

Chapter 7

Molecular Genetics: From DNA to Proteins Worksheets



(Opening image copyright by 4designerart, 2010. Used under license from Shutterstock.com.)

- Lesson 7.1: DNA and RNA
- Lesson 7.2: Protein Synthesis
- Lesson 7.3: Mutation
- Lesson 7.4: Regulation of Gene Expression

7.1 DNA and RNA

Lesson 7.1: True or False

Name _____ Class _____ Date _____

Write true if the statement is true or false if the statement is false.

- _____ 1. For many decades, scientists thought that proteins were the genetic material.
- _____ 2. In eukaryotic cells, proteins always remain in the nucleus, but DNA is made at ribosomes in the cytoplasm.
- _____ 3. RNA is much larger than DNA.
- _____ 4. Erwin Chargaff demonstrated that in DNA, the amount of adenine is about the same as the amount of guanine.
- _____ 5. The shape of DNA is similar to a spiral staircase, and is referred to as a double helix.
- _____ 6. Because of Chargaff's rules, if the order of bases on one strand of DNA is known, the order of bases on the other strand can be predicted.
- _____ 7. There are 4 types of RNA: mRNA, rRNA, sRNA, and tRNA.
- _____ 8. Proteins are made on the ribosomes in the cytoplasm.
- _____ 9. In DNA replication, half of the parent DNA molecule is conserved in each of the two daughter DNA molecules.
- _____ 10. mRNA is a copy of the genetic instructions from the DNA.
- _____ 11. Oswald Avery was the first to conclude that DNA is the genetic material.
- _____ 12. James Watson and Francis Crick used X rays to learn about DNA's structure.
- _____ 13. RNA uses the instructions in DNA to make a protein.
- _____ 14. If one strand of DNA is GAATTC, the opposite strand would be CTTAAG.
- _____ 15. DNA contains instructions for all the proteins your body makes.

Lesson 7.1: Critical Reading

Name _____ Class _____ Date _____

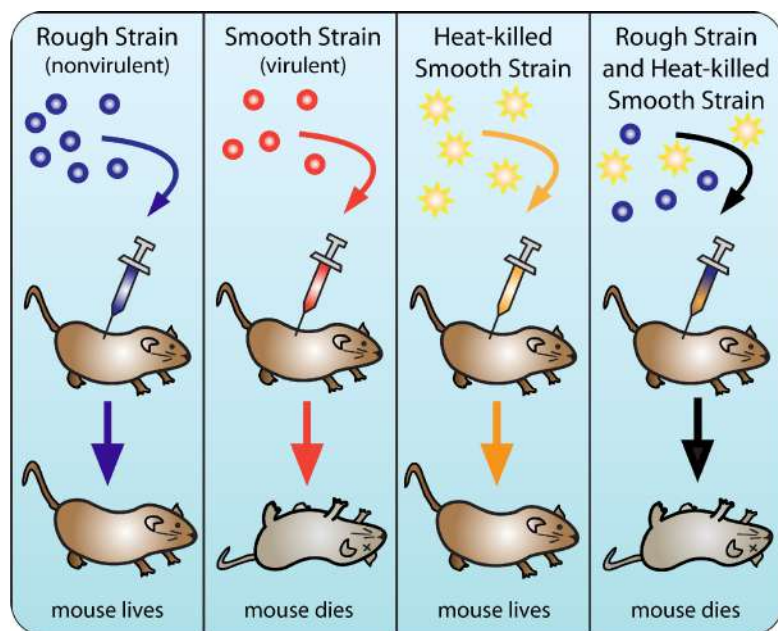
Read these passages from the text and answer the questions that follow.

DNA

DNA is the genetic material in your cells. It was passed on to you from your parents and determines your characteristics. The discovery that DNA is the genetic material was another important milestone in molecular biology.

Griffith Searches for the Genetic Material

Many scientists contributed to the identification of DNA as the genetic material. In the 1920s, Frederick Griffith made an important discovery. He was studying two different strains of a bacterium, called R (rough) strain and S (smooth) strain. He injected the two strains into mice. The S strain (virulent) killed the mice, but the R strain (nonvirulent) did not (see the figure below). Griffith also injected mice with S-strain bacteria that had been killed by heat. As expected, the killed bacteria did not harm the mice. However, when the dead S-strain bacteria were mixed with live R-strain bacteria and injected, the mice died.



Griffith's Experimental Results. Griffith showed that a substance could be transferred to harmless bacteria and make them deadly. (Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)

Based on his observations, Griffith deduced that something in the killed S-strain was transferred to the previously harmless R-strain, making the R-strain deadly. What was that something? What type of substance could change the characteristics of the organism that received it?

Hershey and Chase Seal the Deal

The conclusion that DNA is the genetic material was not widely accepted at first. It had to be confirmed by other research. In the 1950s, Alfred Hershey and Martha Chase did experiments with viruses and bacteria. Viruses are not cells. They are basically DNA inside a protein coat. To reproduce, a virus must insert its own genetic material into a cell (such as a bacterium). Then it uses the cell's machinery to make more viruses. The researchers used different radioactive elements to label the DNA and proteins in viruses.

This allowed them to identify which molecule the viruses inserted into bacteria. DNA was the molecule they identified. This confirmed that DNA is the genetic material.

Questions

1. In Griffith's experiments, what killed the mice?
2. Why did the rough strain and heat-killed smooth strain kill the mice?
3. Why are viruses not considered cells?
4. What were the results of Hershey and Chase's experiment?
5. The term given to Griffith's observations is **transformation**. Why do you think that term is appropriate?

Lesson 7.1: Multiple Choice

Name _____ Class _____ Date _____

Circle the letter of the correct choice.

- The order of experiments proving that DNA is the genetic material is
 - Avery → Griffith → Hershey and Chase.
 - Hershey and Chase → Griffith → Avery.
 - Griffith → Avery → Hershey and Chase.
 - Griffith → Hershey and Chase → Avery.
- Chargaff's rules state that
 - the amount of adenine equals the amount of thymine.
 - the amount of adenine equals the amount of guanine.
 - the amount of thymine equals the amount of guanine.
 - the amount of cytosine equals the amount of thymine.
- Which of the following statements concerning DNA is correct? (1) DNA contains instructions for all the proteins your body makes. (2) The shape of DNA is a double helix. (3) The central dogma of molecular biology states RNA → DNA → Protein.
 - 1 only
 - 1 and 2
 - 2 and 3
 - 1, 2, and 3
- The structure of DNA was identified by
 - Rosalind Franklin.
 - Erwin Chargaff.
 - Alfred Hershey and Martha Chase.
 - James Watson and Francis Crick.
- If one strand of DNA is CAGGTTACG, the opposite strand is
 - GTCCAATGC.
 - GTCCTTAGC.
 - CAGGTTACG.
 - GTCCTTAGC.
- The subunits of DNA are nucleotides consisting of
 - a sugar, a carbon group, and a nitrogen-containing base.
 - a sugar, a phosphate group, and a nitrogen-containing base.
 - a sugar, a phosphate group, and an oxygen-containing base.
 - a lipid, a phosphate group, and a nitrogen-containing base.
- Differences between DNA and RNA include which of the following? (1) RNA consists of one nucleotide chain. (2) RNA contains the nitrogen base uracil instead of thymine. (3) RNA contains the sugar ribose instead of deoxyribose.
 - 1, 2, and 3
 - 1 and 2
 - 2 and 3
 - 2 only
- The types of RNA include

- (a) messenger RNA.
- (b) nuclear RNA.
- (c) cytoplasmic RNA.
- (d) all of the above

Lesson 7.1: Vocabulary I

Name _____ Class _____ Date _____

Match the vocabulary word with the proper definition.

Definitions

- _____ 1. the shape of DNA
- _____ 2. found that there exists a substance that could change the characteristics of another organism
- _____ 3. helps form ribosomes
- _____ 4. used X rays to learn more about DNA's structure
- _____ 5. subunit of DNA
- _____ 6. DNA → RNA → Protein
- _____ 7. brings amino acids to ribosomes
- _____ 8. confirmed that DNA is the genetic material
- _____ 9. the amount of A = T, and the amount of C = G
- _____ 10. copies the genetic instructions from DNA in the nucleus, and carries the instructions to the cytoplasm
- _____ 11. discovered the shape of DNA
- _____ 12. the process in which DNA is copied

Terms

- a. central dogma of molecular biology
- b. Chargaff's rules
- c. DNA replication
- d. double helix
- e. Franklin
- f. Griffith
- g. Hershey and Chase
- h. messenger RNA (mRNA)
- i. nucleotide
- j. ribosomal RNA (rRNA)
- k. transfer RNA (tRNA)
- l. Watson and Crick

Lesson 7.1: Vocabulary II

Name _____ Class _____ Date _____

Fill in the blank with the appropriate term.

1. In DNA, A always pairs with _____, and G always pairs with _____.
2. The DNA molecule has a double _____ shape.
3. Griffith showed that a substance could be transferred to harmless bacteria and make them _____-_____.
4. DNA → RNA → _____
5. _____ and Chase confirmed that DNA is the genetic material.
6. The amount of A equals the amount of T and the amount of G equals the amount of C is known as _____ rules.
7. _____ RNA copies the genetic instructions from DNA in the nucleus, and carries them to the cytoplasm.
8. Proteins are made in the cytoplasm on small organelles called _____.
9. _____ contains the nitrogen base uracil.
10. _____ RNA helps form ribosomes,
11. _____ RNA brings amino acids to ribosomes,
12. DNA stands for _____.

Lesson 7.1: Critical Writing

Name _____ Class _____ Date _____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the process of DNA replication. What allows the correct base to be placed in the new DNA strand?

7.2 Protein Synthesis

Lesson 7.2: True or False

Name _____ Class _____ Date _____

Write true if the statement is true or false if the statement is false.

- _____ 1. The process in which cells make proteins is called protein expression.
- _____ 2. Transcription takes place in three steps: initiation, elongation, and termination.
- _____ 3. Splicing removes introns from mRNA.
- _____ 4. A codon can be described as a three-letter genetic “word.”
- _____ 5. UAG, UGA, AGU, and UAA are the four stop codons
- _____ 6. The anticodon is part of each tRNA molecule.
- _____ 7. Initiation of transcription occurs when the enzyme, DNA polymerase, binds to the promoter of a gene.
- _____ 8. All known living organisms, except some species of primitive bacteria, have the same genetic code.
- _____ 9. Elongation is the addition of amino acids to the mRNA strand.
- _____ 10. Translation always begins at an AUG codon.
- _____ 11. Many proteins are modified in the Golgi apparatus after translation.
- _____ 12. During translation, rRNA brings the amino acids into the ribosome.
- _____ 13. Termination of transcription occurs at a stop codon.
- _____ 14. Transcription uses DNA as a template to make an RNA molecule.
- _____ 15. Translation takes place in a ribosome.

Lesson 7.2: Critical Reading

Name _____ Class _____ Date _____

Read these passages from the text and answer the questions that follow.

The Genetic Code

How is the information in a gene encoded? The answer is the genetic code. The **genetic code** consists of the sequence of nitrogen bases — A, C, G, T (or U) — in a polynucleotide chain. The four bases make up the “letters” of the genetic code. The letters are combined in groups of three to form code “words,” called **codons**. Each codon stands for (encodes) one amino acid, unless it codes for a start or stop signal. There are 20 common amino acids in proteins. There are 64 possible codons, more than enough to code for the 20 amino acids. The genetic code is shown in the FlexBook.

Reading the Genetic Code

As shown in the Genetic Code figure (see **Figure 7.8** in the FlexBook), the codon AUG codes for the amino acid methionine. This codon is also the start codon that begins translation. The start codon establishes the reading frame of mRNA. The reading frame is the way the letters are divided into codons. After the AUG start codon, the next three letters are read as the second codon. The next three letters after that are read as the third codon, and so on. The mRNA molecule is read, codon by codon, until a stop codon is reached. UAG, UGA, and UAA are all stop codons. They do not code for any amino acids.

Characteristics of the Genetic Code

The genetic code has a number of important characteristics.

- The genetic code is universal. All known living things have the same genetic code. This shows that all organisms share a common evolutionary history.
- The genetic code is unambiguous. Each codon codes for just one amino acid (or start or stop). What might happen if codons encoded more than one amino acid?
- The genetic code is redundant. Most amino acids are encoded by more than one codon. What might be an advantage of having more than one codon for the same amino acid?

Questions

1. What is the genetic code?

2. Explain the significance of an AUG codon.

3. Why is the genetic code read three bases at a time?

4. “The genetic code is universal.” Explain this statement.

5. What might happen if codons encoded more than one amino acid?

Lesson 7.2: Multiple Choice

Name _____ Class _____ Date _____

Circle the letter of the correct choice.

- How many possible codons exist in the genetic code?
 - 3
 - 20
 - 46
 - 64
- The two processes of protein synthesis are
 - gene expression and protein expression.
 - transcription and translation.
 - replication and translation.
 - transcription and the genetic code.
- For protein synthesis to initiate,
 - RNA polymerase must bind to a gene's promoter.
 - nucleotides must be added to the mRNA strand.
 - the mRNA must be flow from the nucleus to the cytoplasm.
 - the tRNA and rRNA molecules must be made.
- Which of the following terms is most closely associated with a tRNA molecule?
 - codon
 - anticodon
 - transcription
 - ribosome
- Which of the following statements is correct?
 - Translation occurs in a ribosome when the codons on the mRNA are "read."
 - Translation occurs in a ribosome when the anticodons on the mRNA are "read."
 - Translation occurs in a ribosome when the codons on the rRNA are "read."
 - Transcription occurs in a ribosome when the codons on the mRNA are "read."
- "The genetic code is universal." This statement means that
 - each codon codes for just one amino acid.
 - all known living things have the same genetic code.
 - most amino acids are encoded by more than one codon.
 - all of the above
- Which of the following statements is correct? (1) Translation always begins with an UAG start codon. (2) The start codon establishes the reading frame of mRNA. (3) The mRNA molecule is read one codon at a time until a stop codon is reached.
 - 1 only
 - 2 only
 - 2 and 3
 - 1, 2, and 3
- Which of the following statements is correct?
 - Editing changes some of the nucleotides in DNA.
 - Polyadenylation adds a string of Cs to the mRNA.

- (c) Splicing removes introns from mRNA.
- (d) all of the above

Lesson 7.2: Vocabulary I

Name _____ Class _____ Date _____

Match the vocabulary word with the proper definition.

Definitions

- _____ 1. the process in which cells make proteins
- _____ 2. removes introns from mRNA
- _____ 3. the sequence of A, C, G, T (or U) bases in a polynucleotide chain
- _____ 4. complementary to a strand of DNA
- _____ 5. contains an anticodon that is complementary to the codon for an amino acid
- _____ 6. RNA → Protein
- _____ 7. DNA → RNA
- _____ 8. a group of three nitrogen bases
- _____ 9. regions of mRNA that code for proteins
- _____ 10. regions of mRNA that do not code for proteins
- _____ 11. the way the groups of three bases are divided into codons
- _____ 12. a region of a gene where RNA polymerase binds

Terms

- a. codon
- b. exons
- c. genetic code
- d. introns
- e. mRNA
- f. promoter
- g. protein synthesis
- h. reading frame
- i. splicing
- j. tRNA
- k. transcription
- l. translation

Lesson 7.2: Vocabulary II

Name _____ Class _____ Date _____

Fill in the blank with the appropriate term.

1. Transcription takes place in the _____ of the cell.
2. RNA polymerase binds to the _____ of a gene.
3. A group of three bases in the mRNA is a _____.
4. Transcription takes place in three steps: initiation, elongation, and _____.
5. All known living things have the same _____ code.
6. _____ is the second part of the central dogma of molecular biology: RNA → Protein.
7. Polyadenylation adds a “tail” of _____ to the mRNA.
8. AUG is the start codon and it codes for the amino acid _____.
9. Splicing removes _____ from mRNA.
10. The mRNA molecule is read, codon by codon, until a _____ codon is reached.
11. An _____ of the tRNA is complementary to the codon.
12. Transcription is the transfer of genetic instructions in DNA to _____.

Lesson 7.2: Critical Writing

Name _____ Class _____ Date _____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe the genetic code and its important characteristics.

7.3 Mutation

Lesson 7.3: True or False

Name _____ Class _____ Date _____

Write true if the statement is true or false if the statement is false.

- _____ 1. Mutations only occur in DNA.
- _____ 2. All mutations are harmful.
- _____ 3. Somatic mutations can be transmitted to offspring.
- _____ 4. A point mutation is a change in a single nucleotide in DNA.
- _____ 5. Neutral mutations can have a significant effect on the organism.
- _____ 6. Bacteria can have mutations that allow them to survive in the presence of antibiotic drugs.
- _____ 7. A deletion or insertion of one or more nucleotides may result in a frameshift mutation.
- _____ 8. Chromosomal alterations are mutations that change chromosome structure.
- _____ 9. Mutagens are caused by environmental factors known as mutations.
- _____ 10. A genetic disorder is a disease caused by a mutation in one or a few genes.
- _____ 11. The cell does not have the capability to repair damaged DNA.
- _____ 12. Point mutations can be described as silent, missense, senseless, or nonsense.
- _____ 13. A translocation mutation swaps sections from two non-homologous chromosomes.
- _____ 14. Natural sunlight can cause mutations.
- _____ 15. Mutations are the source of all new genetic material in a species.

Lesson 7.3: Critical Reading

Name _____ Class _____ Date _____

Read these passages from the text and answer the questions that follow.

Beneficial Mutations

Some mutations have a positive effect on the organism in which they occur. They are called beneficial mutations. They lead to new versions of proteins that help organisms adapt to changes in their environment. Beneficial mutations are essential for evolution to occur. They increase an organism's chances of surviving or reproducing, so they are likely to become more common over time. There are several well-known examples of beneficial mutations. Here are just two:

1. Mutations in many bacteria that allow them to survive in the presence of antibiotic drugs. The mutations lead to antibiotic-resistant strains of bacteria.
2. A unique mutation is found in people in a small town in Italy. The mutation protects them from developing atherosclerosis, which is the dangerous buildup of fatty materials in blood vessels. The individual in which the mutation first appeared has even been identified.

Harmful Mutations

Imagine making a random change in a complicated machine such as a car engine. The chance that the random change would improve the functioning of the car is very small. The change is far more likely to result in a car that does not run well or perhaps does not run at all. By the same token, any random change in a gene's DNA is likely to result in a protein that does not function normally or may not function at all. Such mutations are likely to be harmful. Harmful mutations may cause genetic disorders or cancer.

- A **genetic disorder** is a disease caused by a mutation in one or a few genes. A human example is cystic fibrosis. A mutation in a single gene causes the body to produce thick, sticky mucus that clogs the lungs and blocks ducts in digestive organs.
- Cancer is a disease in which cells grow out of control and form abnormal masses of cells. It is generally caused by mutations in genes that regulate the cell cycle. Because of the mutations, cells with damaged DNA are allowed to divide without limits. Cancer genes can be inherited.

Questions

1. What is a beneficial mutation?

2. What is a harmful mutation?

3. What type of mutation can cause cancer?

4. How can a mutation result in a genetic disorder? Give an example.

5. Why are beneficial mutations essential for evolution to occur?

Lesson 7.3: Multiple Choice

Name _____ Class _____ Date _____

Circle the letter of the correct choice.

- Which of the following statements concerning mutations is correct?
 - Mutations can happen spontaneously without any outside influence.
 - Cigarette smoke is a significant cause of mutations.
 - Mutations may occur during DNA replication or transcription.
 - all of the above
- Germline mutations are potentially dangerous, as they
 - are confined to just one cell and its daughter cells.
 - can be passed on to offspring.
 - can be silent mutations and go undetected.
 - all of the above
- Which of the following types of mutations can result in a genetic disorder?
 - a deletion
 - an insertion
 - a duplication
 - all of the above
- A frameshift mutation
 - changes the reading frame of the base sequence.
 - can be due to a translocation between two chromosomes.
 - may not have an effect on how the codons in mRNA are read.
 - all of the above.
- Beneficial mutations
 - may only cause mild genetic disorders.
 - are silent mutations, which code for the same amino acid.
 - help organisms adapt to changes in their environment.
 - are only caused by beneficial mutagens, like barbecuing and tanning.
- A missense mutation
 - results in a premature stop codon.
 - codes for a different amino acid.
 - codes for the same amino acid.
 - results in a frameshift mutation.
- Chromosomal alterations include deletions and
 - transfer mutations.
 - doubling mutations.
 - inversion mutations.
 - location mutations.
- Which of the following statements are correct concerning mutations?
 - Mutations are essential for evolution to occur.
 - A mutation is a change in the sequence of bases only in DNA.
 - Most mutations have a big effect on the organism in which they occur.
 - all of the above

Lesson 7.3: Vocabulary I

Name _____ Class _____ Date _____

Match the vocabulary word with the proper definition.

Definitions

- _____ 1. a deletion or insertion of one or more nucleotides that changes the reading frame
- _____ 2. removal of nucleotides or removal of a segment of a chromosome
- _____ 3. doubling of a segment of a chromosome
- _____ 4. a change in the sequence of bases in DNA or RNA
- _____ 5. occur in cells other than gametes
- _____ 6. mutations that change chromosome structure
- _____ 7. adding additional nucleotides into a chromosome
- _____ 8. a change in a single nucleotide in DNA
- _____ 9. reversal of a segment of a chromosome
- _____ 10. anything in the environment that can cause a mutation
- _____ 11. caused by a mutation in one or a few genes
- _____ 12. generally caused by mutations in genes that regulate the cell cycle
- _____ 13. swapping of material between two non-homologous chromosomes
- _____ 14. occur in gametes

Terms

- a. cancer
- b. chromosomal alteration
- c. deletion
- d. duplication
- e. frameshift mutation
- f. genetic disorder
- g. germline mutations
- h. insertion
- i. inversion
- j. mutagen
- k. mutation
- l. point mutation
- m. somatic mutations
- n. translocation

Lesson 7.3: Vocabulary II

Name _____ Class _____ Date _____

Fill in the blank with the appropriate term.

1. A change in the sequence of bases in _____ is called a mutation.
2. A change in a single nucleotide in DNA is a _____.
3. Chromosomal alterations are mutations that change _____ structure.
4. A silent point mutation codes for the same _____.
5. Mutations are essential for _____ to occur because they increase genetic variation.
6. Neutral mutations have _____ effect on the organism.
7. A _____ mutation is a deletion or insertion of one or more nucleotides that changes the reading frame of the base sequence.
8. _____ mutations can be transmitted to offspring.
9. A _____ disorder is a disease caused by a mutation in one or a few genes.
10. _____ is a disease in which cells grow out of control.
11. _____ mutations have a positive effect on the organism in which they occur.
12. _____ smoke contains dozens of mutagenic chemicals.

Lesson 7.3: Critical Writing

Name _____ Class _____ Date _____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What is a frameshift mutation? Explain how such a mutation can occur.

7.4 Regulation of Gene Expression

Lesson 7.4: True or False

Name _____ Class _____ Date _____

Write true if the statement is true or false if the statement is false.

- _____ 1. In your body, different types of cells have different genes.
- _____ 2. Using a gene to make a protein is called protein expression.
- _____ 3. A regulatory element is located on the DNA.
- _____ 4. An operon is a region of prokaryotic DNA.
- _____ 5. lacX, lacY, lacZ, and lacA are genes for the four proteins needed to digest lactose.
- _____ 6. Essentially, regulatory proteins must turn “on” certain genes in particular cells.
- _____ 7. In prokaryotic cells, RNA polymerase binds to the operator.
- _____ 8. Repressors promote transcription by enhancing the interaction of RNA polymerase with the promoter.
- _____ 9. The ATAT box is a regulatory element that is part of the promoter of most eukaryotic genes.
- _____ 10. Because of a mutation, it is possible for a fly to have legs growing out of its head.
- _____ 11. Mutations in some regulatory genes can cause cancer.
- _____ 12. In eukaryotic gene regulation, regulatory proteins must bind to the regulatory elements before RNA polymerase binds to the promoter.
- _____ 13. In the lac operon, when lactose is absent, the repressor protein does not bind to the operator.
- _____ 14. Homeobox genes code for regulatory proteins that switch on whole series of major developmental genes.
- _____ 15. In your body, different types of cells use different genes.

Lesson 7.4: Critical Reading

Name _____ Class _____ Date _____

Read these passages from the text and answer the questions that follow.

Eukaryotic Gene Regulation

In eukaryotic cells, the start of transcription is one of the most complicated parts of gene regulation. There may be many regulatory proteins and regulatory elements involved. Regulation may also involve enhancers. Enhancers are distant regions of DNA that can loop back to interact with a gene's promoter.

The TATA Box

Different types of cells have unique patterns of regulatory elements that result in only the necessary genes being transcribed. That's why a skin cell and nerve cell, for example, are so different from each other. However, some patterns of regulatory elements are common to all genes, regardless of the cells in which they occur. An example is the **TATA box**. This is a regulatory element that is part of the promoter of most eukaryotic genes. A number of regulatory proteins bind to the TATA box, forming a multi-protein complex. It is only when all of the appropriate proteins are bound to the TATA box that RNA polymerase recognizes the complex and binds to the promoter. Once RNA polymerase binds, transcription begins.

Regulation During Development

The regulation of gene expression is extremely important during the development of an organism. Regulatory proteins must turn on certain genes in particular cells at just the right time so the organism develops normal organs and organ systems. **Homeobox genes** are an example of genes that regulate development. They code for regulatory proteins that switch on whole series of major developmental genes. In insects, homeobox genes called hox genes ensure that body parts such as limbs develop in the correct place.

Questions

1. List three factors involved in eukaryotic gene regulation.

2. Describe the TATA box and its role.

3. Where does RNA polymerase bind to the DNA? What happens next?

4. What is a homeobox gene?

5. What is an enhancer?

Lesson 7.4: Multiple Choice

Name _____ Class _____ Date _____

Circle the letter of the correct choice.

- Using a gene to make a protein is called
 - protein expression.
 - gene expression.
 - gene regulation.
 - protein synthesis.
- Gene expression is regulated
 - to ensure that all cells make the same proteins.
 - to ensure that the correct proteins are made from the right genes.
 - to ensure that the correct proteins are made in the cells in which they are needed.
 - to ensure that all cells only use some genes.
- Which of the following statements concerning the lac operon is correct?
 - When lactose is present, the repressor protein binds to the operator.
 - When lactose is absent, a repressor protein binds to the operator.
 - When lactose is absent, a repressor protein binds to the promoter.
 - When lactose is present, the repressor protein binds to the promoter.
- Gene regulation during development involves
 - homeobox genes.
 - proto-oncogenes and tumor-suppressor genes.
 - the lac operon.
 - all of the above
- Which three factors are involved in eukaryotic gene regulation?
 - regulatory proteins, regulatory elements, and activators
 - regulatory proteins, operator, and promoter
 - regulatory proteins, regulatory elements, and RNA polymerase
 - regulatory proteins, regulatory elements, and enhancers
- Which of the following statements is correct? (1) Activators promote transcription by enhancing the interaction of RNA polymerase with the promoter. (2) Repressors promote transcription by enhancing the progress of RNA polymerase along the DNA strand. (3) Repressors prevent transcription by impeding the progress of RNA polymerase along the DNA strand. (4) Activators prevent transcription by impeding the interaction of RNA polymerase with the promoter.
 - 1 and 3
 - 2 and 4
 - 1 only
 - All 4 statements are correct.
- Which statement best describes the TATA box?
 - The TATA box is a regulatory element that is part of the promoter of most prokaryotic genes.
 - The TATA box is a regulatory element that is part of the promoter of most eukaryotic genes.
 - The TATA box is a regulatory protein that binds to the promoter of most eukaryotic genes.
 - The TATA box is a regulatory protein that binds to the promoter of most prokaryotic genes.
- Which of the following statements is correct?

- (a) Regulatory proteins bind to regulatory elements, which are located near promoters.
- (b) Regulatory elements bind to regulatory proteins, which are located near promoters.
- (c) Regulatory proteins bind to regulatory elements, which are also known as operons.
- (d) Regulatory proteins bind to regulatory elements, which are located near enhancers.

Lesson 7.4: Vocabulary I

Name _____ Class _____ Date _____

Match the vocabulary word with the proper definition.

Definitions

- _____ 1. using a gene to make a protein
- _____ 2. regulatory region of DNA located near the promoter
- _____ 3. a region of prokaryotic DNA that consists of one or more genes that encode the proteins needed for a specific function and their regulatory regions
- _____ 4. when inactivated leads to tumor formation and cancer
- _____ 5. enzyme that transcribes DNA to mRNA
- _____ 6. code for regulatory proteins that switch on whole series of major developmental genes
- _____ 7. protein that binds to regulatory region on DNA
- _____ 8. a regulatory element that is part of the promoter of most eukaryotic genes
- _____ 9. promotes transcription by enhancing the interaction of RNA polymerase with the promoter.
- _____ 10. region of a gene where RNA polymerase binds
- _____ 11. gene for a regulatory protein that controls the cell cycle
- _____ 12. consists of a promoter, an operator, and three genes that encode the enzymes needed to digest lactose

Terms

- a. activator
- b. gene expression
- c. homeobox genes
- d. lac operon
- e. operon
- f. promoter
- g. proto-oncogene
- h. regulatory element
- i. regulatory protein
- j. RNA polymerase
- k. TATA box
- l. tumor-suppressor gene

Lesson 7.4: Vocabulary II

Name _____ Class _____ Date _____

Fill in the blank with the appropriate term.

1. The _____ is a region of an operon where regulatory proteins bind.
2. Transcription is partly controlled by _____ proteins.
3. Using a gene to make a protein is called _____ expression.
4. RNA _____ is the enzyme that transcribes DNA to mRNA.
5. The _____ box is a regulatory element that is part of the promoter of most eukaryotic genes.
6. Regulatory proteins bind to regions of DNA, called regulatory _____.
7. Gene expression is regulated to ensure that the correct _____ are made.
8. Mutations in tumor-suppressor genes can cause _____.
9. Homeobox genes regulate _____.
10. Activators _____ transcription.
11. Repressors _____ transcription.
12. An _____ is a region of DNA that consists of one or more genes that encode the proteins needed for a specific function.

Lesson 7.4: Critical Writing

Name _____ Class _____ Date _____

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe gene regulation in the lac operon.