Name _____ Class _____ Date _____

12.1 Identifying the Substance of Genes

Lesson Objectives

- Summarize the process of bacterial transformation.
- Describe the role of bacteriophages in identifying genetic material.
- Identify the role of DNA in heredity.

Lesson Summary

Bacterial Transformation In 1928, Frederick Griffith found that some chemical factor from heat-killed bacteria of one strain could change the inherited characteristics of another strain.

- He called the process **transformation** because one type of bacteria (a harmless form) had been changed permanently into another (a disease-carrying form).
- Because the ability to cause disease was inherited by the offspring of the transformed bacteria, he concluded that the transforming factor had to be a gene.

In 1944, Oswald Avery tested the transforming ability of many substances. Only DNA caused transformation. By observing bacterial transformation, Avery and other scientists discovered that the nucleic acid DNA stores and transmits genetic information from one generation of bacteria to the next.

Bacterial Viruses A **bacteriophage** is a kind of virus that infects bacteria. When a bacteriophage enters a bacterium, it attaches to the surface of the bacterial cell and injects its genetic material into it.

- In 1952, Alfred Hershey and Martha Chase used radioactive tracers to label proteins and DNA in bacteriophages.
- Only the DNA from the bacteriophage showed up in the infected bacterial cell.
- Hershey and Chase concluded that the genetic material of the bacteriophage was DNA.
- Their work confirmed Avery's results, convincing many scientists that DNA was the genetic material found in genes—not just in viruses and bacteria, but in all living cells.

The Role of DNA The DNA that makes up genes must be capable of storing, copying, and transmitting the genetic information in a cell.

Bacterial Transformation

1. What happened when Griffith injected mice with the pneumonia-causing strain of bacteria that had been heat-killed?

_____

2. What happened when Griffith injected mice with a mixture of heat-killed, pneumonia-causing bacteria and live bacteria of the harmless type?

_____

Name _____ Class _____ Date _____

3. What was the purpose of Oswald Avery's experiments?

_____

_____

4. What experiments did Avery do?

_____

_____

_____

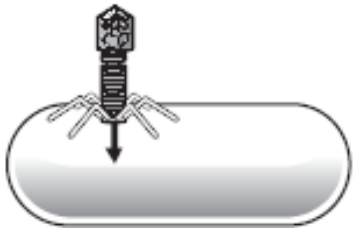
5. What did Avery conclude?

_____

Bacterial Viruses

6. Fill in the blanks to summarize the experiments of Hershey and Chase. (Note: The circles represent radioactive labels.)

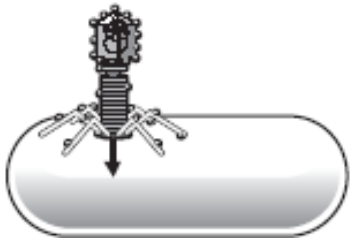
_____ with radioactive label



_____

_____

_____ with radioactive label



_____

_____

7. What did Hershey and Chase conclude? Why?

_____

_____

8. How did Hershey and Chase confirm Avery's results?

_____

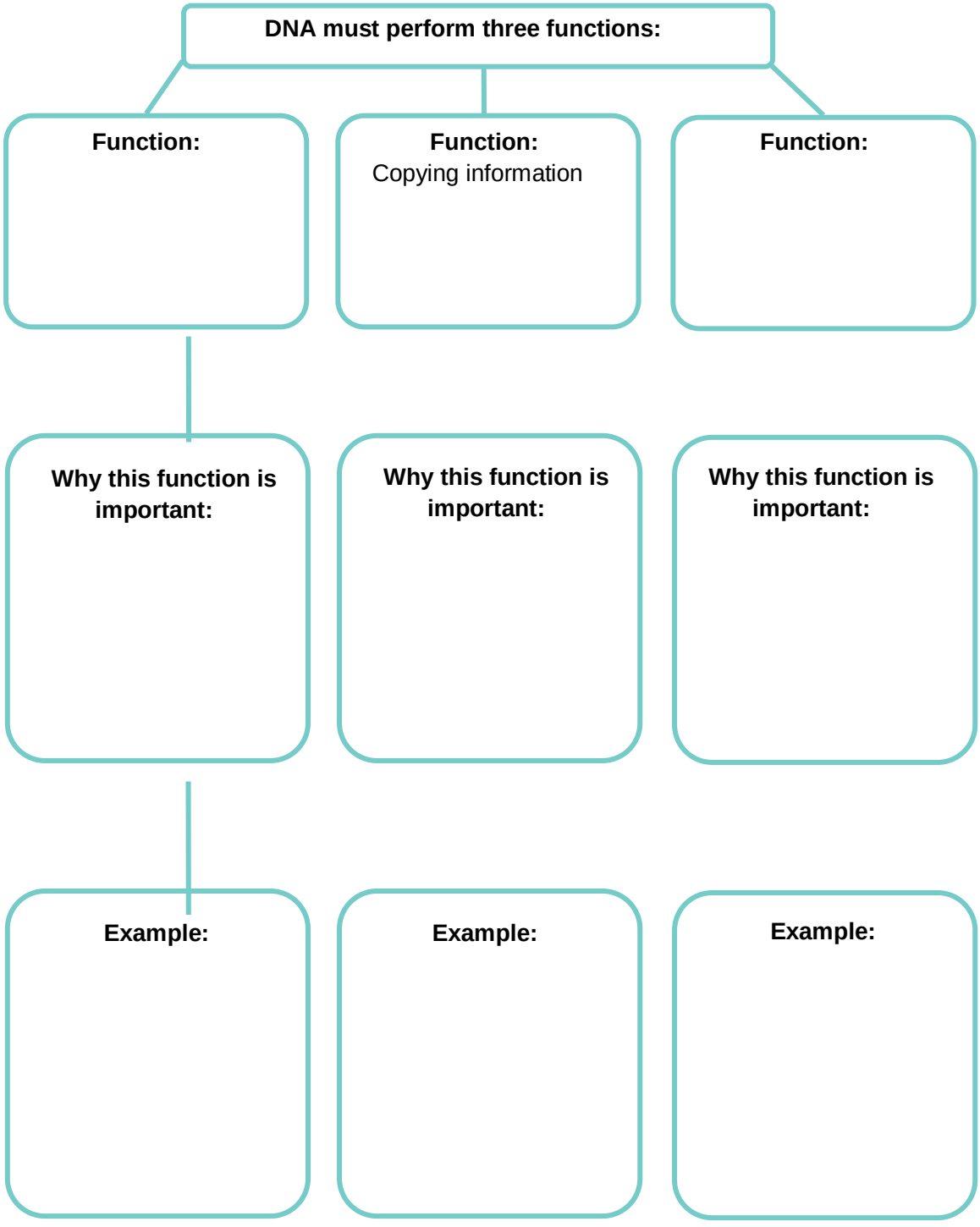
_____

_____

Name _____ Class _____ Date _____

The Role of DNA

9. Complete this graphic organizer to summarize the assumptions that guided research on DNA in the middle of the twentieth century. Use an oak tree to give an example of each function.



Name _____ Class _____ Date _____

VISUAL ANALYSIS

10. DNA is like a book titled *How to Be a Cell.* Explain why that title is appropriate for each of DNA's three functions.

a. _____

_____

_____

_____

_____

b. _____

_____

_____

_____

_____

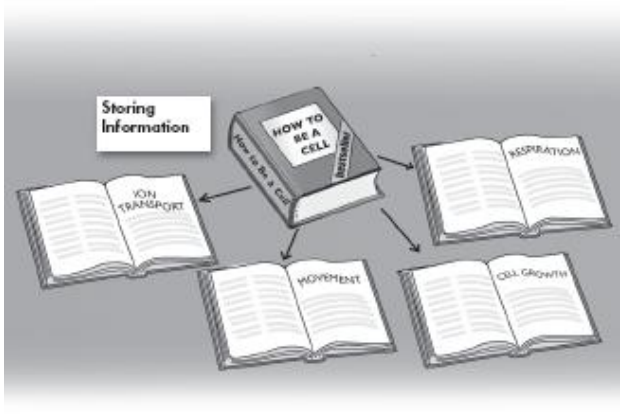
c. _____

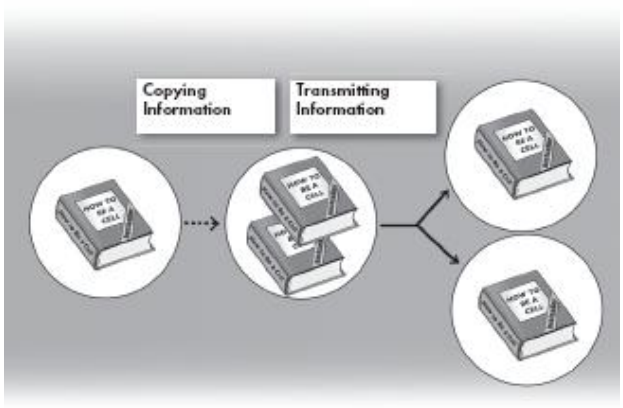
_____

_____

_____

_____





Apply the Big idea

11. By 1952, many scientists were convinced that genes are made of DNA, but they did not yet know how DNA worked. Why was it important to determine the structure of DNA to understand how DNA stored, copied, and transmitted information?

_____

_____

_____

_____

12. Why was the fact of transformation so important to the study of DNA's role? What did transformation demonstrate?

_____

_____

_____

Name _____ Class _____ Date _____

12.2 The Structure of DNA

Lesson Objectives

- Identify the chemical components of DNA.
- Discuss the experiments leading to the identification of DNA as the molecule that carries the genetic code.
- Describe the steps leading to the development of the double-helix model of DNA.

Lesson Summary

The Components of DNA DNA is a nucleic acid made up of nucleotides joined into long strands or chains by covalent bonds. Nucleotides may be joined in any order.

- A DNA nucleotide is a unit made of a nitrogenous base, a 5-carbon sugar called deoxyribose, and a phosphate group.
- DNA has four kinds of nitrogenous bases: adenine, guanine, cytosine, and thymine.

Solving the Structure of DNA

- Erwin Chargaff showed that the percentages of adenine and thymine are almost always equal in DNA. The percentages of guanine and cytosine are also almost equal.
- Rosalind Franklin's X-ray diffraction studies revealed the double-helix structure of DNA.
- James Watson and Francis Crick built a model that explained the structure of DNA.

The Double-Helix Model The double-helix model explains Chargaff's rule of base pairing and how the two strands of DNA are held together. The model showed the following:

- The two strands in the double helix run in opposite directions, with the nitrogenous bases in the center.
- Each strand carries a sequence of nucleotides, arranged almost like the letters in a fourletter alphabet for recording genetic information.
- Hydrogen bonds hold the strands together. The bonds are easily broken allowing DNA strands to separate.
- Hydrogen bonds form only between certain base pairs–adenine with thymine, and cytosine with guanine. This is called **base pairing.**

The Components of DNA

For Questions 1–5, complete each statement by writing in the correct word or words.

1. The building blocks of DNA are _____.

2. Nucleotides in DNA are made of three basic components: a sugar called _____,a _____, and a nitrogenous_____.

3. DNA contains four kinds of nitrogenous bases: _____, _____, _____, and _____.

4. In DNA, _____ can be joined in any order.

5. The nucleotides in DNA are joined by _____ bonds.

Name_____ Class _____ Date _____

Solving the Structure of DNA

6. Complete the table to describe each scientist's contribution to solving the structure of DNA.

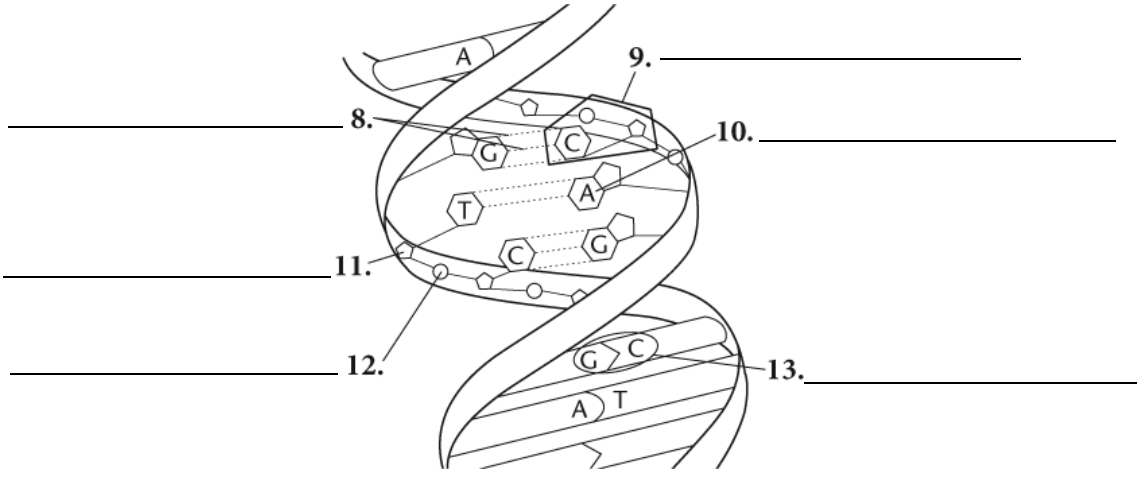
Scientist	Contribution
Erwin Chargaff	
Rosalind Franklin	
James Watson and Francis Crick	

7. Complete the table by estimating the percentages of each based on Chargaff's rules.

DNA sample	Percent of adenine	Percent of thymine	Percent of guanine	Percent of cytosine
1	31.5			
2		30	20	
3				17

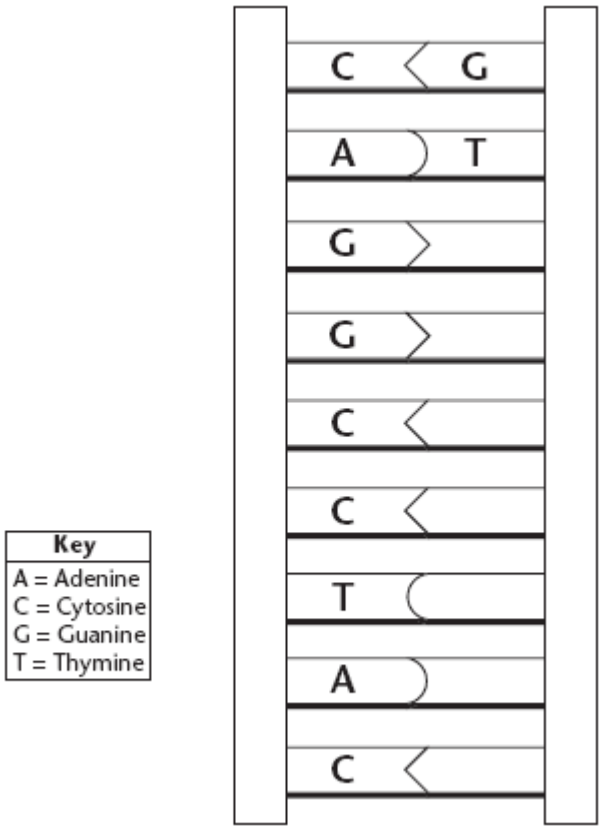
The Double-Helix Model

For Questions 8–13, on the lines provided, label the parts of the DNA molecule that correspond to the numbers in the diagram.



Name _____ Class _____ Date _____

14. **THINK VISUALLY** The drawing below shows half of a DNA molecule. Fill in the appropriate letters for the other half. Explain why you drew your sketch the way you did.



_____

_____

Apply the Big idea

15. Complete this table to show how the structure of the DNA molecule allows it to perform each essential function.

Function	Structure of the Molecule
Store information	
Copy information	
Transmit information	

Name_____ Class _____ Date _____

12.3 DNA Replication

Lesson Objectives

- Summarize the events of DNA replication.
- Compare DNA replication in prokaryotes with that of eukaryotes.

Lesson Summary

Copying the Code Each strand of the double helix has all the information needed to reconstruct the other half by the mechanism of base pairing. Because each strand can be used to make the other strand, the strands are said to be complementary. DNA copies itself through the process of **replication:**

- The two strands of the double helix unzip, forming replication forks.
- New bases are added, following the rules of base pairing (A with T and G with C).
- Each new DNA molecule has one original strand and one new strand.
- **DNA polymerase** is an enzyme that joins individual nucleotides to produce a new strand of DNA.
- During replication, DNA may be lost from the tips of chromosomes, which are called **telomeres.**

Replication in Living Cells The cells of most prokaryotes have a single, circular DNA molecule in the cytoplasm. Eukaryotic cells have much more DNA. Nearly all of it is contained in chromosomes, which are in the nucleus.

- Replication in most prokaryotic cells starts from a single point and proceeds in two directions until the entire chromosome is copied.
- In eukaryotic cells, replication may begin at dozens or even hundreds of places on the DNA molecule, proceeding in both directions until each chromosome is completely copied.

Copying the Code

1. Why are the strands of a DNA molecule said to be complementary?

_____

2. What is the first step in eukaryotic DNA replication?

_____

_____

3. If the base sequence on a separated DNA strand is CGTAGG, what will the base sequence on its complementary strand be?

_____

4. What enzyme joins individual nucleotides to produce the new strand of DNA?

_____

Name_____ Class _____ Date _____

5. What enzyme makes it less likely that DNA will be lost from telomeres during replication?

_____

6. How does this enzyme work?

_____

7. What is a replication fork?

_____

8. Does DNA replication take place in the same direction along both strands of the DNA molecule that is being replicated? Explain your answer. (Hint: Look at the illustration of DNA replication in your textbook.)

_____

_____

9. Make a sketch of the double helix of DNA. Show how it unzips for replication and how complementary strands are built. Label the nitrogenous bases, replication fork, DNA polymerase, the original strand, and the new strand.

Name_____ Class _____ Date _____

Replication in Living Cells

10. Complete the table to compare and contrast DNA replication in prokaryotes and eukaryotes.

	Prokaryotes	Eukaryotes
Location of DNA		
Amount of DNA		
Starting Point(s) for Replication		

11. Is DNA replication always a foolproof process? Explain your answer.

_____

_____

_____

Apply the Big idea

12. Why is the pairing of bases during replication essential for the transmission of inherited traits from parent to offspring?

_____

_____

_____

_____

Name _____ Class _____ Date _____

Chapter Vocabulary Review

For Questions 1–6, match the term with its definition.

Definition

_____ **1.** In DNA, the fit between thymine and adenine and the fit between cytosine and guanine.

_____ **2.** An enzyme that joins individual nucleotides to produce a new strand of DNA

_____ **3.** The process that can change a harmless bacterial strain into a disease-causing strain

_____ **4.** The tip of a chromosome

_____ **5.** The process that copies a DNA molecule

_____ **6.** A kind of virus that infects bacteria

Term

A. transformation

B. bacteriophage

C. base pairing

D. replication

E. DNA polymerase

F. telomere

For Questions 7–15, complete each statement by writing in the correct word or words.

7. Each time a chromosome is replicated, some DNA may be lost from the tip of the chromosome, or __.

8. Griffith's experiments showed that some chemical compound in cells must be responsible for bacterial __.

9. Hershey and Chase studied a _____ that was composed of a DNA core and a protein coat.

10. The center of the DNA strand exhibits _____.

11. The enzyme that "proofreads" each new DNA strand so that each molecule is a near- perfect copy of the original is _____.

12. In eukaryotic cells, _____ can begin at dozens or even hundreds of places on the DNA molecule.

13. The double-helix model explains Chargaff's rule of _____.

14. The DNA molecule separates into two strands during _____.

15. The principal enzyme involved in DNA replication is _____.

Name _____ Class _____ Date _____

Chapter Review

Use the clues and words to help you write the vocabulary terms from the chapter in the blanks. You may use a word once or not at all.

bacteriophage	**DNA polymerase**	**telomere**
base pairing	**replication**	

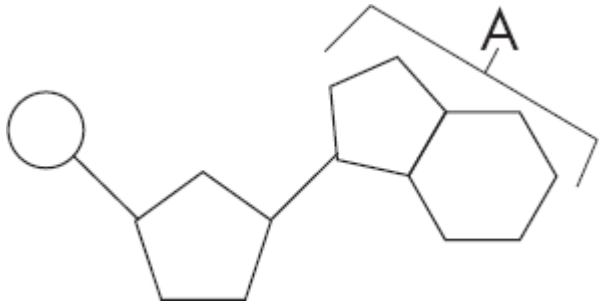
1. tip of a chromosome _____

2. enzyme that joins nucleotides to make a new strand of DNA _____

3. virus that infects bacteria _____

4. process of making a copy of DNA _____

Answer the following questions. Use the diagram to answer Questions 5 and 6.



5. What is the structure shown above?

A. replication fork **C.** enzyme

B. nucleotide **D.** hydrogen bond

6. What is the molecule labeled A?

A. sugar **C.** nitrogen base

B. phosphate group **D.** deoxyribose

7. Use the terms below to draw a linear graphic organizer in the space below.

adenine	**cytosine**	**guanine**
bases	**DNA**	**thymine**

Nucleotides

Name _____ Class _____ Date _____

13.1 RNA

Lesson Objectives

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

Lesson Summary

The Role of RNA

RNA (ribonucleic acid) is a nucleic acid like DNA. It consists of a long chain of nucleotides. The RNA base sequence directs the production of proteins. Ultimately, cell proteins result in phenotypic traits. The main differences between RNA and DNA are:

- The sugar in RNA is ribose instead of deoxyribose.
- RNA is generally single-stranded and not double-stranded like DNA.
- RNA contains uracil in place of thymine.

RNA can be thought of as a disposable copy of a segment of DNA. Most RNA molecules are involved in protein synthesis. The three main types of RNA are:

- **Messenger RNA** (mRNA) carries copies of instructions for polypeptide synthesis from the nucleus to ribosomes in the cytoplasm.
- **Ribosomal RNA** (rRNA) forms an important part of both subunits of the ribosomes, the cell structures where proteins are assembled.
- **Transfer RNA** (tRNA) carries amino acids to the ribosome and matches them to the coded mRNA message.

RNA Synthesis

Most of the work of making RNA takes place during transcription. In **transcription**, segments of DNA serve as templates to produce complementary RNA molecules. In prokaryotes, RNA synthesis and protein synthesis takes place in the cytoplasm. In eukaryotes, RNA is produced in the cell's nucleus and then moves to the cytoplasm to play a role in the production of protein. The following focuses on transcription in eukaryotic cells.

- The enzyme **RNA polymerase** binds to DNA during transcription and separates the DNA strands. It then uses one strand of DNA as a template from which to assemble nucleotides into a complementary strand of RNA.
- RNA polymerase binds only to **promoters,** regions of DNA that have specific base sequences. Promoters are signals to the DNA molecule that show RNA polymerase exactly where to begin making RNA. Similar signals cause transcription to stop when a new RNA molecule is completed.
- RNA may be "edited" before it is used. Portions that are cut out and discarded are called **introns.** The remaining pieces, known as **exons**, are then spliced back together to form the final mRNA.

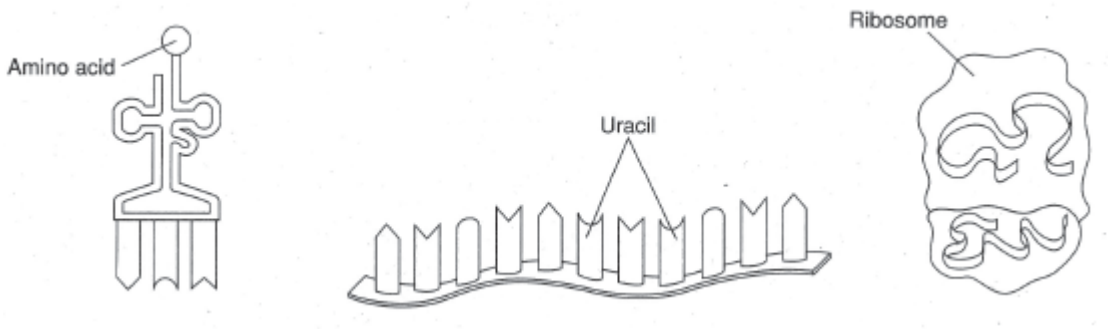
Name _____ Class _____ Date _____

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.** _____

3. **VISUAL ANALOGY** The master plan of a building shows how to build and place important parts of the building, such as walls, pipes, and electrical outlets. On the building site, workers use copies of the master plan called blueprints to show them what to do. The master plan is kept in the office. Explain how mRNA works like a blueprint in constructing proteins.

_____

_____

_____

Name _____ Class _____ Date _____

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.

11. **THINK VISUALLY** Sketch the sequence in which pre-mRNA is "edited" after it is made on the DNA template and before it is ready to function as mRNA in the cytoplasm. Show the original DNA, the pre-mRNA, and the final mRNA. Be sure to label exons and introns.

12. Use the analogy of the master plan and blueprints used by builders to identify what represents messenger RNA, where the "ribosome" is, and who performs the same kind of job as transfer RNA.

Explain your reasoning.

Apply the Big idea

Name _____ Class _____ Date _____

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.

Lesson Summary

The Genetic Code A specific sequence of bases in DNA carries the directions for forming a **polypeptide,** a chain of amino acids. The types and order of amino acids in a polypeptide determine the properties of the protein. The sequence of bases in mRNA is the **genetic code.** The four bases, A, C, G, and U, act as "letters."

- The code is read three "letters" at a time, so that each "word" is three bases long and corresponds to a single amino acid. Each three-letter "word" in mRNA is known as a **codon.**
- Some codons serve as "start" and "stop" signals for protein synthesis.

Translation Ribosomes use the sequence of codons in mRNA to assemble amino acids into polypeptide chains. The process of decoding of an mRNA message into a protein is **translation.**

- Messenger RNA is transcribed in the nucleus and then enters the cytoplasm.
- On the ribosome, translation begins at the start codon. Each codon attracts an **anticodon,** the complementary sequence of bases on tRNA.
- Each tRNA carries one kind of amino acid. The match between the codon and anticodon ensures that the correct amino acid is added to the growing chain.
- The amino acids bond together, each in turn. The ribosome moves along the mRNA, exposing codons that attract still more tRNAs with their attached amino acids.
- The process concludes when a "stop code" is reached. The newly formed polypeptide and the mRNA molecule are released from the ribosome.

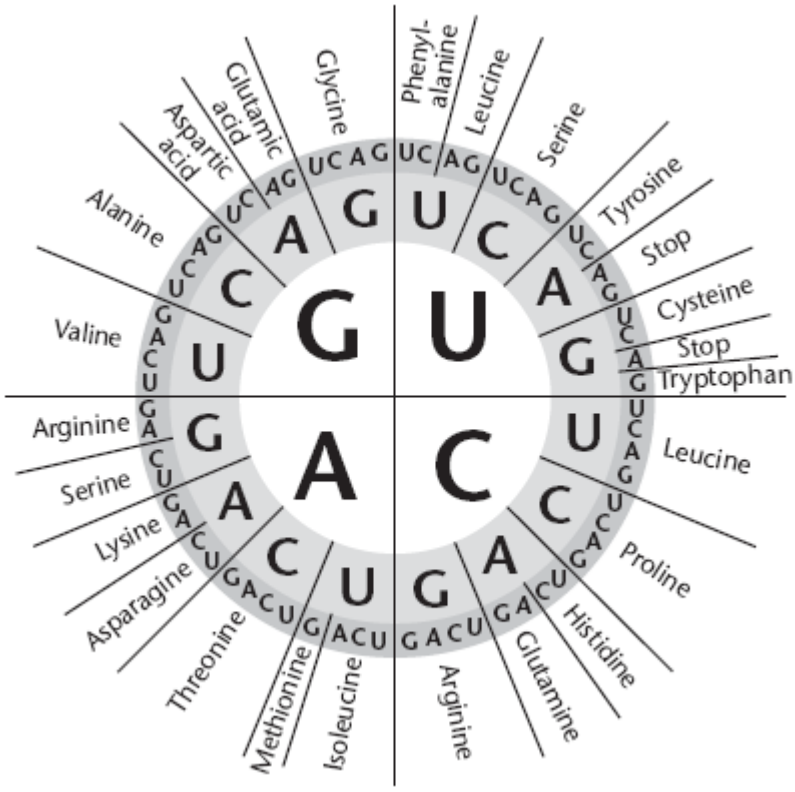
The Molecular Basis of Heredity Molecular biology seeks to explain living organisms by studying them at the molecular level, using molecules like DNA and RNA.

- The central dogma of molecular biology is that information is transferred from DNA to RNA to protein.
- **Gene expression** is the way in which DNA, RNA, and proteins are involved in putting genetic information into action in living cells.
- The genetic code is generally the same in all organisms.

Name _____ Class _____ Date _____

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?

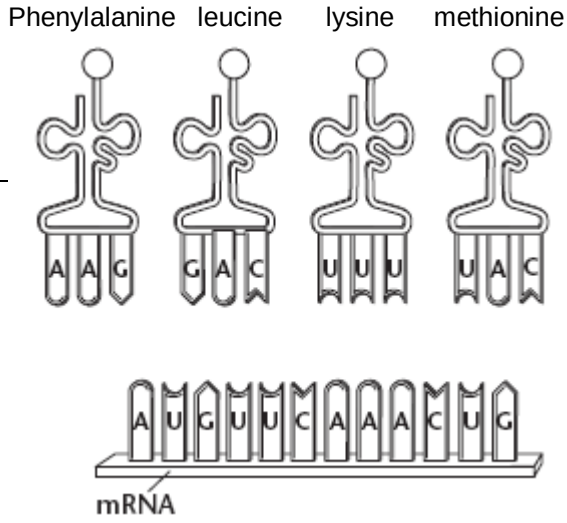
_____

7. What are three other codons for alanine?

Name _____ Class _____ Date _____

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.

_____

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.

_____

_____

_____

Name _____ Class _____ Date _____

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?

_____

_____

_____

_____

Name_____ Class_____ Date_____

13.3 Mutations

Lesson Objectives

- Define mutations and describe the different types of mutations.
- Describe the effects mutations can have on genes.

Lesson Summary

Types of Mutations

Mutations are heritable changes in genetic information. There are two categories of mutations: gene mutations and chromosomal mutations.

- Gene mutations produce changes in a single gene. **Point mutations** involve only one or a few nucleotides. Substitutions, insertions, and deletions are all types of point mutations.
  - In a substitution, one base is changed to a different base, which may affect only a single amino acid and have no effect at all.
  - In insertions and deletions, one base is inserted or removed from the DNA sequence. Insertions and deletions are called **frameshift mutations** because they shift the "reading frame" of the genetic message. Frameshift mutations can change every amino acid that follows the point of mutation and can have dramatic effects on the organism.
- Chromosomal mutations produce changes in the number or structure of chromosomes. They include deletions, duplications, inversions, and translocations.
  - Deletion involves the loss of all or part of a chromosome.
  - Duplication produces an extra copy of all or part of a chromosome.
  - Inversion reverses the direction of parts of a chromosome.
  - Translocation occurs when part of one chromosome breaks off and attaches to another.

Effects of Mutations

Genetic material can be altered by natural events or by artificial means. Errors can be made during replication. Environmental conditions may increase the rate of mutation. **Mutagens** are chemical or physical agents in the environment that cause mutations.

The effects of mutations on genes vary widely:

- Some mutations have little or no effect.
- Some mutations produce beneficial variations. One example is **polyploidy** in plants, in which an organism has extra sets of chromosomes. Polyploid plants are often larger and stronger than diploid plants. Mutations can also produce proteins with new or altered functions that can be useful to organisms in different or changing environments.
- Some mutations negatively disrupt gene function or dramatically change protein structure. Genetic disorders such as sickle cell disease can result.

Name_____ Class_____ Date_____

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?

_____

_____

_____

Name_____ Class_____ Date_____

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.

_____ **17.** Polyploidy is the condition in which

A. a piece of a chromosome breaks off and reattaches to another chromosome.

B. an organism has an extra set of chromosomes.

C. a mutagen speeds the mutation rate.

D. an insect develops a resistance to a pesticide.

18. In the space below, draw an example of a normal blood cell and an example of a sickle cell.

Apply the Big idea

19. A gene that codes for one of the polypeptide chains of the blood protein hemoglobin lies on chromosome 11 in humans. A substitution mutation in that gene causes the amino acid valine to be incorporated into hemoglobin in a place where glutamic acid would normally lie. The result is sickle cell disease. Explain how a change in a single base in DNA can bring about such a serious disorder.

Name _____ Class _____ Date _____

Chapter Vocabulary Review

For Questions 1–7, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

_____ **1.** DNA contains the sugar ribose.

_____ **2.** Messenger RNA carries copies of the instructions for making proteins from DNA to other parts of the cell.

_____ **3.** RNA polymerase transfers amino acids to ribosomes.

_____ **4.** The process of transcription produces a complementary strand of RNA on a DNA template.

_____ **5.** The enzyme that assembles a complementary strand of RNA on a DNA template is RNA polymerase.

_____ **6.** The region of DNA where the production of an RNA strand begins is called the intron.

_____ **7.** Exons are spliced together in forming messenger RNA.

For Questions 8–16, match the term with its definition.

Definition

_____ **8.** The sequence of bases that serves as the "language" of life

_____ **9.** A sequence of three bases on a tRNA molecule that is complementary to a sequence of bases on an mRNA molecule

_____ **10.** How genetic information is put into action in a living cell

_____ **11.** Having extra sets of chromosomes

_____ **12.** The decoding of an mRNA message into a protein

_____ **13.** A heritable change in genetic information

_____ **14.** A chain of amino acids

_____ **15.** The three consecutive bases that specify a single amino acid to be added to the polypeptide chain

_____ **16.** A chemical or physical agent that causes a change in a gene

Term

A. polypeptide

B. genetic code

C. codon

D. translation

E. anticodon

F. gene expression

G. mutation

H. mutagen

I. polyploidy

For Questions 17–19, complete each statement by writing the correct word or words.

17. A group of genes that are regulated together is called a(n) _____.

18. A region of DNA where a repressor can bind is a(n) _____.

19. Master control genes, called_____ genes, regulate organs that develop in specific parts of the body.

Name _____ Class _____ Date _____

Chapter Review

Use the clues and words to help you write the vocabulary terms from the chapter in the blanks. You may use a word once, more than once, or not at all.

codon	anticodon	mutation	promoter

1. a change in genetic material _____

2. region of DNA where RNA polymerase can bind _____

3. group of three nucleotide bases in mRNA _____

Answer the questions.

4. What causes cell differentiation during an organism's development? _____

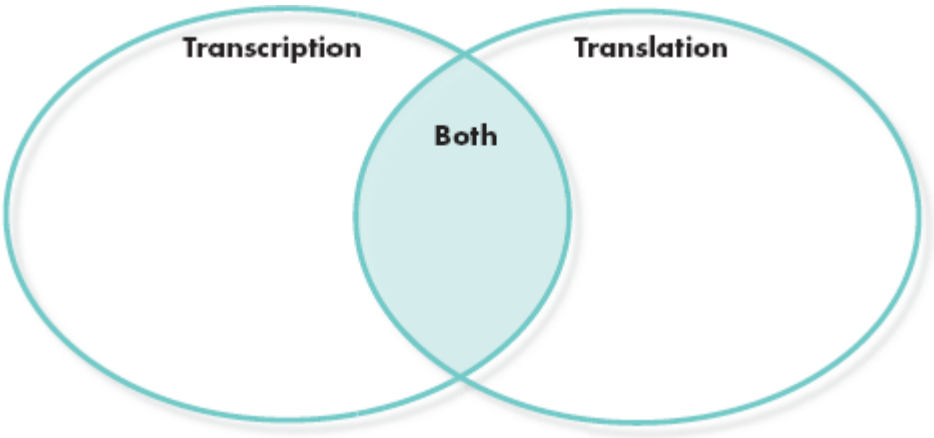
_____

5. Which of the following is a type of point mutation?

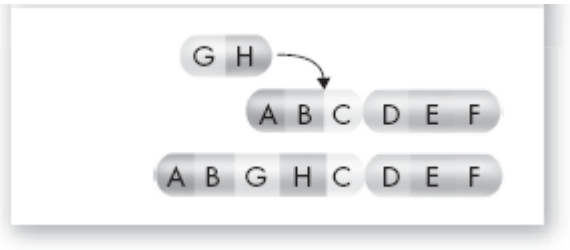
A. duplication **C.** insertion

B. inversion **D.** translocation

6. Use these phrases to complete the Venn diagram: *requires RNA polymerase; part of gene expression; proteins are made; RNA is made; protein synthesis.*



7. Complete the sentence about the diagram below.



In the diagram, one part of the chromosome breaks off and _____to another. This is called _____.