



13.1 RNA

Lesson Objectives

-  Contrast RNA and DNA.
-  Explain the process of transcription.

The Role of RNA

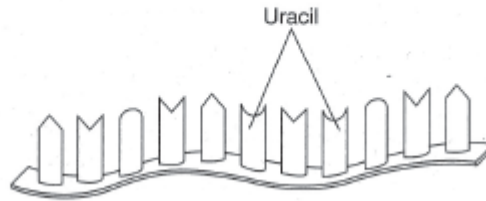
1. Complete the table to contrast the structures of DNA and RNA.

| | Sugar | Number of Strands | Bases |
|-----|-------|-------------------|-------|
| DNA | | | |
| RNA | | | |

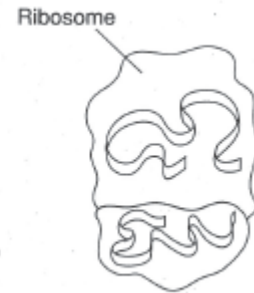
2. On the lines provided, identify each kind of RNA.



a. _____



b. _____



c. _____

RNA Synthesis

For Questions 4–10, complete each statement by writing the correct word or words.

4. The process of using DNA to produce complementary RNA molecules is called _____.
5. The sequence of _____ in mRNA complements the sequence in the DNA template.
6. In eukaryotes, RNA is formed in the _____ and then travels to the _____.
7. The enzyme _____ binds to DNA during transcription.
8. RNA polymerase binds to regions of DNA called _____, which are “start” signals for transcription.
9. _____ are portions of RNA that are cut out and discarded.
10. _____ are spliced together to make the final mRNA.

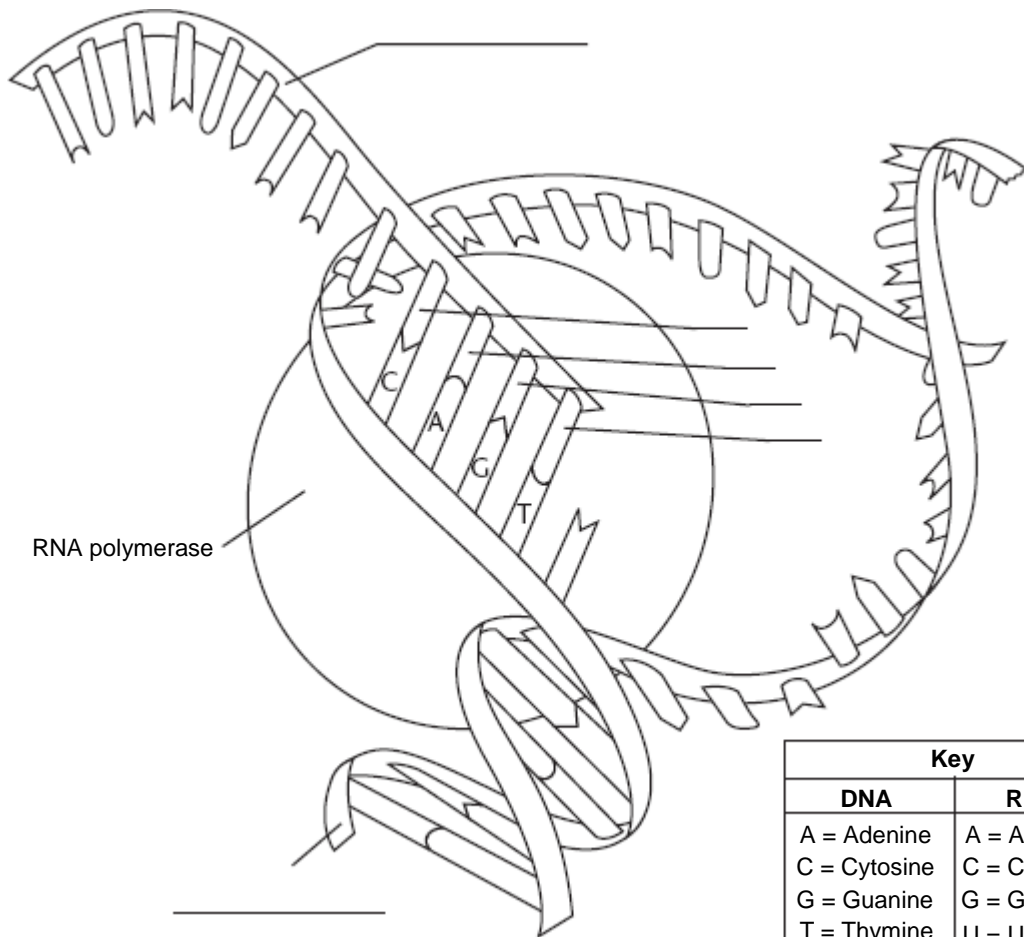
13.1 RNA

RNA Synthesis

In transcription, RNA polymerase separates the two DNA strands. RNA then uses one strand as a template to make a complementary strand of RNA. RNA contains the nucleotide uracil instead of the nucleotide thymine.

Follow the directions.

1. Label the RNA
2. Label the DNA.
3. Use the key to label the missing nucleotides marked on the diagram.



Answer the questions. Circle the correct answer.

4. In DNA, _____ is always paired with cytosine.
 adenine guanine uracil

5. In RNA, _____ replaces thymine.
 uracil cytosine adenine

6. In DNA, _____ is paired with adenine.
 uracil thymine guanine

RNA Synthesis

In DNA replication a cell copies its DNA. Both strands of the double helix are used as templates to make complementary, or matching, strands of DNA. In DNA transcription a single strand of DNA is used as a template to generate a strand of mRNA.

Follow the directions.

1. Fill in the missing information. One row has been completed for you.

| Template | Complementary DNA | Messenger RNA (mRNA) |
|----------|-------------------|----------------------|
| TTACGG | AATGCC | AAUGCC |
| | GGCGGC | |
| | | ACGUAG |
| AGACTC | | |
| | GATAAG | |
| | | CUGGCUACA |

Answer the questions.

2. What is the mRNA if the complementary DNA is TCTGAG? _____
3. What does a cell copy in DNA replication? _____
4. How many strands of DNA are used to make complementary strands of DNA? _____
5. How does the cell make RNA? _____

6. What are introns? _____

7. What are exons? _____




Follow the directions.

Create your own example of DNA. Fill in the chart.

| Template | Complementary DNA | Messenger RNA (mRNA) |
|----------|-------------------|----------------------|
| | | |

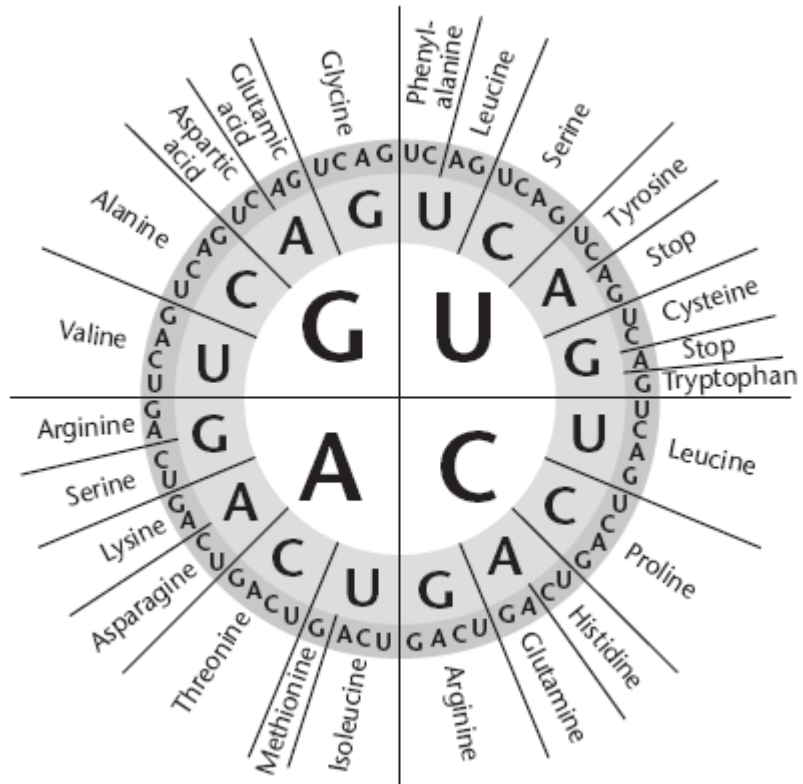
13.2 Ribosomes and Protein Synthesis

Lesson Objectives

-  Identify the genetic code and explain how it is read.
-  Summarize the process of translation.
-  Describe the “central dogma” of molecular biology.

The Genetic Code

Use the diagram to answer Questions 1–7.



1. What are the words along the outside of the circle?

2. What can you find by reading this diagram from the inside out?

3. For which amino acid is AAA a codon?

4. What is the codon for tryptophan?

5. For which amino acid is GGA a codon?

6. What is a codon for alanine?

7. What are three other codons for alanine? _____

Translation

Use the diagram to answer Questions 8–10.

8. What is the anticodon for leucine? _____

9. What is the codon for leucine? _____

10. List the amino acids in the order they would appear in the polypeptide coded for by this mRNA.

Phenylalanine leucine lysine methionine



11. What is the difference between transcription and translation?

12. Complete the table to describe the steps in protein synthesis

| Step | Description |
|----------------------------|-------------|
| Beginning of translation | |
| Assembly of polypeptide | |
| Completing the polypeptide | |

13. Describe the role of rRNA during translation.

The Molecular Basis of Heredity

For Questions 14–18, write the letter of the correct answer on the line at the left.

- _____ 14. The instructions for assembling proteins are contained in the
- A. genes.
 - B. ribosomes.
 - C. exons.
 - D. introns.
- _____ 15. The central dogma of molecular biology is that information is transferred from
- A. RNA to protein to DNA.
 - B. DNA to protein to RNA.
 - C. protein to DNA to RNA.
 - D. DNA to RNA to protein.
- _____ 16. An exception to the central dogma is
- A. the infection of a virus by a bacteriophage.
 - B. the ability of some viruses to transfer information from RNA to DNA.
 - C. the expression of different genes during different stages of development.
 - D. the translation of the codon into the anticodon of tRNA.
- _____ 17. The way in which DNA, RNA, and proteins are all involved in putting genetic information into action in living cells is called
- A. translation.
 - B. transcription.
 - C. gene expression.
 - D. viral transfer.
- _____ 18. All organisms are mostly the same in
- A. the proteins they make on their ribosomes.
 - B. how their proteins catalyze chemical reactions.
 - C. the size of their genes.
 - D. the molecular biology of their genes.

Apply the Big idea

19. Whether the organism is a pea plant or a human being, the information in the DNA of the cell's nucleus directs synthesis of proteins in the cytoplasm. Why, then, are pea plants and human beings so different?

13.3 Mutations

Lesson Objectives



Define mutations and describe the different types of mutations.



Describe the effects mutations can have on genes.

Types of Mutations

For Questions 1–8, match the term with its definition.

Definition

- _____ 1. The change of one base to another in a DNA sequence
- _____ 2. A change in one or a few nucleotides that occur at a single point in the DNA sequence
- _____ 3. Part of one chromosome breaks off and attaches to another
- _____ 4. A heritable change in genetic information
- _____ 5. A mutation that produces an extra copy of all or part of a chromosome
- _____ 6. A chromosomal mutation that reverses the direction of parts of a chromosome
- _____ 7. A kind of mutation that can change every amino acid that follows the point of mutation
- _____ 8. The addition of a base to the DNA sequence

Term

- A. mutation
- B. substitution
- C. point mutation
- D. frameshift mutation
- E. insertion
- F. translocation
- G. inversion
- H. duplication

9. Complete the table to describe the processes and outcomes of the different types of gene (point) mutations.

| Type | Description | Outcome |
|--------------|-------------|---------|
| Substitution | | |
| Insertion | | |
| Deletion | | |

10. Deletion can happen as a gene mutation or as a chromosomal mutation. What is the difference?

Effects of Mutations

For Questions 10–17, write the letter of the correct answer on the line at the left.

- _____ 10. The cellular machinery that replicates DNA inserts an incorrect base
- A. most of the time.
 - B. about half the time.
 - C. roughly once in every million bases.
 - D. roughly once in every 10 million bases.
- _____ 11. Small changes in genes
- A. disappear quickly.
 - B. gradually accumulate over time.
 - C. prevent the next generation from developing.
 - D. do not affect future generations.
- _____ 12. A possible mutagen is
- A. an anticodon.
 - B. translocation.
 - C. hemoglobin.
 - D. ultraviolet light.
- _____ 13. What happens when cells cannot repair the damage caused by a mutagen?
- A. The DNA base sequence changes permanently.
 - B. The DNA base sequence is not affected.
 - C. The organism is not affected.
 - D. The organism is affected temporarily.
- _____ 14. Which of the following most accurately summarizes the effects of mutations on living things?
- A. Most mutations are harmful, but some have little effect.
 - B. Many mutations have little or no effect, but some can be harmful or beneficial.
 - C. Most mutations are beneficial and a few are harmful.
 - D. About half of mutations are beneficial and half are harmful.
- _____ 15. Mutations are important to the evolution of a species because they
- A. happen over the long period of time that evolution requires.
 - B. cut out and replace damaged or useless genes.
 - C. are a source of genetic variability.
 - D. accelerate the transcription rate of DNA.
- _____ 16. Cancer is the product of a mutation that
- A. causes the uncontrolled growth of cells.
 - B. changes the structure of hemoglobin in the blood.
 - C. brings about stunted growth and severe pain.
 - D. causes a translocation in a pair of chromosomes.

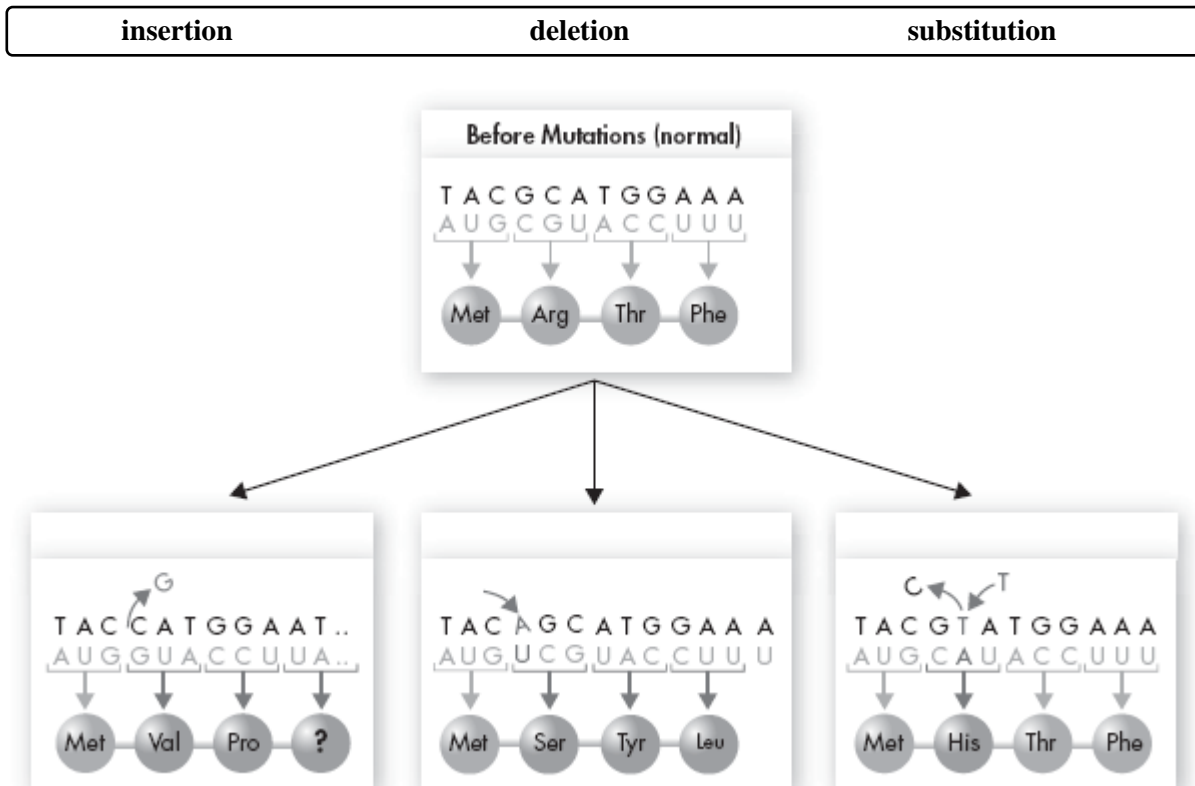
13.3 Mutations

Types of Mutations

Gene mutations produce a change in one gene. Point mutations produce gene mutations that involve a change in one or more nucleotides. Point mutations also occur at only one point in the DNA sequence. The diagram below shows an original chromosome and three possible point mutations.

Follow the directions.

- Use the words in the box to add headings to the three lower parts of the diagram.



Complete the sentences. Use the terms from the box above.

- In a(n) _____, one base is changed to a different base.
- In a(n) _____, a base is inserted into the DNA sequence.
- In a(n) _____, one base is removed from the DNA sequence.

Answer the questions.

- Which of the following can result in a frameshift mutation? Circle each correct answer.

- A. deletion
- B. substitution
- C. insertion

- Why is a frameshift mutation more damaging than a substitution? _____

Types of Mutations

Mutations that change whole chromosomes are called chromosomal mutations. The diagrams below show chromosomal mutations. Each diagram represents an original chromosome and a possible mutation of the chromosome.



Follow the directions.

1. Use the diagrams to help you complete the table.

| Mutation | Description |
|----------|---|
| deletion | Part of the chromosome is lost. |
| | Extra copies of a part of a chromosome are made. |
| | Part of a chromosome breaks off and attaches to another chromosome. |
| | Sections of a chromosome are reversed. |

Answer the questions.

2. Which types of mutations can add genes to a chromosome? _____
3. Which type of mutation can take genes away from a chromosome? _____
4. Which type of mutation changes the order of the genes, but not the number of genes in a chromosome? _____