

Biology 101 Chapter 14

Name: _____

Fill-in-the-Blanks

Which base follows the next in a strand of DNA is referred to. as the base (1) Sequence. The region of DNA that calls for the assembly of specific amino acids into a polypeptide chain is a (2) gene. The two steps from genes to proteins are called (3) transcription and (4) translation. In eukaryotes, during (5) transcription single-stranded molecules of RNA are assembled on DNA templates in the nucleus. During (6) translation, the RNA molecules are shipped from the nucleus into the cytoplasm, where they are used as templates for assembling (7) polypeptide chains. Following translation, one or more chains become (8) folded into the three-dimensional shape of protein molecules. Proteins have (9) structural and (10) functional roles in cells, including control of DNA.

Complete the Table

Three types of RNA are transcribed from DNA in the nucleus (from genes that code only for RNA). Complete the following table, which summarizes information about these molecules.

RNA Molecule	Abbreviation	Description/Function
a. Ribosomal RNA	rRNA	a type of RNA that combines with proteins to form Ribosomes on which polypeptide chains of proteins are assembled
b. Messenger RNA	mRNA	single strand of RNA transcribed from DNA and translated into a poly peptide chain the only RNA with protein building instructions
c. Transfer RNA	tRNA	an RNA molecule that binds and delivers an amino acid to a ribosome and that pairs with an mRNA codon during the translation stage of protein synthesis

Sequence

Arrange the steps of transcription in correct chronological sequence. Write the letter of the first step next to 15, the letter of the second step next to 16, and so on.

- 15. **C** A. The RNA strand grows along exposed bases until RNA polymerase meets a DNA base sequence that signals "stop."
- 16. **B** B. RNA polymerase binds with the DNA promoter region to open up a local region of the DNA double helix.
- 17. **A** C. An RNA polymerase enzyme locates the DNA bases of the promoter region of one DNA strand by recognizing DNA-associated proteins near a promoter.
- 18. **E** D. RNA is released from the DNA template as a free, single-stranded transcript.
- 19. **D** E. RNA polymerase moves stepwise along exposed nucleotides of one DNA strand; as it moves, the DNA double helix keeps unwinding.

Completion

20. Suppose the line below represents the DNA strand that will act as a template for the production of mRNA through the process of transcription. Fill in the blanks below the DNA strand with the sequence of complementary bases that will represent the message carried from DNA to the ribosome in the cytoplasm.

P
 \ /
 D
 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
 T A C A A G A T A A C A T T A T T T C C C T A C C G T C A T C

| | | | |
 R R R R R
 \ / \ / \ / \ / \ /
 P P P P P P P

Matching

- 1. **F** codon
- 2. **B** three at a time
- 3. **G** sixty-one
- 4. **H** the genetic code
- 5. **C** release factors
- 6. **A** ribosome
- 7. **E** anticodon
- 8. **D** the "stop" codons
- A. Composed of two subunits, the small subunit with P and A amino acid binding sites as well as a binding site for mRNA
- B. Reading frame of the nucleotide bases in mRNA
- C. Detach protein and mRNA from the ribosome
- D. UAA, UAG, UGA
- E. A sequence of three nucleotide bases that can pair with a specific mRNA codon
- F. Name for each base triplet in mRNA
- G. The number of codons that actually specify amino acids
- H. Term for how the nucleotide sequences of DNA and then mRNA correspond to the amino acid sequence of a polypeptide chain

Complete the Table

9. Complete the following table, which distinguishes the stages of translation.

<i>Translation Stage</i>	<i>Description</i>
a. INITIATION	Special initiator tRNA loads onto small ribosomal subunit and recognizes AUG; small subunit binds with mRNA, and large ribosomal subunit joins small one.
b. ELONGATION	Amino acids are strung together in sequence dictated by mRNA codons as the RNA strand passes through the two ribosomal subunits; two tRNAs interact at P and A sites
c. TERMINATION	mRNA "stop" codon signals the end of the polypeptide chain; release factors detach the ribosome and polypeptide chain from the mRNA.

Completion

10. Given the following DNA sequence, deduce the composition of the mRNA transcript:

TAC AAG ATA ACA TTA TTT CCT ACC GTC ATC

AUG UUC UAU UGU AAU AAA GGA UGG GAG UAG_____

(mRNA transcript)

11. Deduce the composition of the tRNA anticodons that would pair with the above specific mRNA codons as these tRNAs deliver the amino acids (identified below) to the P and A binding sites of the small ribosomal subunit.

UAC AAG AUA ACA UUA UUU CCU ACC GUC AUC

(tRNA anticodons)

From the mRNA transcript, use the text to deduce the composition of the amino acids of the polypeptide sequence.

MET PHEN TYR CYS ASP LYS GLU TRY GLU STOP

(amino acids)

Fill-in-the-Blanks

The order of (13) **amino acid** in a protein is specified by a sequence of nucleotide bases. The genetic code is read in units of (14) **three** nucleotides; each unit of three codes for (15) **one** amino acids). In the table that showed which triplet specified a particular amino acid, the triplet code was incorporated in (16) **mRNA** molecules. Each of these triplets is referred to as a(n) (17) **codon**. (18) **mRNA** alone carries the instructions for assembling a particular sequence of amino acids from the DNA to the ribosomes in the cytoplasm, where (19) **assembly** of the polypeptide occurs. (20) **transfer** RNA acts as a shuttle molecule as each type brings its particular (21) **Amino acid** to the ribosome where it is to be incorporated into the growing (22) **polypeptide**. A(n) (23) **AUG codon** is a triplet on mRNA that forms hydrogen bonds with a(n) (24) **UAC anticodon**, which is a triplet on tRNA.

Fill-in-the-Blanks

In addition to changes in chromosomes (crossing over, recombination, deletion, addition, translocation, and inversion), changes can also occur in the structure of DNA; these modifications are referred to as gene mutations. Complete the following exercise on types of spontaneous gene mutations.

Viruses, ultraviolet radiation, and certain chemicals are examples of environmental agents called

(2) **mutagen** that may enter cells and damage strands of DNA. If A becomes paired with C instead of T during DNA replication, this spontaneous mutation is a base-pair

(3) **substitution**. Sickle-cell anemia is a genetic disease whose cause has been traced to a single DNA base pair; the result is that one (4) **amino acid** is substituted for another in the beta

chain of (5) **HbS**. A(n) (6) **frameshift** mutation is defined as the insertion or deletion of one to several DNA base pairs; this puts the nucleotide sequence out of phase, and abnormal proteins are produced. Some DNA regions "jump" to new DNA locations and often inactivate the genes

in their new environment; such (7) **transposable** elements may give rise to observable changes in the phenotype of an organism. (8) **DNA** is the source of the unity of life;

(9) **gene mutation** are the original source of life's diversity; they are heritable, small-scale alterations in the (10) **nucleotide** sequence of DNA. Each gene has a characteristic

(11) **mutation rate**, which is the probability it will mutate spontaneously during a given interval of time. But not all mutations are spontaneous. (12) **ionizing** radiation causes base substitutions or breaks in one or both strands.

Self Quiz

- Transcription _____
 - occurs on the surface of the ribosome
 - is the final process in the assembly of a protein
 - occurs during the synthesis of any type of RNA by use of a DNA template
 - is catalyzed by DNA polymerase
- _____ carry(ies) amino acids to ribosomes, where amino acids are linked into the primary structure of a polypeptide.
 - mRNA
 - tRNA
 - Introns
 - rRNA
- Transfer RNA differs from other types of RNA because it
 - transfers genetic instructions from cell nucleus to cytoplasm
 - specifies the amino acid sequence of a particular protein
 - carries an amino acid at one end
 - contains codons
- _____ dominates the process of transcription.
 - RNA polymerase
 - DNA polymerase
 - Phenylketonuria
 - Transfer RNA
- _____ and, _____ are found in RNA but not in DNA.
 - Deoxyribose; thymine
 - Deoxyribose; uracil
 - Uracil; ribose
 - Thymine; ribose
- If each kind of nucleotide is coded to select only one amino acid, how many different types of amino acids could be selected?
 - four
 - sixteen
 - twenty
 - Sixty-four
- Each "word" in the mRNA language consists of _____ letters.
 - three
 - four
 - five
 - more than five
- The genetic code is composed of codons.
 - three
 - twenty
 - sixteen
 - sixty-four
- The cause of sickle-cell anemia has been traced a. to mosquito-transmitted virus
 - two DNA mutations that result in two incorrect amino acids in a hemoglobin chain
 - three DNA mutations that result in three incorrect amino acids in a hemoglobin chain
 - one DNA mutation that results in one incorrect amino acid in a hemoglobin chain
- An example of a mutagen is
 - virus
 - ultraviolet radiation
 - certain chemicals
 - all of the above