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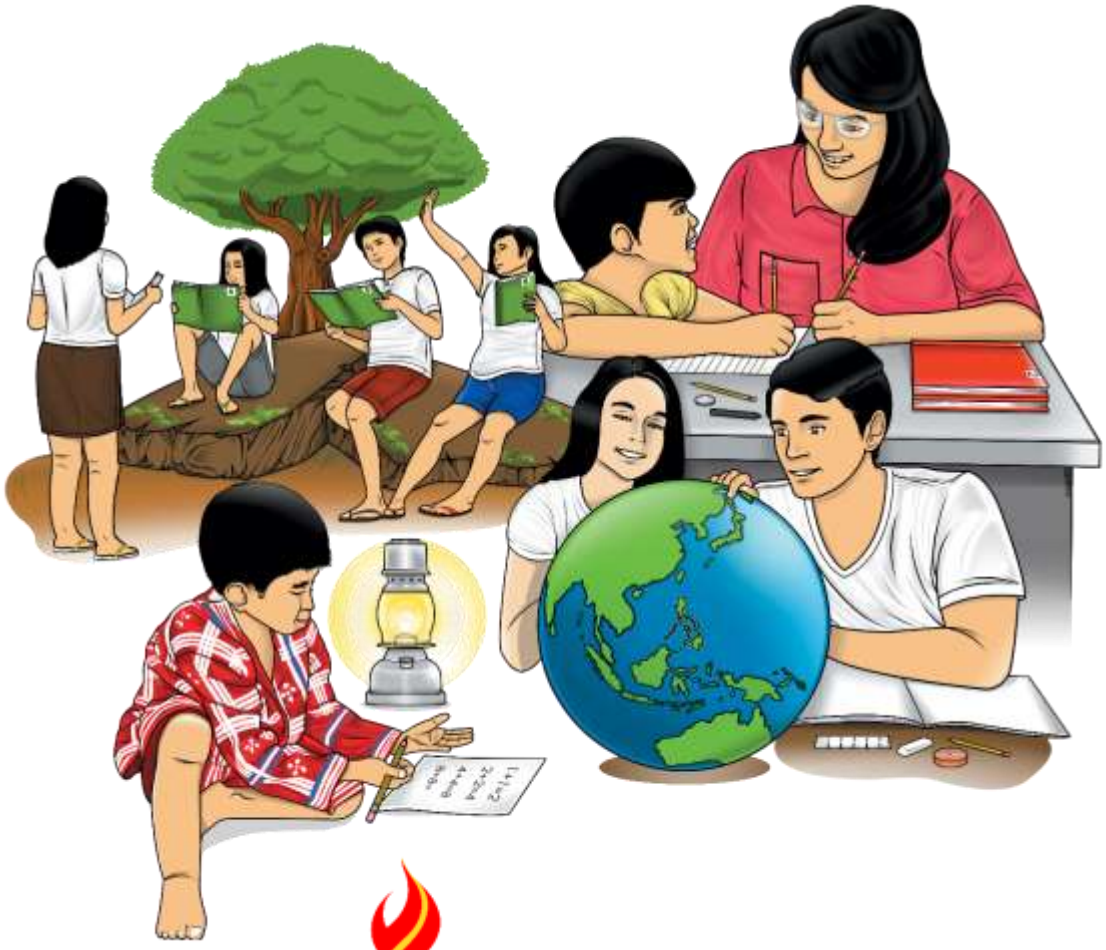
Science

Quarter 3 – Module 4:
Protein Synthesis



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Science

Quarter 3 – Module 4:
Protein Synthesis

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

"Our own genomes carry the story of evolution, written in DNA, the language of molecular genetics, and the narrative is unmistakable."

-Kenneth R. Miller

The quote above reflects the importance of studying the DNA and genetics. In this module, you are going to learn about protein synthesis. What first comes to your mind when you encounter the term '*protein*'? You might be thinking of food like egg, chicken and fish. You are correct! All of these foods contain protein-because proteins are one of the biomolecules inside cells, and they compose a number of structures and perform various functions inside cells. Without proteins, the cells cannot perform certain processes which may lead to death. The cells are constantly making new proteins as required by our body. This is accomplished through a process called protein synthesis.

So, how is protein made? What makes up proteins? This module will introduce you to the structures in the cells and the processes involved in making proteins. Have fun while learning from this module so that after completing this, you would be able to:

1. Explain how protein is made using information from DNA **(S10LTIIId-37).**

Going through this module can be a meaningful learning experience. All you need to do is make use of your time and resources efficiently. To do this, here are some tips for you:

1. **Take the pretest** before reading the rest of the module.
2. **Take time** in reading and understanding the lesson. Follow instructions carefully. Do all activities diligently. This module is designed for independent or self-paced study. It is better to be slow but sure than to hurry and miss the concepts you are supposed to learn.
3. Use a **clean sheet of paper** for your answers in each activity/ assessment. **Don't forget to write your name**. Label it properly.
4. Try to **recall and connect the ideas** about Life Science that you had in the lower years. Use the concept discussed in the lesson to explain the results of activities or performance task. You may answer in English or a combination of your vernacular and English.
5. **Be honest.** When doing the activities, record only what you have really observed. Take the self-assessments after each activity, but do not turn to the Answer Key page unless you are done with the entire module.
6. **Don't hesitate to ask.** If you need to clarify something, approach or contact your teacher or any knowledgeable person available to help you. You may also look into other references for further information. There is a list of references at the back part of this module.

7. **Take the posttest** prepared at the end of the module, so you can assess how much you have learned from this module.
8. You can **check your answers** in the activities, self-assessments, and posttest after you finished the entire module to know how much you have gained from the lesson and the activities.

What I Know

Directions: Read each question carefully. Choose the letter of the correct answer. Use a separate sheet of paper for your answers.

1. What are the building blocks of proteins?
    a. amino acid
    b. fatty acid
    c. glucose
    d. nucleotides

2. What is the molecule that serves as the "blueprint" of life?
    a. deoxyribonucleic acid
    b. messenger RNA
    c. ribonucleic acid
    d. transfer RNA

3. What are the nitrogenous bases in DNA?
    a. adenine, cytosine, uracil only
    b. adenine, cytosine, thymine only
    c. adenine, cytosine, guanine, thymine
    d. adenine, cytosine, guanine, uracil

4. Which is the correct complement pairing of bases in DNA?
    a. adenine-guanine, cytosine-guanine
    b. adenine-cytosine, guanine-thymine
    c. adenine-thymine, cytosine-guanine
    d. uracil-adenine, cytosine-guanine

5. Which of the following sequences of DNA bases is complementary to the sequence: ATC-GTG-CCC
    a. TAG-CAC-GGG
    b. TAG-TAT-GGG
    c. AUG-CAC-GGG
    d. AUG-TAT-GGG

6. What are the nitrogenous bases in RNA?
   a. adenine, cytosine, uracil only
   b. adenine, cytosine, thymine only
   c. adenine, cytosine, guanine, thymine
   d. adenine, cytosine, guanine, uracil

7. What is the correct description for a DNA molecule?
   a. covalent
   b. double helix
   c. octahedral
   d. triple triangle

8. The DNA of a cell is found inside the _____.
   a. Golgi body
   b. nucleus
   c. nuclear envelope
   d. ribosomes

9. What are the types of RNA?
   a. messenger RNA and ribosomal RNA only
   b. messenger RNA and transfer RNA only
   c. messenger RNA, ribosomal RNA, and transfer RNA
   d. ribosomal RNA and transfer RNA only

10. According to the rule on complementary pairing of nucleotide bases, adenine (A) will only make a bond with _____ in DNA.
   a. cytosine
   b. guanine
   c. thymine
   d. uracil

11. Most genes DNA hold instructions for the cell to make a specific _____.
   a. carbohydrate
   b. chromosome
   c. lipid
   d. protein

12. The codes for the production of proteins need to leave the nucleus of the cell. This can be accomplished by using _____to take messages out of the nucleus.
   a. DNA
   b. RNA
   c. amino acids
   d. lipids

13. A _____is a long molecule of tightly coiled DNA.
   a. cellulose
   b. centromere
   c. chromosome
   d. cytoplasm

14. Which of the following is **NOT** a stop codon?
    a) UAA
    b) UAG
    c) UGA
    d) GGA
15. What do you call the basic physical and functional unit of heredity?
    a. centromere
    b. gene
    c. genome
    d. kinetochore

Answer Key on Page 19

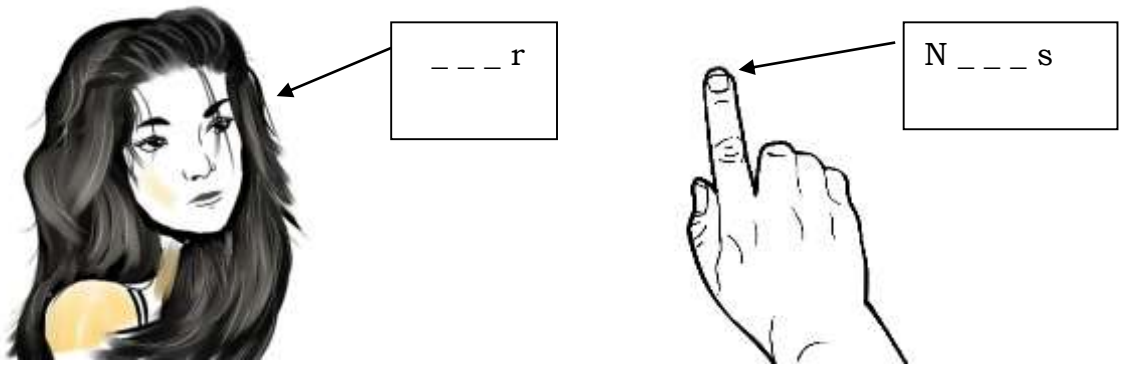
How did you find the pre-test? What was your score? If you got 15 items correctly, you may skip the module. But if your score is 14 and below, you must proceed with the module.

Lesson 2 Protein Synthesis

What's In

What is protein synthesis? How can the genes in the DNA be translated into proteins?

Let's begin with these examples. What body parts are pointed at? Use separate sheet of paper for your answer.



Illustrator: Jayson A. De Guzman

Yes, you got them right!
Our hair, skin and nails are made up of proteins.

What are proteins? They are composed of amino acids linked together by peptide bonds.
What are the roles and functions of proteins?

- *channels in membranes – control the movement of molecules in and out of the cell*
- *structural molecules – for example, making up hair or muscle in animals*
- *hormones – to regulate the activity of cells*
- *antibodies – in the immune system*
- *enzymes – to act as catalysts in biological systems.*

DNA (deoxyribonucleic acid) and RNA (ribonucleic acid) work together to produce proteins from genetic codes. Genetic codes are found in DNA or RNA which is made up of nucleotide bases usually in three's (triplet) that code for the amino acids making up the proteins.

DNA vs. RNA – A Comparison Chart

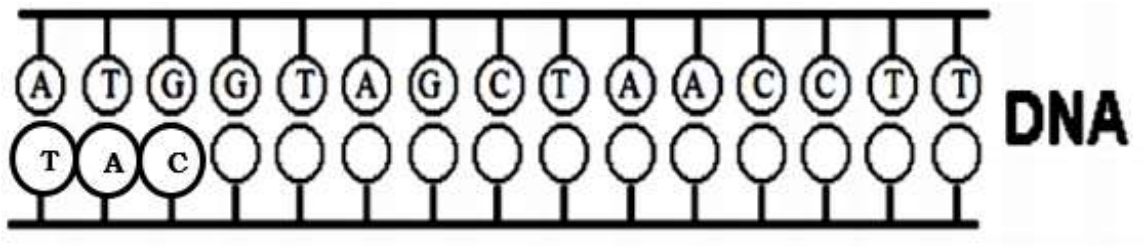
Before we proceed, let's recall what you have learned in Grade 9 about the structure, components and function of DNA. To check if you are ready for our new lesson, complete the table below by writing the correct words/description about RNA or DNA. Choose the words from the box below.

- Double stranded helix
- Single stranded
- Sugar deoxyribose, phosphate and nucleotide basis
- Sugar ribose, phosphate and nucleotide basis
- A, T, C, G
- A, U, C, G
- Stores genetic materials
- Functions in protein synthesis transcribing and translating the genetic code

Comparison	DNA	RNA
Structure		
Components		
Function		

What's New

Directions: Fill in the complimentary DNA strand using DNA base pairing rules. The first three nitrogenous bases were paired already and given as examples.



Illustrator: Jayson A. De Guzman

Congratulations! You have just simulated a part of the transcription stage wherein DNA's template is made, so that mRNA can copy the template for the protein synthesis. Now that you have accomplished this activity, you can now move on to the next challenge, which is the DNAmazing Challenge! Let's learn more about the stages and process of protein synthesis! Good luck!

What Is It

DNAmazing Challenge!

Before we proceed, let us talk about the different types of ribonucleic acids and their functions.

There are 3 types of RNA:

1. **Messenger RNA (mRNA)**
   - transcribes the DNA nucleotide bases to RNA nucleotide bases
2. **Ribosomal RNA (rRNA)**
   - binds the mRNA and tRNA to ensure that codons are translated correctly
3. **Transfer RNA (tRNA)**
   - translates the mRNA codons into the correct amino acids

There are two stages of protein synthesis:

1. Transcription
2. Translation

To further understand the protein synthesis, let's talk about genetic code. *Genetic codes are found in DNA or RNA which is made up of nucleotide bases usually in three's (triplet) that code for the amino acids making up the proteins.* Specifically,

the DNA genetic codes have mRNA codon counterparts determined during transcription. The mRNA codons code for specific amino acids (Table 1).

FIRST NUCLEOTIDE	SECOND NUCLEOTIDE: U		C		A		G		THIRD NUCLEOTIDE
U	UUU	Phenylalanine (Phe)	UCU	Serine (Ser)	UAU	Tyrosine (Tyr)	UGU	Cysteine (Cys)	U
	UUC		UCC		UAC		UGC		C
	UUA	Leucine (Leu)	UCA		UAA	STOP	UGA	STOP	A
	UUG		UCG		UAG		UGG	Tryptophan (Trp)	G
C	CUU	Leucine (Leu)	CCU	Proline (Pro)	CAU	Histidine (His)	CGU	Arginine (Arg)	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	Glutamine (Gln)	CGA		A
	CUG		CCG		CAG		CGG		G
A	AUU	Isoleucine (Ile)	ACU	Threonine (Thr)	AAU	Asparegine (Asn)	AGU	Serine (Ser)	U
	AUC		ACC		AAC		AGC		C
	AUA		ACA		AAA	Lysine (Lys)	AGA	Arginine (Arg)	A
	AUG	Methionine (Met) START	ACG		AAG		AGG		G
G	GUU	Valine (Val)	GCU	Alanine (Ala)	GAU	Aspartic Acid (Asp)	GGU	Glycine (Gly)	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	Glutamic Acid (Glu)	GGA		A
	GUG		GCG		GAG		GGG		G

Table 1. mRNA Codon Chart

Source: https://www.flickr.com/photos/97216967@N04/9723142289

Important Codons:

Start Codons: AUG (starts the translation stage);

Stop Codons: UAG, UGA, UAA (stops the translation stage).

When the ribosome reads the start codon, AUG, it will present the codons to the tRNA for translation stage to begin.

To deepen our understanding about how proteins in our body are made, let's have an activity called DNAmazing Challenge!

What you need:

- ✓ work sheet
- ✓ sheet of paper
- ✓ ball pen

This is an activity for you to understand more about the processes that are involved in protein synthesis. Just follow the instructions and surely, you will easily accomplish this activity. Good luck!

1. Study the figures carefully and read the captions very well. Get a sheet of paper for your answers and observation. Each figure has captions and labels. Study and analyze what the figure is all about by reading the captions and the labels.

After that, there will be guide questions about the figure. Do not copy the questions, just write down your answer or observations about the figure.

2. Figure 1 illustrates transcription, which is the first phase in protein synthesis. Study Figure 1 to help you answer the following questions:

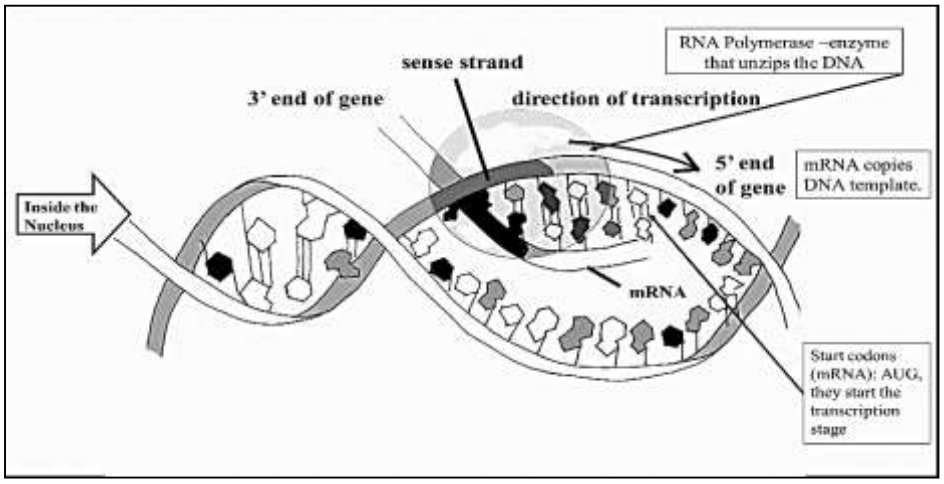


Figure 1. Transcription

Illustrator: Jayson A. De Guzman

2.1. What happens to the DNA during transcription?

A. The DNA unzips.

B. The DNA does not unzip.

2.2. Which enzyme unzips the DNA?

A. RNA polymerase

B. mRNA

2.3. What happens after the DNA is unzipped?

A. The mRNA copies the DNA template.

B. The mRNA connects the DNA together.

2.4. What are "start codons" for? _____

Transcription occurs inside the nucleus, and it is the first step in gene expression.

In transcription stage of protein synthesis, the DNA unzips through the help of enzymes called RNA polymerases. They combine nucleotides to form an RNA strand (using one of the DNA strands as a template).

3. Figure 2 shows an mRNA exiting the nucleus. Study the figure to help you answer the following questions:

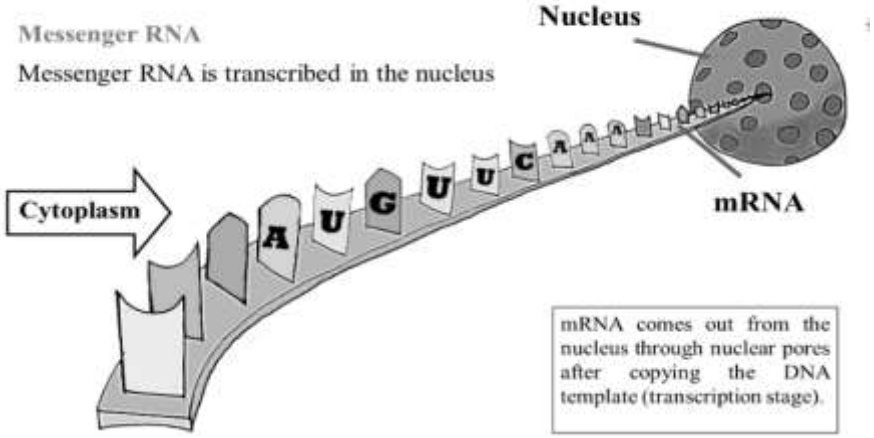


Figure 2. mRNA exiting the nucleus

Illustrator: Jayson A. De Guzman

3.1. Why does the newly synthesized mRNA go out of the nucleus after transcription?

A. The next phase in protein synthesis occurs in the cytoplasm.

B. The nucleus cannot accommodate the newly synthesized mRNA.

3.2. What happens after the mRNA goes out of the nucleus?

A. The codons are translated to produce proteins.

B. The codons are transcribed from amino acids.

For a protein-coding gene, the messenger RNA carries the information needed to build a polypeptide. The messenger RNA (mRNA) is the RNA form of the gene that leaves the nucleus through the nuclear pore and moves to the cytoplasm where proteins are made. Take note, transcription is the process wherein the DNA sequence of a gene is "rewritten" using RNA nucleotides.

Now, let's take a look on the next stage which is called translation.

4. Figure 3 depicts the initial stage in translation, which is the second phase of protein synthesis. This involves the complementary pairing of codons in mRNA with anticodons in tRNA; a process that is facilitated by the ribosome. Study the figure to help you answer the following questions:

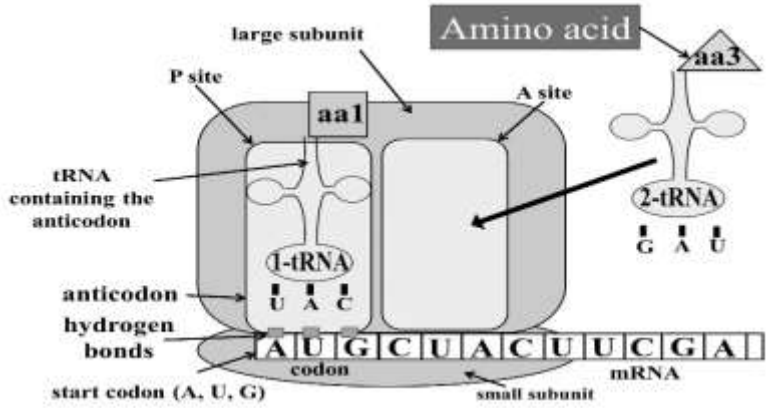


Figure 3. Initiation stage of translation

Illustrator: Jayson A. De Guzman

4.1. What are the two subunits of the ribosome? _____

4.2. What are the two sites in the large subunit of the ribosome?

_____

4.3 Which part of the large subunit of the ribosome accommodates tRNA?

_____

4.4. What do you call the codes that are carried by tRNA?

A. anticodons

B. codons

4.5. Translation is the process where proteins are synthesized from the codes in the mRNA. Which molecule is carried by tRNA and corresponds to the codons in mRNA?

A. amino acid

B. glucose

4.6. Why does complementary pairing of codons and anticodons occur during translation?

A. This ensures that the amino acid carried by the tRNA corresponds to the codons.

B. The pairing allows anticodons to select the codons to be translated.

The second stage of protein synthesis is translation. It is where the codes in the messenger RNA is translated to a polypeptide that contains a specific series of amino acids. Amino acid bonds with each other to form polypeptides which make up proteins.

So, let's take a look on the first stage of translation which is **initiation**. In this stage of translation, the ribosome sandwiches the mRNA between its small and large subunit to be translated. The first codon that will be read is AUG that is called the start codon, and consequently codes for the amino acid methionine.

5. Figure 4 shows the elongation stage in translation. Study the figure to help you answer the following questions:

5.1 What happens as the ribosome moves along the mRNA? _____

5.2 Which covalent chemical bond connects the adjacent amino acids to form a protein or peptide? _____

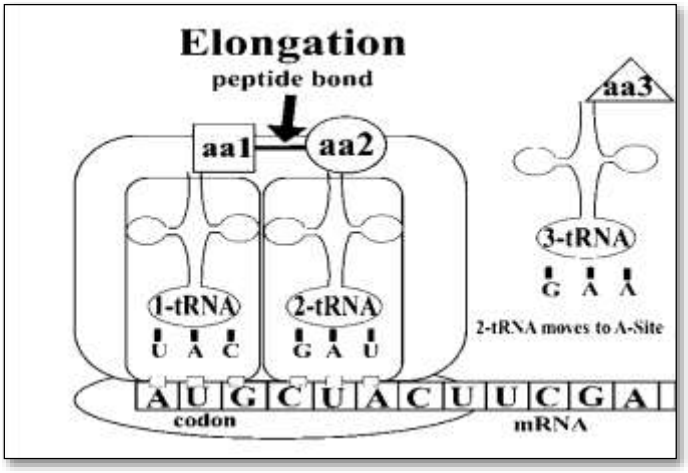


Figure 4. Elongation stage of translation

Illustrator: Jayson A. De Guzman

Elongation is the second stage in translation where the amino acid chain gets longer. In this stage, messenger RNA reads **one codon at a time**. Then, the amino acid corresponding each codon is added to a growing polypeptide chain. Remember, genetic codes are found in DNA or RNA which is made up of nucleotide bases usually in three's (triplet) that code for the amino acids making up the proteins. Specifically, the DNA genetic codes have mRNA codon counterparts determined during transcription. The mRNA codons code for specific amino acids.

Each time a new codon is read, a matching transfer RNA gets into the ribosomes carrying the anticodon and the corresponding amino acid of the mRNA codon. Amino acids are connected with each other by peptide bonds becoming a polypeptide.

During elongation, transfer RNAs move through the A and P sites of the ribosome, as shown above. This process repeats many times as new codons are translated and new amino acids are added to the polypeptide chain.

6. Figure 5 shows the termination stage in translation. Study the figure to help you answer the following questions:

6.1 When is translation terminated? _____

6.2 What is the product of translation phase?

A. carbohydrate

B. protein

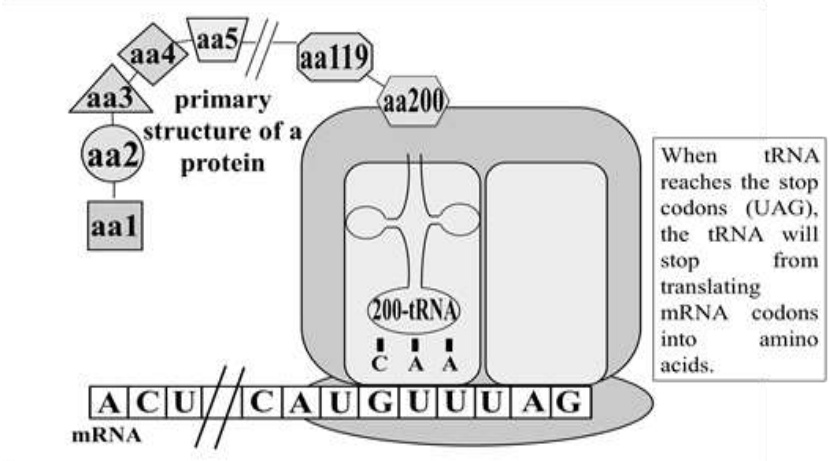


Figure 5. Termination stage in translation

Illustrator: Jayson A. De Guzman

Termination is the last stage of translation. It is where the finished polypeptide is released. It starts when a stop codon (UAG, UAA, or UGA) is read by the ribosome, activating a series of events that stop translation and disassemble the subunits of the ribosomal RNA.

The polypeptide produced in this stage will be processed further before it becomes a functional protein.

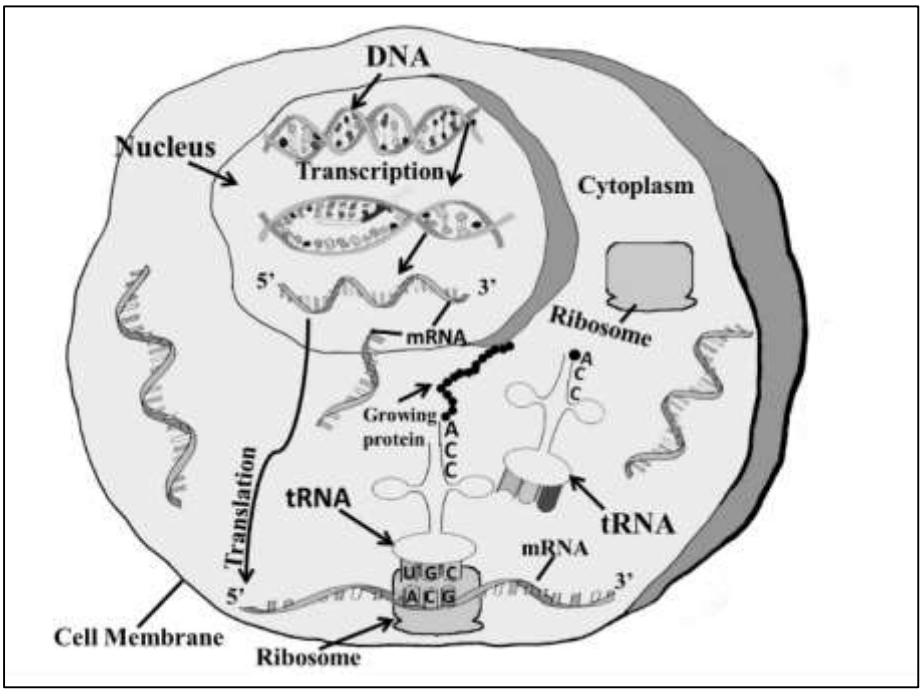


Figure 7. Protein Synthesis

Illustrator: Jayson A. De Guzman

What's More

Since you have accepted and conquered the DNAmazing challenge a while ago, here are some enrichment activities for you to strengthen the basic concepts you have learned from our mini-lesson and to validate your observations in the activity part.

Column A	Column B
____1. Amino acids ____2. Proteins ____3. DNA ____4. mRNA ____5. Codons	____ A. It copies the DNA's codes. ____ B. mRNA triplet of nucleotide bases that code for an amino acid. ____ C. They are composed of amino acids linked together by peptide bonds. ____ D. They are the building blocks of proteins ____ E. It is a double-helical molecule that contains the genetic codes.

Directions: Explain the concepts pertaining to protein synthesis by doing this Frayer Model. Write key terms and examples for each box. For the diagram box, you can draw a flowchart or a concept map that will help you remember the protein synthesis.

Formal definition here (copy from text)	Importance (in your own words)
PROTEIN SYNTHESIS	
Analogy of protein synthesis to a process.	Diagram to help you remember the stages and sub-stages

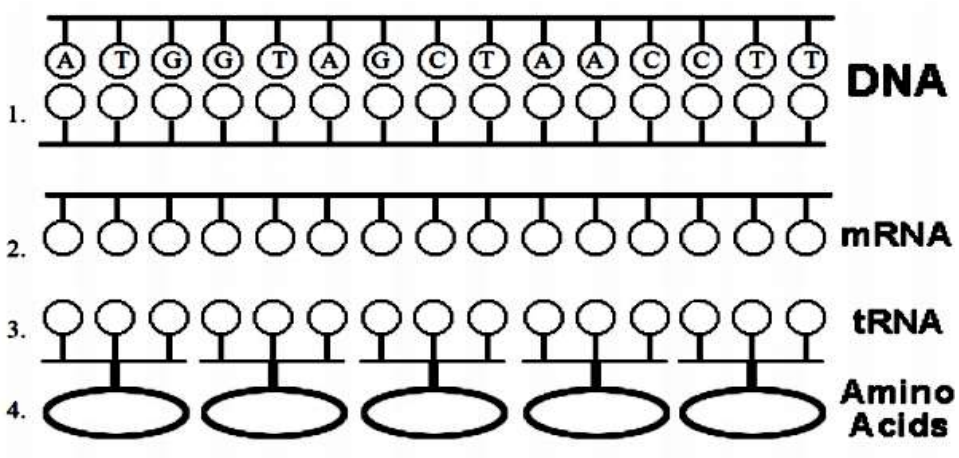
Scoring Criteria	**Unacceptable (0)**	**Needs Improvement (2)**	**Proficient (4)**
Definition	Does not clearly communicate the meaning of the word or concept	Clearly communicates apportion of the meaning of the word or concept	Clearly communicates the full meaning of the word or concept
Facts	Does not list an accurate fact about the word or concept	Lists one to two accurate facts about the word or concept	Lists at least three facts about the word or concept
Illustration/ Diagram	Does not provide an illustration that reflects understanding of the word or concept	Provides an illustration that reflects some understanding of the word or concept	Provides an illustration that reflects understanding of the word or concept
Sentence	Does not include a sentence/key term	Provides a sentence that reflects some understanding of the word or concept	Provides a sentence that reflects understanding of the word or concept

Can you "fill" me

Directions:

Step 1. Fill in the correct mRNA bases by transcribing the bottom DNA strand.

Step 2. Translate the mRNA codons.



Illustrator: Jayson A. De Guzman

Step 3. Write in the anti-codon of the tRNA and the corresponding amino acids.

Step 4. Find the correct amino acid using the Codon Chart.

FIRST NUCLEOTIDE	SECOND NUCLEOTIDE: U		C		A		G		THIRD NUCLEOTIDE
U	UUU	Phenylalanine (Phe)	UCU	Serine (Ser)	UAU	Tyrosine (Tyr)	UGU	Cysteine (Cys)	U
	UUC		UCC		UAC		UGC		C
	UUA	Leucine (Leu)	UCA		UAA	STOP	UGA	STOP	A
	UUG		UCG		UAG		UGG	Tryptophan (Trp)	G
C	CUU	Leucine (Leu)	CCU	Proline (Pro)	CAU	Histidine (His)	CGU	Arginine (Arg)	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	Glutamine (Gln)	CGA		A
	CUG		CCG		CAG		CGG		G
A	AUU	Isoleucine (Ile)	ACU	Threonine (Thr)	AAU	Asparagine (Asn)	AGU	Serine (Ser)	U
	AUC		ACC		AAC		AGC		C
	AUA		ACA		AAA	Lysine (Lys)	AGA	Arginine (Arg)	A
	AUG	Methionine (Met) START	ACG		AAG		AGG		G
G	GUU	Valine (Val)	GCU	Alanine (Ala)	GAU	Aspartic Acid (Asp)	GGU	Glycine (Gly)	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	Glutamic Acid (Glu)	GGA		A
	GUG		GCG		GAG		GGG		G

Table 1. mRNA Codon Chart

Source: https://www.flickr.com/photos/97216967@N04/9723142289

Step 5. Answer the questions below about protein synthesis.

1. What stage of protein synthesis does step 1 illustrate? _____

2. What stage of protein synthesis do steps 2 and 3 illustrate? _____

What I Have Learned

Great job! You are almost done with this module. Let us summarize what you have learned from the lesson and activities by choosing the correct word inside the parentheses. Use a separate sheet of paper for your answer.

1-3. (Proteins, Nucleic acids) are composed of (amino acids, glucose) linked together by (hydrogen bonds, peptide bonds). Proteins function as channels in membranes, structural molecules, hormones and enzymes.

4-6. (DNA, RNA) consists of two strands, arranged in a double helix. These strands are made up of subunits called (nucleotides, glyceraldehyde).

RNA only has one strand, but like DNA, is made up of nucleotides. The bases in RNA are adenine, (thymine, uracil), guanine and cytosine.

7-9. The first type of RNA is the (messenger RNA, transfer RNA) which transcribes the DNA and will be read by the ribosomes for translation. The (ribosomal RNA, transfer RNA), with protein, makes up the ribosomes, and the (ribosomal RNA, transfer RNA) carries anticodon and amino acid to translate the codons to polypeptide.

10-12. There are two phases in protein synthesis. First is transcription, where the (DNA, mRNA) code will be copied into (DNA, mRNA). Second is translation where the (DNA, mRNA) is "decoded" to build a polypeptide that contains specific series of amino acids. The polypeptide will be processed further to be a functional protein.

13-15. There are three stages of translation. First, (initiation, elongation, termination), where the ribosome assembles around the mRNA to be read. Next is the (initiation, elongation, termination), where the amino acid chain gets longer and lastly, (initiation, elongation, termination) where the finished polypeptide chain is released.

As a conclusion, protein synthesis starts with transcription of DNA into the messenger RNA or mRNA. This is followed by translation where the mRNA codons will base pair with the transfer RNA or tRNA that carries specific amino acids based on the mRNA codons. These amino acids will be connected by peptide bonds to a protein. There you have it! I hope you enjoyed our lesson today!

What I Can Do

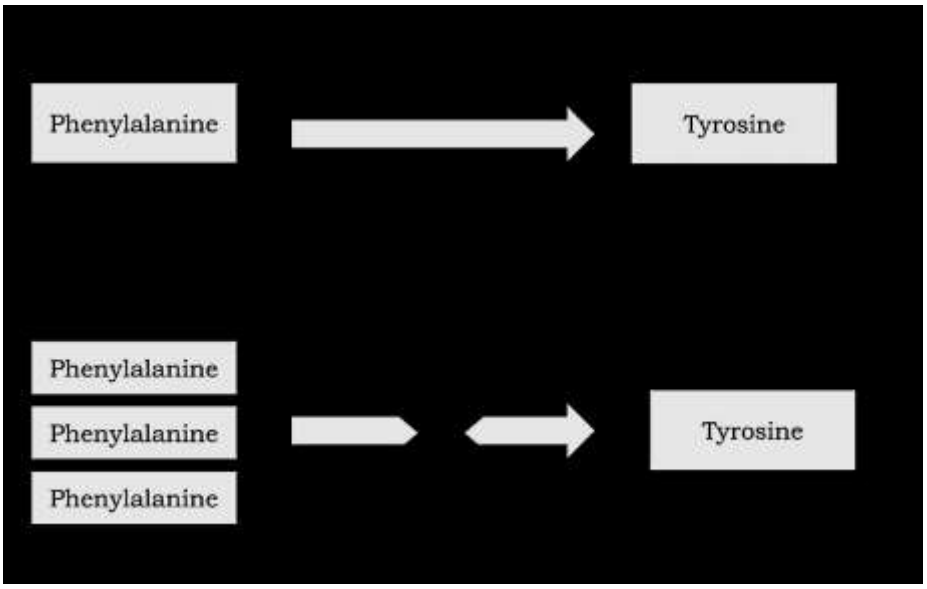
Activity 1: Protein is essential to the building block of muscles. Muscle protein synthesis is a naturally occurring process in which protein is produced to repair muscle damage caused by intense exercise. It is an opposing force to muscle protein breakdown (MPB) in which protein is lost as a result of exercise. (Source: https://www.encyclopedia.com/sports/sports-fitness-recreation-and-leisure-magazines/muscle-protein-synthesis). For example, you are an athlete, and you want to maintain the strength and mass of your muscles.

1. How important is protein synthesis in your body?

2. How are you going to boost the protein synthesis in your body? How are you going to boost the amount of essential amino acids and proteins in your body?

Activity 2: Phenylketonuria (PKU) is a genetic disorder that causes the abnormal metabolism of the amino acid called phenylalanine. PKU is an autosomal recessive disease due to a mutation in the gene encoding the enzyme phenylalanine hydroxylase. Phenylalanine hydroxylase (PAH) usually converts **excess** phenylalanine into tyrosine. In persons with PKU, the remaining phenylalanine is instead converted into phenylpyruvate (also known as phenylketone). This results in a poisonous build-up of phenylketone in the blood and urine that is why it is called phenylketonuria. When PKU is untreated, it can lead to brain damage, mental retardation and other serious medical problems.

Babies with PKU are normal at birth due to the mother's ability to break down phenylalanine during pregnancy. PKU can be diagnosed through a simple blood test for elevated phenylalanine levels shortly after birth.



Illustrator: Jayson A. De Guzman

Answer the following questions:

1. What is phenylketonuria (PKU)? How important is the synthesis of correct proteins?

2. How can PKU be treated in relation to the diet or intake of phenylalanine?

Standards Rubric

Appropriateness of Topic	:10 points
Accuracy of Details and Information	:5 points
Techniques (persuasiveness/humor in words/English or vernacular)	:5 points
TOTAL -	**: 20 points**

Good job! You are now ready to have your posttest. You may want to go over again the lessons and activities to review for the final assessment. God bless you!

Assessment

Directions: Read each question carefully. Choose the letter of the correct answer. Use a separate sheet of paper for your answers.

1. Which molecule carries a copy of the genetic information out of the nucleus?
   A. amino acid mRNA
   B. mRNA
   C. rRNA
   D. tRNA
2. What do you call the sequence of three bases in mRNA that corresponds to an amino acid?
   A. amino acid
   B. anticodon
   C. code
   D. codon
3. What do you call the sequence of three bases in tRNA that corresponds to an amino acids?
   A. amino acid
   B. anticodon
   C. code
   D. codon

4. Where does transcription take place?
   A. Golgi bodies
   B. mitochondria
   C. nucleus
   D. ribosome

5. Which of the following is directly involved in translation phase of protein synthesis?
   A. cytoplasm
   B. mitochondria
   C. nucleus
   D. ribosome

6. Which of the following is carried by the transfer RNA (tRNA)?
   A. amino acid
   B. DNA
   C. nucleic acid
   D. ribosome

7. Which of the following is **NOT** ~~a~~ part of protein synthesis?
   A. elongation
   B. replication
   C. transcription
   D. translation

8. In the RNA molecule, which nitrogen base is found in place of thymine?
   A. cytosine
   B. guanine
   C. thymine
   D. uracil

9. During the process of transcription, which of the following is produced?
   A. ATP
   B. DNA
   C. H_2O
   D. mRNA

10. If the DNA template reads “ATA”, which of the following would be the corresponding mRNA codon?
    A. ATA
    B. TUT
    C. UAU
    D. UCU

11. The genetic code is based upon the reading of how many bases at a time?
    A. one
    B. two
    C. three
    D. four

12. Amino acids are held together by ____ bonds.
    A. hydrogen
    B. ionic
    C. high energy
    D. peptide

13. How many codons are needed to specify three amino acids?
    A. 3
    B. 6
    C. 9
    D. 12

14. Which of the following is a similarity between DNA and messenger RNA molecules? They both contain
    A. uracil
    B. double-stranded polymers
    C. phosphates
    D. the same sugar

15. Events that take place during the synthesis of a specific protein are listed below.
    A. Messenger RNA attaches to a ribosome.
    B. DNA serves as a template for the production of RNA.
    C. Transfer RNA bonds to a specific codon.
    D. Amino acids are bonded together.
    E. RNA exits from the nucleus to the cytoplasm.

    The correct order of these events is
    A. B E A C D
    B. D A E C B
    C. B C E D A
    D. C B A E D

Answer Key on Page 21

Answer Key

WHAT I KNOW

1. A 2.A 3.C 4.C 5.A

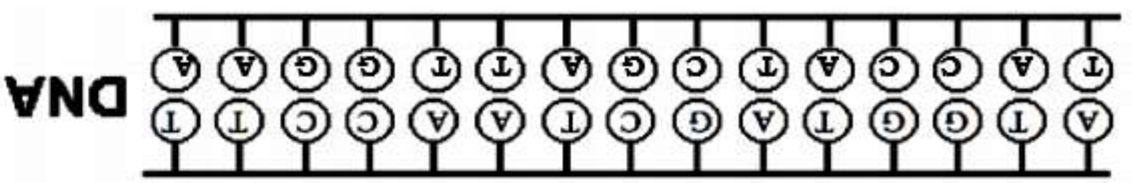
6. D 7.B 8.B 9.C 10.C

11. D 12.B 13.C 14.D 15.B

WHAT'S IN

Comparison	**DNA**	**RNA**
Structure	Double stranded helix	Single stranded
Components	Sugar deoxyribose, phosphate and nucleotide basis • A, T, C, G	Sugar ribose, phosphate and nucleotide basis • A, U, C, G
Function	• Stores genetic materials	• Functions in protein synthesis transcribing and translating the genetic code

WHAT'S NEW



WHAT IS IT

2.1 A
2.2 A
2.3 A
2.4 THEY START THE TRANSCRIPTION STAGE
3.1 A
3.2 A
4.1 LARGE SUBUNIT AND SMALL SUBUNIT
4.2 P AND A SITE
4.3 LARGE SUBUNIT
4.4 A
4.5 A
4.6 A
5.1 TRNA MOVES TO A SITE/ ONE CODON IS READ AT A TIME
5.2 PEPTIDE BOND
6.1 WHEN TRNA REACHES THE STOP CODONS (UAG)
6.2 B

WHAT'S MORE

1. D
2. C
3. E
4. A
5. B

Note: Answers may vary, but the following themes must be included:

PROTEIN SYNTHESIS

Formal Definition Here (copy from text) Protein synthesis is the process in which cells make proteins. It occurs in two stages: transcription and translation.	Importance (in your own words) Proteins are important in all cells and do different roles and so the protein synthesis is very important.
Analogy of protein synthesis to a process. It is like a construction of a building. The amino acids are the building blocks and the building itself is the protein.	Diagram to help you remember the stages and sub-stages DNA –RNA-amino acids-proteins

1-3. PROTEINS, AMINO ACIDS, PEPTIDE BONDS

4-6. DNA, NUCLEOTIDES, URACIL

7-9. MRNA, RIBOSOMAL, TRANSFER

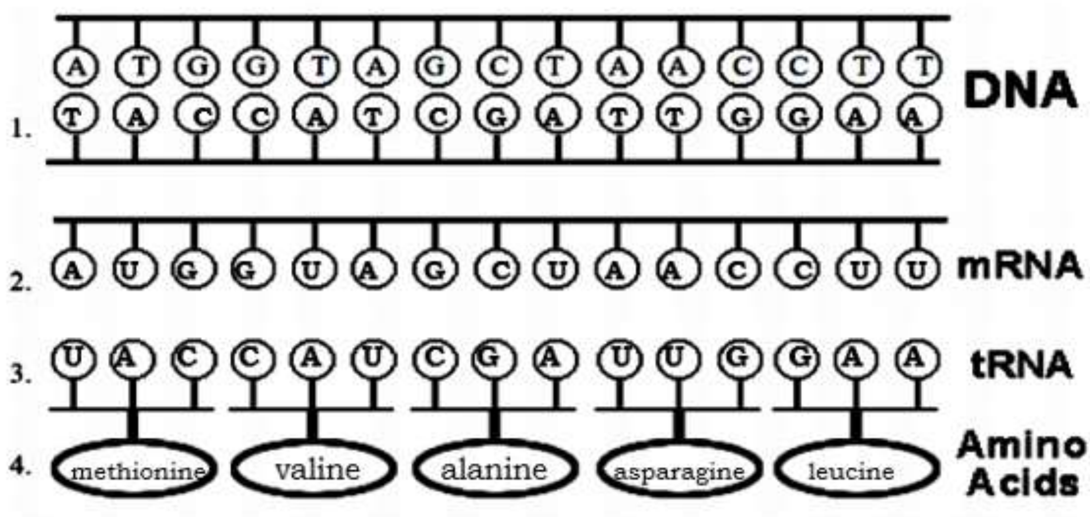
10-12. DNA, MRNA, MRNA

13-15. INITIATION, ELONGATION, TERMINATION

<u>WHAT I HAVE LEARNED</u>

Step 1: Transcription

Step 2: Translation



WHAT I CAN DO

Possible answers in Activity 2 may contain the following themes:

- PKU is treated by enforcing a strict diet that restricts the intake of phenylalanine to prevent its build up within the body.
- This low-protein diet should include certain types of fruits, grains, vegetables and special formula milk.
- This diet should be supplemented with a medical formula that contains precise quantities of essential amino acids.
- Patients who are diagnosed early and maintain this strict diet can have a normal life span without damaging symptoms.

Possible answers in Activity 1 may contain the following themes:

- Consume protein after exercise to maximize protein synthesis and promote adaptation.
- Liquid forms of protein are best due to their rapid digestion rate.
- Rapidly digested proteins are best with isolated proteins such as whey, milk proteins, or soy appearing to be most efficient.
- A carbohydrate/protein/electrolyte sports drink that contains antioxidants can slow muscle breakdown through a number of mechanisms including:
- Electrolytes help re-hydrate thereby reducing cortisol levels
- Carbohydrate stimulates insulin which increases protein synthesis, reduces cortisol and slows protein breakdown
- Protein provides the raw material for the rebuilding and repair of muscle protein
- Antioxidants reduce reactive oxygen species and slow protein degradation
- Maintain protein balance
- Have a proper step in exercising (warm up, exercise and cool down)

ASSESSMENT

1. B 2.D 3.B 4.C 5.D

6. A 7. B 8. D 9. D 10. C

11. C 12. D 13. A 14. C 15. A

References:

Herma D. Acosta et al, *Science – Grade 10 Learner's Material* (Pasig City, Philippines: Rex Bookstore, Inc. and Department of Education, 2015), 263-281.

Herma D. Acosta et al, *Science – Grade 10 Teacher's Guide* (Pasig City, Philippines: Rex Bookstore, Inc. and Department of Education, 2015), 191-209.

Electronic Sources:

Department of Education. "K to 12 Curriculum Guide Science (Grade 3 to 10)" Accessed October 2019 "https://www.deped.gov.ph/wp-content/uploads/2019/01/Science-CG_with-tagged-sci-equipment_revised.pdf"

LRMDS Portal. Science Modules. December 29, 2014. Accessed October 13, 2019. http://lrmds.deped.gov.ph/detail/6838

mRNA Codon Chart. Digital image. Flicker. Accessed March 24, 2021. https://www.flickr.com

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