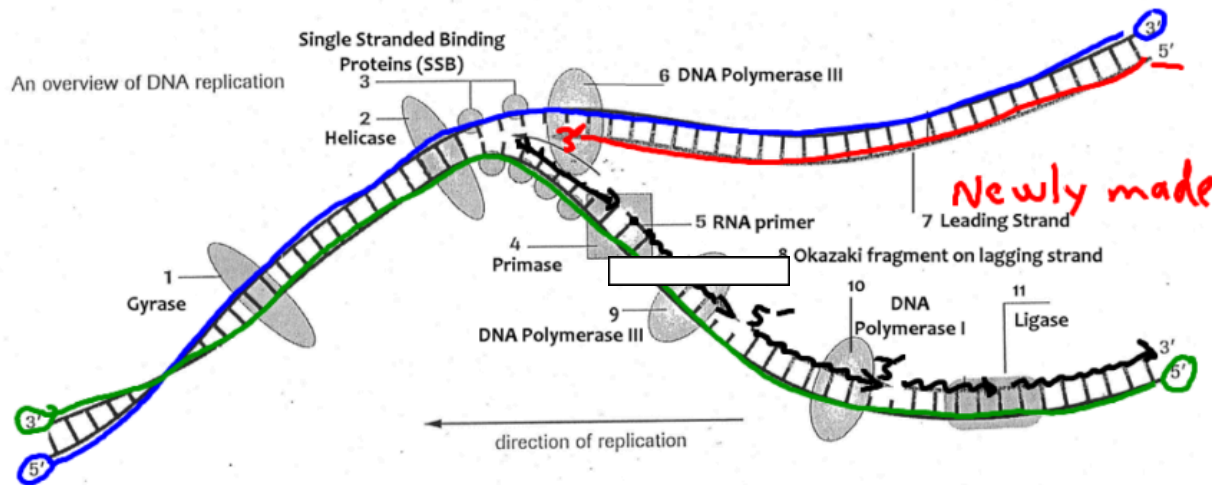
5 a) Name the process shown in this diagram.

b) Label this diagram.

c) List three details for each of the four stages: initiation, synthesis of the leading strand, synthesis of the lagging strand, termination.

Label the structures and enzymes

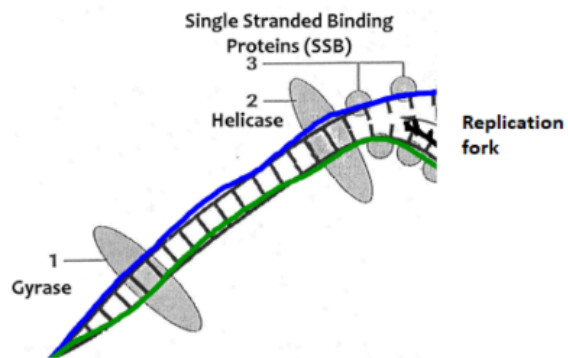
Use 4 colours for DNA



Parent DNA strands - blue and green
New DNA leading strand - red
New DNA lagging strand - black

1. Initiation

- the enzyme gyrase uncoils the DNA helix
- the hydrogen bonds between the nitrogen bases are broken by the enzyme helicase
- to keep the nitrogen bases from rebonding single-stranded binding proteins (SSB's) bond to the nitrogen bases
- a replication fork is formed
- there can be many replication forks at the same time on one strand of DNA to make replication go faster



2A. Elongation: Leading Strand – quickly synthesized

- the RNA **primase** enzyme starts the new section of DNA with a small section of RNA called RNA primer!!!
- RNA is a single stranded nucleic acid so the RNA **primase** enzyme works on single stranded DNA
- next DNA **polymerase III** enzyme adds complementary nucleotides to the 3' end of the **new DNA strand at the primer**
- new DNA synthesized going **towards** the replication fork
- remember enzymes can only work in a certain orientation

2B. Elongation: Lagging Strand – slowly synthesized

- again **RNA primase** adds a small section of RNA primer
- **DNA polymerase III** adds complementary nucleotides to the new DNA at the open 3' end
- new DNA synthesized going **away from** the replication fork
- many small Okazaki fragments are formed as the replication fork opens more
- **DNA polymerase I** replaces the RNA primers with DNA nucleotides where 2 Okazaki fragments meet
- **DNA ligase** joins the Okazaki fragments

3. Termination

- other DNA polymerase enzymes also error check the hydrogen bonding to prevent mutations
- if hydrogen bonds do **not** line up enzymes remove the wrong nucleotide and substitute the correct one
- all the enzymes are released
- the DNA is correctly coiled up again

6. For the diagram below:

- Name the process. Transcription
- What is the starting molecule? DNA template
- What molecule is being produced? mRNA
- Where does this occur? nucleus
- List 3 facts about each of the stages of initiation, elongation and termination.

1. Initiation

- Promoter regions are upstream or before the gene to be made into a protein.
- The RNA polymerase recognizes promoter regions of DNA which have long strings of Adenine and Thymine (TATA boxes)
- Enzyme RNA polymerase binds to the "template" strand of the DNA (strand being read).
- The RNA polymerase unwinds the DNA and breaks the hydrogen bonds between the **template** and **coding** strands

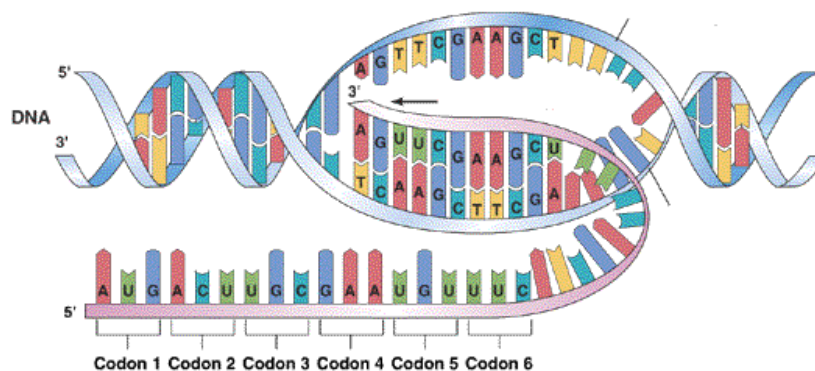
2. Elongation (see fig 8 p. 259)

- The RNA polymerase reads from the **3' to 5' end** of the DNA template strand
- The mRNA starts being synthesized when RNA polymerase finds the beginning of the gene

- The single stranded mRNA is synthesized in the direction of 5'-3' forming phosphodiester bonds
- mRNA is synthesized with uracil instead of thymine and ribonucleotides instead of deoxyribonucleotides

3. Termination

- the RNA polymerase recognizes the terminator sequence in the template DNA
- single strand of pre- mRNA released
- RNA polymerase enzyme released to be reused
- DNA hydrogen bonds reform and DNA re-coils



- Name the process below. translation
- What is the starting molecule? mRNA
- What molecule is being produced? polypeptide
- Where does this occur? cytoplasm
- Name and describe 3 types of RNA required for this process. tRNA= bring in amino acids to ribosome, mRNA the instructions for polypeptide synthesis, rRNA= the ribosome
- List 3 facts about each of the stages of initiation, elongation and termination.

1. INITIATION

- a ribosome forms at the 5' end of the mRNA
- small and large ribosomal subunits bind the mRNA in the middle
- the A-site accepts the incoming tRNA-AA
- first AA must be methionine
- note the complementary anti-codon UAC at the bottom of the tRNA
- the P-site is for peptide bond formation
- the textbook shows the E-site for the exiting tRNA

2A. ELONGATION

- AA that correspond to the mRNA codon enters
- the tRNA-AA for alanine is at the A-site

- peptide bond forms between the met+ala
- the growing polypeptide chain transfers to tRNA in acceptor site
- the ribosome translocates one codon “down” the mRNA in the 5’ to 3’ direction
- empty tRNA leaves

2B. ELONGATION CONTINUES

- tRNA at the P-site now exits to get another AA
- the tRNA-AA with isoleucine enters the acceptor site
- peptide bond forms between ala+ile
- the growing polypeptide chain transfers to tRNA in acceptor site
- ribosome translocates
- empty tRNA leaves

2C. ELONGATION NEARING COMPLETION

- note the STOP codon at the end of the mRNA message
- notice the long, long polypeptide chain
- there is NO tRNA to fill the acceptor site for a stop codon

3. TERMINATION

- all parts of the ribosome detach
- the polypeptide must fold to a functional protein
- the large and small ribosomal subunit, mRNA and tRNA are available to be reused

