SMARTSKILLS

2021-22

Class XI

BIOTECHNOLOGY

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Assignment 1 **Introduction, Protein and Carbohydrates**

1. What is bioinformatics?

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2. What are biosensors?

---
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---
5. What is cloning?

---
6. Give the applications of plant cell culture and animal cell culture.

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7. Briefly describe protein engineering.

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8. How is biotechnology useful in paper-pulp and textile engineering?

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9. Fill up the blanks in the given table.

S.No.	Reagent	Colour of the product	Result
1.	Alkaline Copper salt solution	Yellow-red ppt	----------
2.	----------	Blue	Arginine
3.	Strong acid +-------	----------	Pentose in DNA or RNA
4.	DPA +acid	----------	Deoxyribose in DNA

10. Complete the reaction:
Ninhydrin +---------- --oxidative deamination----→ NH_3=CO_2

Assignment 1.1 *

* taken and modified from Hood-DeGrenier (2015)

A. Structure & Chemical Character of Amino Acids

1. Figure A.1 below shows one of the 20 amino acids that make up proteins. Recall that carbon can form four covalent bonds. Amino acids consist of a central carbon, called the α-**carbon**, that is bonded to four different chemical groups.

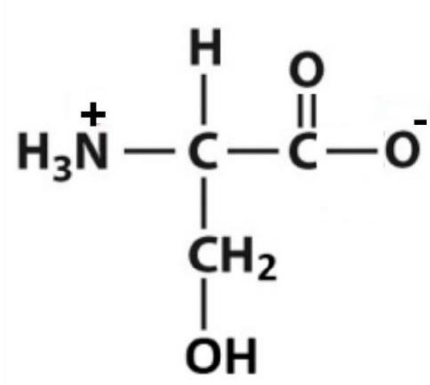

Figure 1. One of the 20 naturally-occurring amino acids.

   a. On the amino acid shown in Figure 1, label the α-carbon.

   b. The α-carbon of each of the 20 amino acids is bonded to one **hydrogen atom**, one **amino group**, and one **carboxyl group**. Circle and label the amino group and the carboxyl group in Figure 1.

   c. The last bond an α-carbon in an amino acid makes is to an **R group**, or **side-chain**. Circle and label the R group in Figure 1.

2. Appendix A on page 17. shows the structures of all 20 amino acids. They are categorized into 4 chemical groups: **nonpolar**, **uncharged polar**, **acidic**, and **basic**.

   a. What is the only thing that is different about each of the 20 amino acids?

   b. Refer back to Figure 1. Using Appendix A, determine which amino acid is the one shown in this figure. To which chemical category does this amino acid belong?

c. Refer again to the amino acid structures in Appendix A. Look at the amino acids in each of the four groups and compare them to the ones in the other groups. Devise rules that describe what the members of each group have in common so that you will be able to identify the chemical group for each of the 20 amino acids if you are shown its structure. Record your rules in the table below.

Chemical Group	Rule Describing Membership in this Group

B. Peptide Bond Formation

Figure B.1 below shows two amino acids and those same two amino acids after they have been linked together by a **peptide bond** to form a **dipeptide**. Addition of more amino acids all linked by peptide bonds would form a **polypeptide**, the precursor to a functional protein.

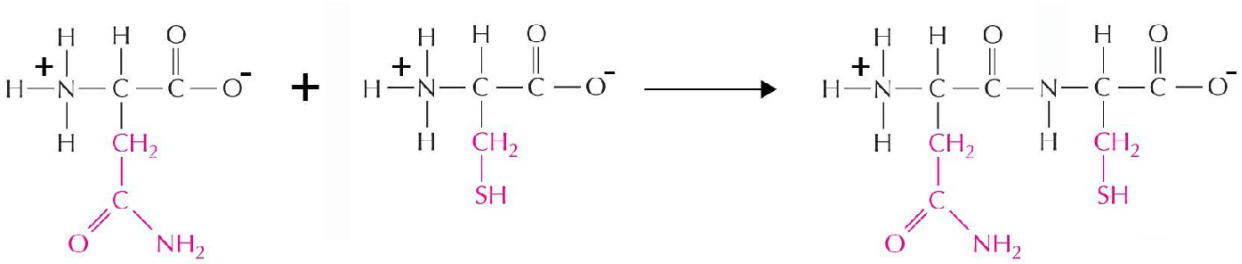

Figure 2. Formation of a peptide bond between two amino acids.

1. Referring again to Appendix A, which two amino acids are the ones shown on the left in Figure 2 above? To which chemical groups do they belong?

2. On the dipeptide shown in Figure 2, label the **peptide bond** that was formed when the two individual amino acids were joined. Also label the **free amino and carboxyl groups** at the ends of this dipeptide (not in the R groups). These are often referred to as the **N-terminus (amino-terminus)** and the **C-terminus** (carboxyl-terminus) of a peptide or polypeptide. (*Note: "peptide" refers to a chain of a small number of amino acids, whereas "polypeptide" refers to a longer chain, potentially that corresponding to an entire protein.)*

3. Look carefully at the chemical reaction shown in Figure B.1. Which atoms that are part of the two individual amino acids on the left are no longer present in the dipeptide on the right? Circle these on the molecules on the left side. Another molecule that is not shown on the right is also a product of this chemical reaction. What molecule do you think this is? (*Hint: remember the type of chemical reaction involved in forming macromolecular polymers.)*

C. Levels of Protein Structure

We can distinguish four distinct organizational levels in the three-dimensional structures of proteins, which are referred to as the *primary*, *secondary*, *tertiary*, and *quaternary* structures. The questions in this section (which begin on the next page) will help you understand the differences between these organizational levels and the types of chemical interactions that hold them together.

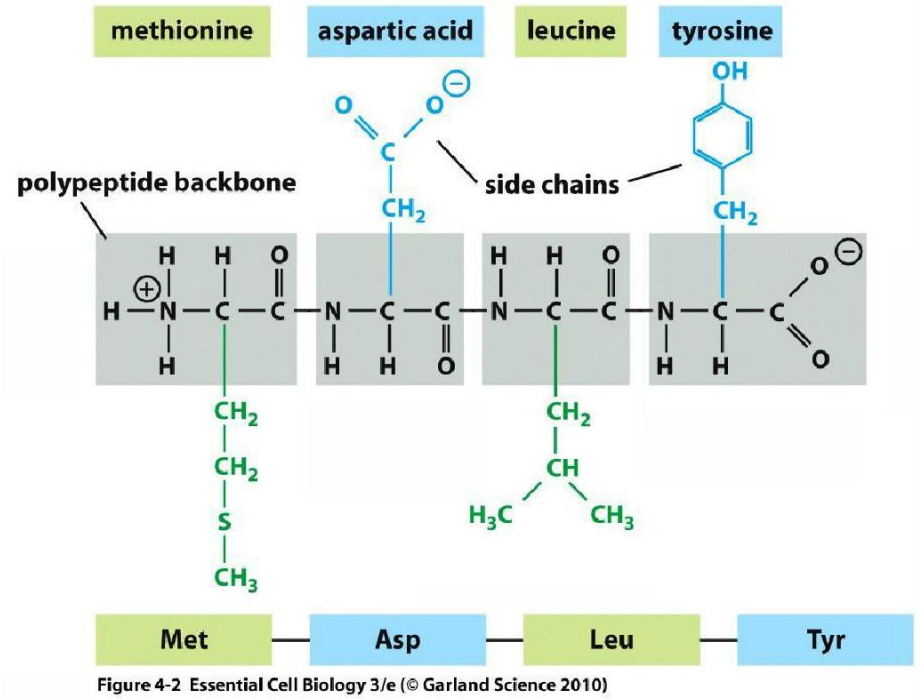

Figure 3 A four-amino acid peptide. The chemical structure of the peptide is shown with the full names of the amino acids above and their three-letter abbreviations below.

1. The **primary sequence** (or primary structure) of a protein is simply the linear sequence of amino acids in the polypeptide chain. Figure 3 above illustrates a peptide consisting of four amino acids. The full names and three-letter abbreviations for these amino acids are shown at the top and the bottom of the figure, respectively. If you were listing the primary sequence of this peptide using the three-letter abbreviations, it would be: Met-Asp-Leu-Tyr.

   a. Looking at the peptide structure shown in Figure C.1, are the primary sequences of proteins listed from N-to-C-terminus or C-to-N-terminus?

b. Fill in the blanks in the following sentence:

In the primary structure of a protein, amino acids are joined together by _____ *bonds, which are a particular type of* _____ *bond.*

2. In a folded protein, segments of the polypeptide typically fold into one of two regular patterns that we call secondary structures. These two patterns are illustrated in Figure 4below.

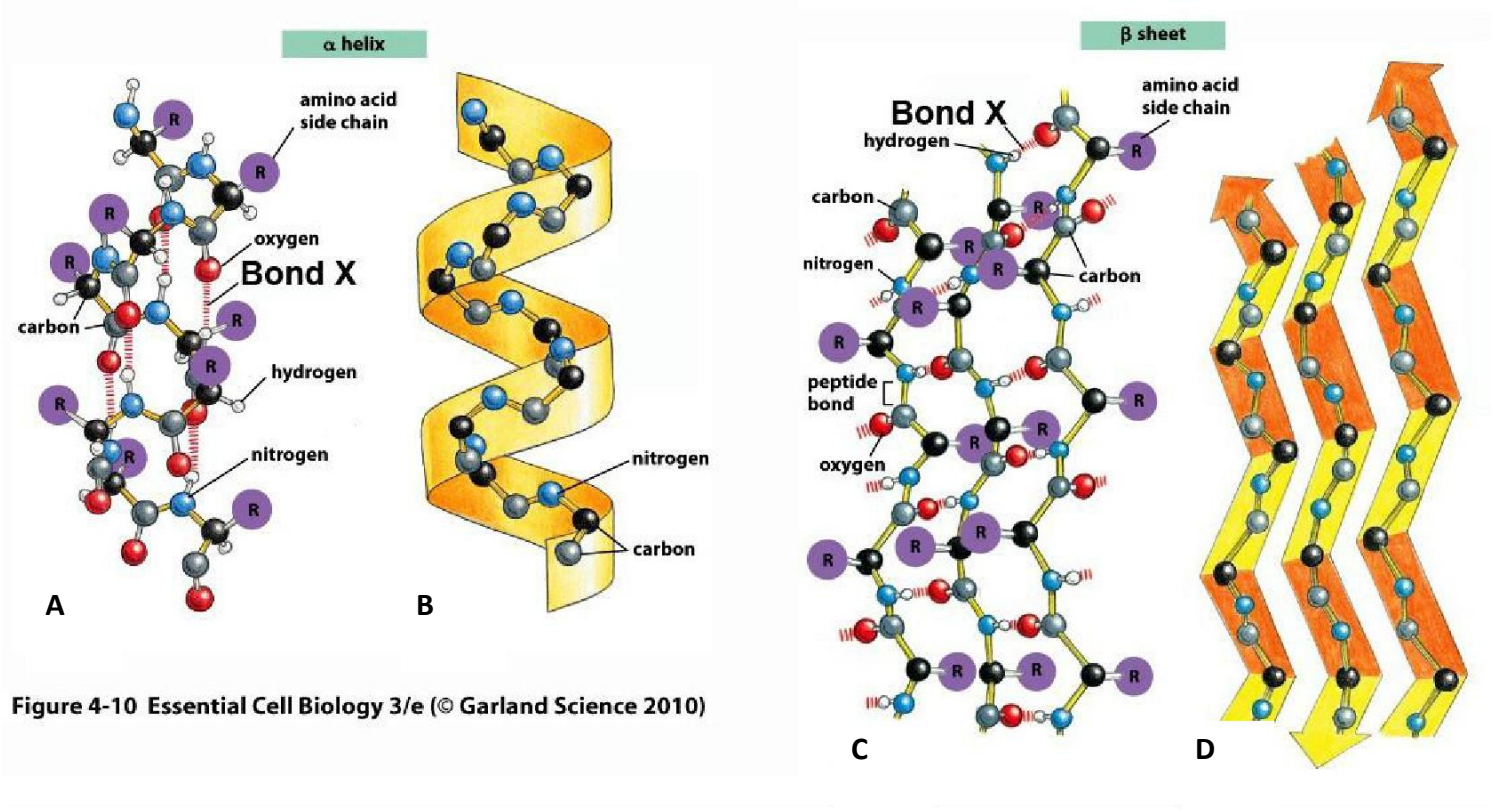

Figure 4-10 Essential Cell Biology 3/e (© Garland Science 2010)

Figure 4. Two types of secondary structure in proteins: **α-helix** and **β-sheet** (constructed from multiple β-strands). A & B, α-helix structure represented in ball-and-stick (A) and ribbon (B) forms. C & D, β-sheet structure represented similarly.

a. The hatched lines connecting atoms in Figure 4 represent the bonds that hold together these secondary structures (e.g. the one labeled "Bond X"). What types of bonds are these? (I know it's hard to see—the bonds are between an oxygen and a hydrogen atom.)

b. Do the "Bond X" bonds in Figure 4 involve atoms in the amino acid R groups or polypeptide "backbone" (or "main chain") atoms?

c. Given your answer to "b," which of the following statements do you think is correct? Explain your reasoning.

____ *Only very specific primary sequences can form* α*-helices and* β*-sheets.*

____ *Many different primary sequences can form* α*-helices and* β*-sheets.*

d. Suppose that the first amino acid in an α-helix is designated "n." An atom from that amino acid will form a "Bond X" bond with an atom from which of the following amino acids? (It will be very useful to look at the colored version of Figure 4 when trying to answer this question!)

____ *The n+1 amino acid in the chain*

____ *The n+2 amino acid in the chain*

____ *The n+3 amino acid in the chain*

e. Each arrow depicted in Figure 4, panel D represents consecutive amino acids in the primary sequence of the polypeptide, while the different arrows may be formed from amino acids that are removed from each other in the primary sequence. Each arrow is referred to as a β-strand and the structure formed through interaction of the β-strands is the β-sheet. In a complete protein, other segments of the protein would connect the different β-strands. Do the "Bond X" bonds in the β-sheet connect atoms from the **same** β-strand or **neighboring** strands?

3. Figure 5 below shows three examples of how secondary structure elements can be arranged in relation to one another in the functional, folded form of a complete protein or one compact portion of a protein (which we refer to as a **domain**—note that proteins can consist of more than one domain).

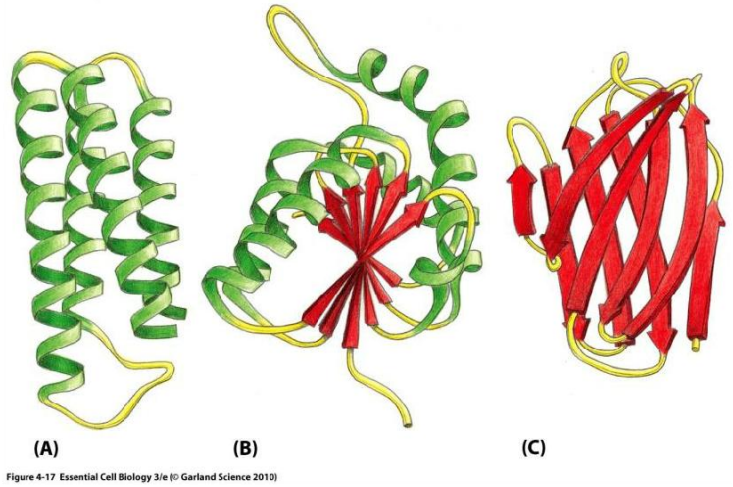

Figure 5. Examples of the arrangement of α-helices and β-sheets in folded protein domains.
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a. We refer to the overall three-dimensional shape (or **conformation**) of a protein (as shown in Figure 5) as its **tertiary structure.** What do you think holds together the various secondary structural elements in a particular three-dimensional pattern? (Hint: think beyond the polypeptide backbone represented by the ribbon diagrams in Figure 5—what is sticking out from the sides of the α-helices and β-strands?)

b. Figure 6. on the next page shows examples of bonds that might stabilize the tertiary structure of a protein (labeled A, B, and C). Do these interactions involve only the amino acid **R groups**, only the polypeptide **backbone atoms**, or **both**?

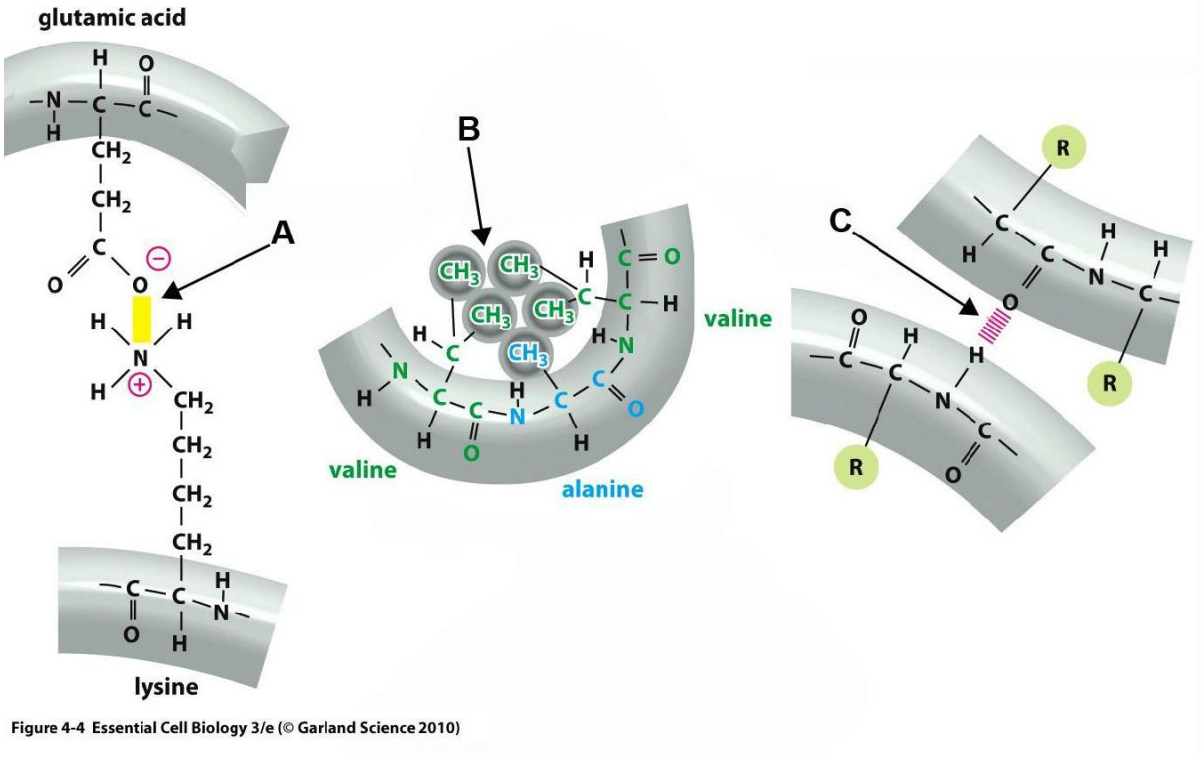

Figure 6 Three examples of bonding interactions that stabilize the tertiary structures of proteins (indicated by arrows A, B, and C).
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c. In the table below, indicate what type of bond/interaction is represented in the examples shown in Figure C.4, panels A, B, and C and whether each interaction involves R group or backbone atoms.

Example	Type of Bonding Interaction	R group or backbone?
A		
B		
C		

d. From what you have seen so far regarding the types of interactions that stabilize the tertiary structure of proteins, is the ability to form a particular tertiary structure likely to depend on the primary sequence of a polypeptide **more**, **less**, or to the **same degree** as the ability to form the two types of secondary structures? Explain your answer.

e. Figure 7 below shows one additional type of bond that can stabilize the tertiary structure of a protein. This bond is called a **disulfide** bond (or disulfide bridge), and it involves the sufhydryl (-SH) R groups from one particular type of amino acid. A disulfide bond can form only under certain conditions (*oxidative* conditions). We'll talk about oxidation and reduction later in the course; for now, just note that this type of bond does exist in some proteins.

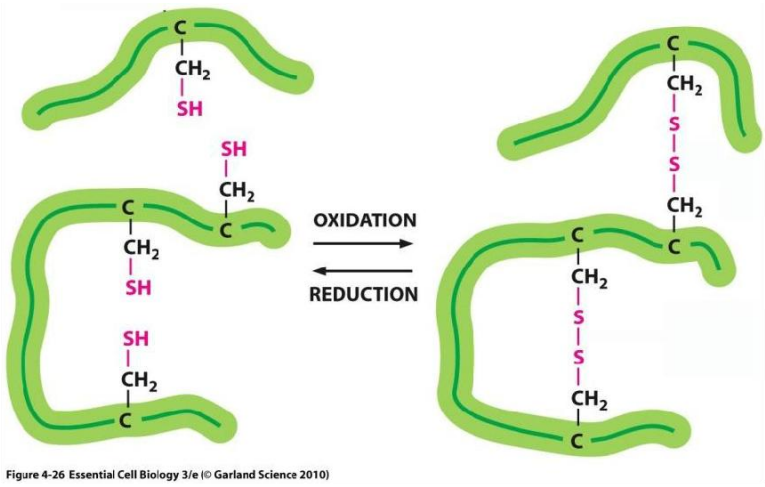

Figure 7. Disulfide bonds within proteins can form (left-pointing arrow) or be broken (right-pointing arrow), depending on their chemical surroundings (oxidative or reducing).

i. Referring again to Appendix A, which amino acid is the one that can form disulfide bonds?

ii. What is different about the disulfide bond compared to the other types of bonds that stabilize tertiary structure? Based on your existing knowledge of bonding, is this bond weaker or stronger than the other types of bonds?

4. One final level of structure exists for some, but not all, proteins. This is called **quaternary structure**. Proteins that have quaternary structure are formed from two or more polypeptides that assemble into one active structure. The different polypeptides in a protein with quaternary structure are often called **subunits**. These subunits may be identical or different. One example of a protein with quaternary structure is hemoglobin, the protein that transports oxygen in our blood. The structure of hemoglobin is shown in Figure C.6 below.

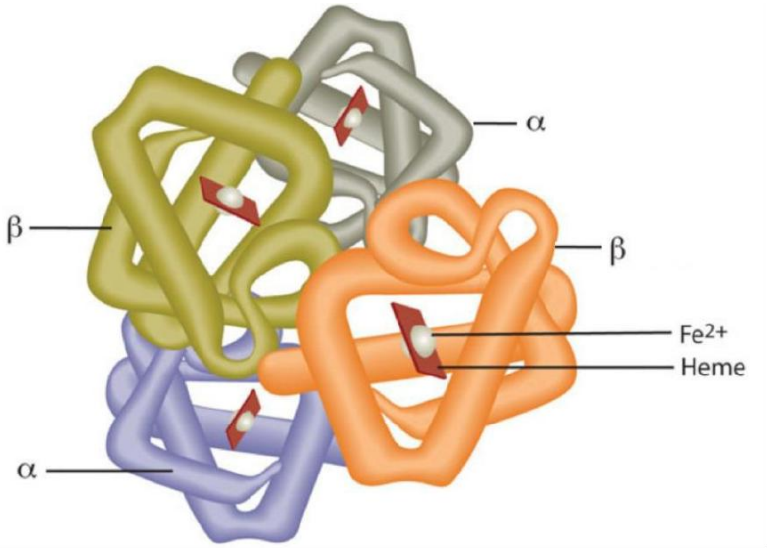

Figure 8. Quaternary structure of hemoglobin with labeled subunits. Each subunit contains one non-protein heme group complexed to an oxidized iron atom (Fe^{2+}); these "prosthetic groups" are required for carrying oxygen in the blood.

Modified from http://2012books.lardbucket.org/books/an-introduction-to-nutrition/s14-04-minerals-important-for-metabol.html under Creative Commons license (http://creativecommons.org/licenses/by-sa/3.0/legalcode)

a. Based on your interpretation of Figure 8, how many subunits does hemoglobin contain? Are they all the same or different?

b. Which types of interactions do you think stabilize the quaternary structure of proteins that have this level of structure? (Hint: is this any different from tertiary structure, except for the fact that multiple polypeptides are involved?)

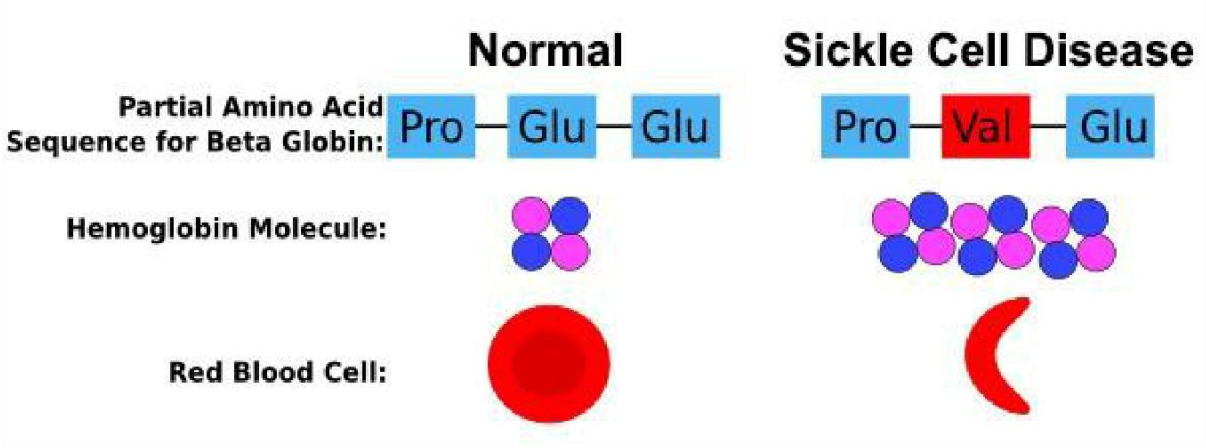

Figure 9. Changes to the Beta-Globin subunit of hemoglobin in sickle cell disease and the functional consequence for red blood cells.
Image modified from https://beyondthedish.wordpress.com/tag/sickle-cell-disease/
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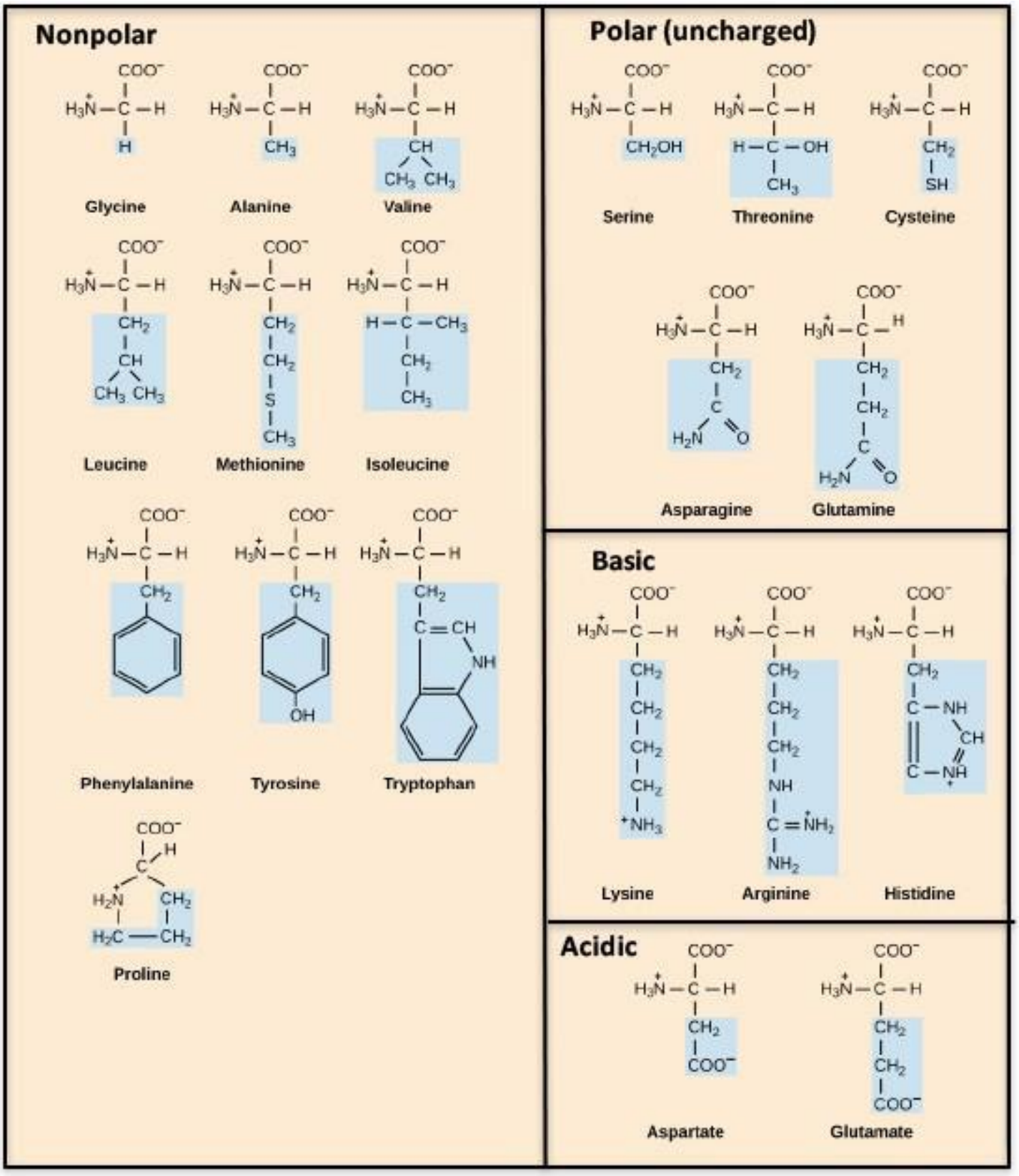
c. Figure 9 above illustrates the basis of the most common version of sickle cell disease. Keeping in mind what you already learned from Figure 8, which levels of hemoglobin protein structure are altered in sickle cell disease, as shown in Figure 9? Explain your answer.

d. Normal red blood cells can easily travel through blood vessels, whereas sickle-shaped red blood cells get stuck. This is the basis of sickle cell anemia. What does this tell you about the relationship between the structure of a protein and its function in a cell/organism?

Appendix A: Structures of the 20 naturally occurring amino acids



ASSIGNMENT: 2 Nucleic Acids

1. What is a nucleotide?

---

2. Name the scientists who gave the structure of DNA.

---

3. How is nucleotide different from nucleoside?

---

5. Name the sugars present in:

    1. DNA----------
    2. RNA----------

6. Draw the structure of the above sugars.

7. Draw the structure of dNTP and rNTP

8. In the backbone of each strand in the DNA double helix molecule, the sugar of one nucleotide is bonded to the
_____ in the next nucleotide.

The _____ of the nucleotides in each strand of DNA extend toward each other in the center of the DNA
double helix molecule.

A in one strand always pairs with _____ in the other strand, and **G** in one strand always pairs with _____ in the other strand. These are the **base-pairing rules**.

9 DNA has the same double helix structure in all living organisms. However, we know that a plant, mammal and bacterium must have different genes in their DNA to result in the very different characteristics of these different organisms. So, the question is: What is different in the DNA of these different organisms? Complete

the following table to identify what is different between the DNA of the plant, mammal and bacterium.

	Compare the plant and mammal DNA	Compare the mammal and bacterium DNA
Is the arrangement of the sugar and phosphate groups the same in each type of DNA?		
Does each type of DNA contain the same four bases (A, T, G, C)?		
Is the Sequence of bases the same in each type of DNA?		
Are the base-pairing rules the same in each type of DNA?		

10 What is the only characteristic that differs between these segments of DNA from a plant, a mammal, and a bacterium?

BIOCHEMICAL TECHNIQUES

1. Complete the table below on the basis of centrifuge types:

S.No.	Centrifuge Type	Speed	RCF	Applications
1.	Low Speed	----------	----------	
2.	----------	12,0000 rpm	----------	----------
3.	----------	----------	----------	----------
4.	----------	---------- ---------	60,0000g	----------
5.	ultracentrifuge	---------- -	----------	----------

2. Complete the table below on the basis of centrifugation techniques:

S.No.	Centrifugation Technique	Principle	Applications
1.	Differential Sedimentation	Differential Speed	
2.	Density Gradient Centrifugation a.Rate Zonal/Velocity Sedimentation b.Isopycnic	a. components of the mixture move as distinct bands	----------
3.	Density Barrier Single Step Density Barrier	Separation on the basis of buoyant density	----------

3. Define Ion Exchange Chromatography.

---

3. Complete the following with respect to the Ion Exchange Chromatography :

1. Sample ions have differential degree of interaction with matrix which depends on: Difference in their ----------,---------- and distribution of ---------- on their surface.

2. This interaction can be controlled by changing ----------and pH.

3. Positively Charged Exchanger are called as ---------- Exchanger because here Negatively charged---------- are exchanged with ----------(anions)sample ions.

4. Negatively Charged Exchanger are called as ---------- Exchanger because here Positively charged---------- are exchanged with ----------(cations)sample ions.
5. Matrix is made up of: ----------or ----------, cellulose and polymers of ---------- and----------.
6. IEC is a powerful technique for separating two proteins differing in only one---------- ---------- ----------.

4. I. a. What is Electrophoresis?

---

b. DNA is ---------- charged but in case of proteins the net charge depends on:----------

----------at a given pH.

c. For separation of DNA, ---------- gel is used due to the large molecular size of: ----------

d. For proteins -------- gel is used because it provides a stable medium, eliminates convection in the electrophoresis tank and does not react with sample or retard its movement.

e. Polyacrylamide gel is made of:

1. Monomers: ----------

2. Initiators: ----------

3.Propagators: ----------

4. Terminator: ----------

II.a. For Polymerisation of acrylamide, Ammonium persulfate forms ----------which

activates----------.Once the linear chain is formed the gelation and cross-linking is brought about by ----------.

b. SDS is used to enable the seaparation of the proteins only on the basis of their -------Chemically SDS is a ----------. It affects the protein by ----------it and causing ----------proteins to separate into ----------.

c. In SDS-PAGE as well as in Agarose gel electrophoresis after the separation the heavy molecules are at ----------part of the gel while the lighter molecules are at ---------- part of the gel.

5. Complete the following on the basis of IEF:
   a. Separation of molecules according totheir……,which is the pH value at which ----------
   b. ------gradient is formed by compounds called as---------- which are complex mixture of synthetic----------.
6. Spectroscopy:
   a. Electro magnetic radiations include:Y rays, ----------,----------,----------,---------
   b. Light source of the colorimeter ----------
   c. Light source of spectrophotometer…….....
   d. Application of the spectrophotometer/colorimeter
      ……....
7. Draw the diagram of the components of a colorimeter.

8. Draw the diagram of the components of a spectrophotometer.

9. State Beer and Lambarts Law.

---

10. In the form of a flow chart describe the procedure of Mass Spectrometry.

11. State the principle of Mass Spectrometry

---

12. Write the applications of Mass Spectrometry

ASSIGNMENT: 4 Cellular Techniques

1. Define Resolving Power.

---

2. Complete the table below on the basis of staining techniques:

S.No.	Name of the stain	Applications
1.	H&E stain	----------
2.	Giemsa stain	----------
3.	Gram's stain	----------
4.	Malachite Green	----------

3. Complete the following table on the basis of Microscopy technique:

S.No.	Type of the Microscopy	Type of lens	Principle	Applications
1.	Phase Contrast			
2.	Dark Field			
3.	Fluorescence			
4.	TEM			
5.	SEM			

4. Complete the following with respect to the Cell Sorting :

7. Extracellular matrix and intercellular junctions are disrupted by treating the tissue with ---------- and ----------.The former acts on proteins while the latter ----------on which cell-cell adhesion depends. This process is known as ----------
8. Separation of different cell types is done by ----------.
9. Here the cells are identified by measuring----------or ---------- as they flow through a laser beam.
10. FACS is ----------.
11. Here cells are labeled with ----------coupled with ----------.

5. a. List various methods of Cell Fractionation:

---

b. Starting from lungs as the sample source make a flow chart to obtain small polyribosomes.

6. Give the disadvantage of the Direct microscopic count.

---

7. What is a Coulter Counter? What is its limitation? How it can be overcome?

---

8. What is MPN?

---

9. What is viable count? How is it obtained?

ASSIGNMENT: 5 Genome Function

1. State Central Dogma.

_____

_____

2. Differentiate between:
    1. Gene and Genome
    2. Monocistronic and polycistronic
    3. Pseudo and mosaic genes
    4. Exon and intron
    5. Translation and Transcription
    6. DNA polymerase 3′ to 5′ exonuclease activity and 5′ to 3′ exonuclease activity

3. Write the genome size of:
    1. *Mycoplasma*
    2. *Methanococcus*
    3. *E. coli*
4. Write the total number of genes in *E.coli* and Humans.
5. Describe in detail the structure of nucleosome.

6. Draw a self-explanatory diagram of Messelson and Sthal's experiment.

7. 1. What are Okazaki fragments?

---

2. Write the structure and function of RNA polymerase.

---

3 How is the transcription site labeled?

---

8. Draw a well labeled diagram of t RNA.

9. Write the prominent features of genetic code.

---

10. In a point wise manner write the process of transcription.

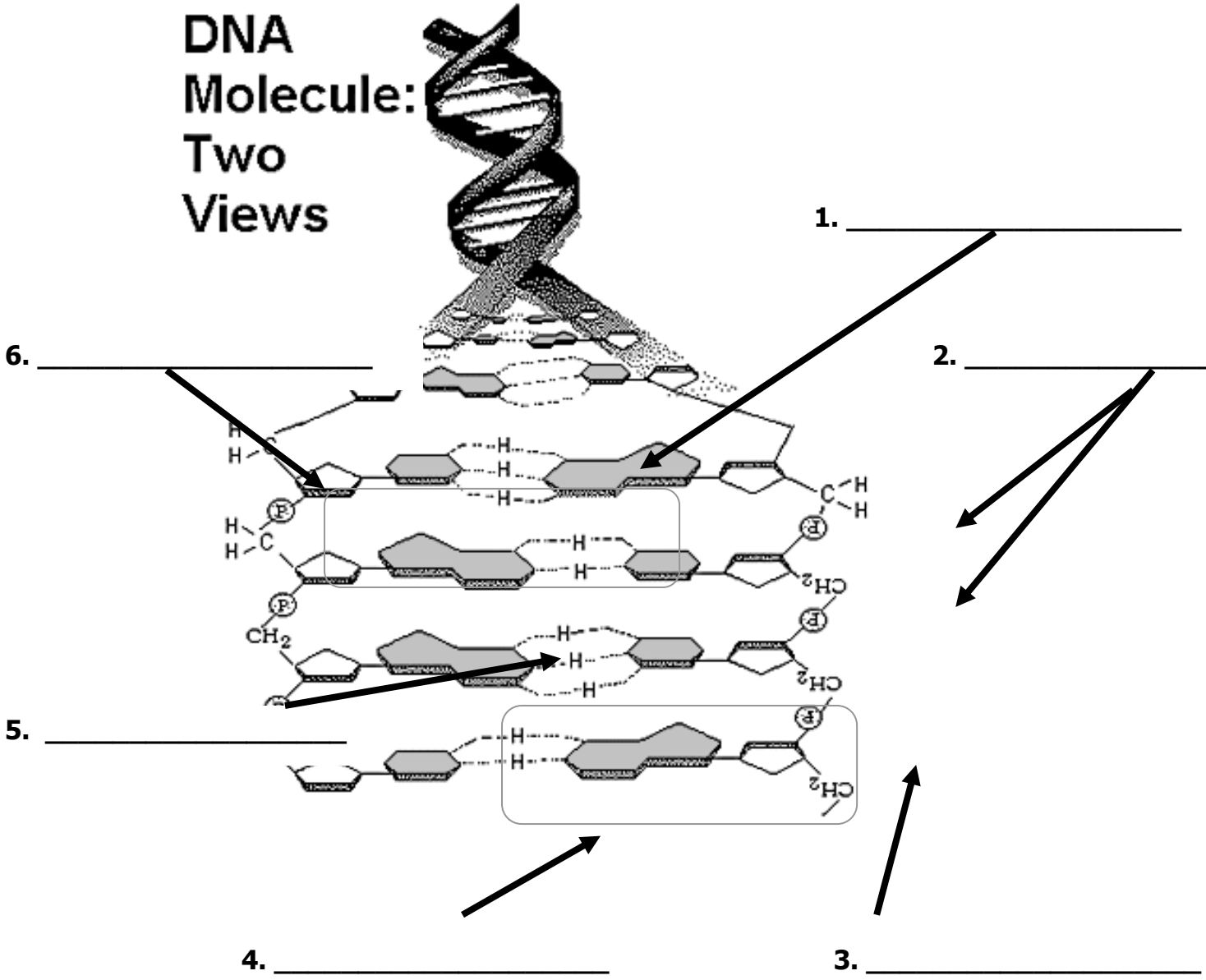
11. In a point wise manner write the process of translation.

12 Draw a flowchart of lac operon.

Structure of DNA and Replication

Directions: Label the diagram below with the following choices:

- Nucleotide
- Base pair
- Deoxyribose
- Hydrogen bond
- Phosphate group
- Nitrogenous base



Directions: Complete each sentence.

7. Guanine, cytosine, thymine, and _____ are the four _____ in DNA.

8. In DNA, guanine always forms hydrogen bonds with _____.

9. The process of _____ produces a new copy of an organism's genetic information, which is passed on to a new cell.

10. The double coiled, "staircase" shape of DNA is called a _____.

Directions: Answer each question in complete sentences.

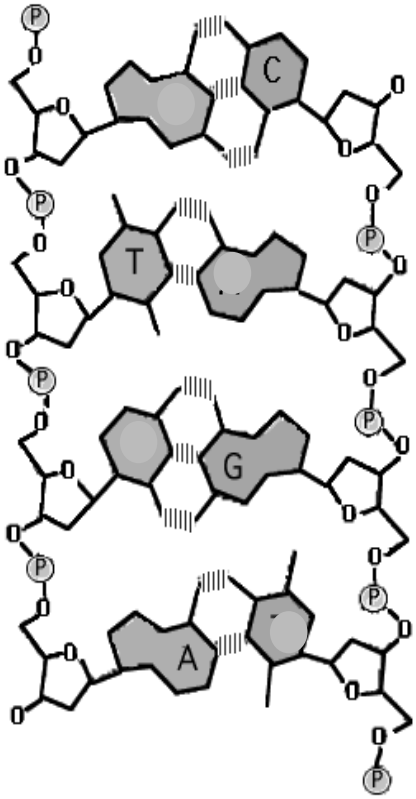
11. What do the letters DNA stand for?

_____

12. Where is DNA found?

_____

13. Label the **nucleotides** (A, T, G, C) in the DNA molecule below:



21. What is the first step in the process of DNA replication?

_____

_____

22. Which enzyme is responsible for "unzipping" the DNA double helix?

_____

23. Which enzyme is responsible for facilitating the hydrogen bonding between nucleotides in a new DNA molecule?

_____

_____

24. Which enzyme is responsible for creating the covalent bonds that connect the sugar-phosphate backbone of the new DNA molecules?

_____

25. If the sequence of one single strand of DNA is C-A-A-G-T-A-G-G-C-T, what is the sequence of the complementary strand?

_____

26. Describe the origin of each strand of the new double helices created after DNA replication.

_____

_____

27. Why is DNA replication important to the growth and development of a multi-cellular organism?

_____

_____

28. List the 3 basic steps of DNA replication:

a. _____

b. _____

c. _____

The model of DNA below is ready to be copied. Compared to the **original** double helix, evaluate the copies made during three attempts of DNA replication.

Original

A	T
T	A
C	G
C	G
G	C
T	A
G	C

29. List any errors with the replication if they occurred:

Replication #1

A	T
T	A
C	G
C	G
G	C
T	A
G	C

AND

A	T
T	A
C	G
A	G
G	C
T	A
G	C

List problems if any:

_____
_____
_____
_____
_____
_____

Replication #2

A	T
T	A
C	G
C	G
G	C
T	A
G	C

AND

A	T
T	A
C	G
C	G
G	C
T	A
G	C

List problems if any:

_____
_____
_____
_____
_____
_____

30. Complete the diagram on the left. Then circle the areas in the diagram on the right that show a genetic mutation.

DNA Correctly Copied

A	
G	
C	
T	
A	
T	
A	

→

DNA Incorrectly Copied

A	
G	
C	
T	
A	
T	
A	

→

A	T
G	C
C	G
T	A
A	T
T	G
A	T

G	T
G	C
C	G
T	A
A	T
C	A
A	T

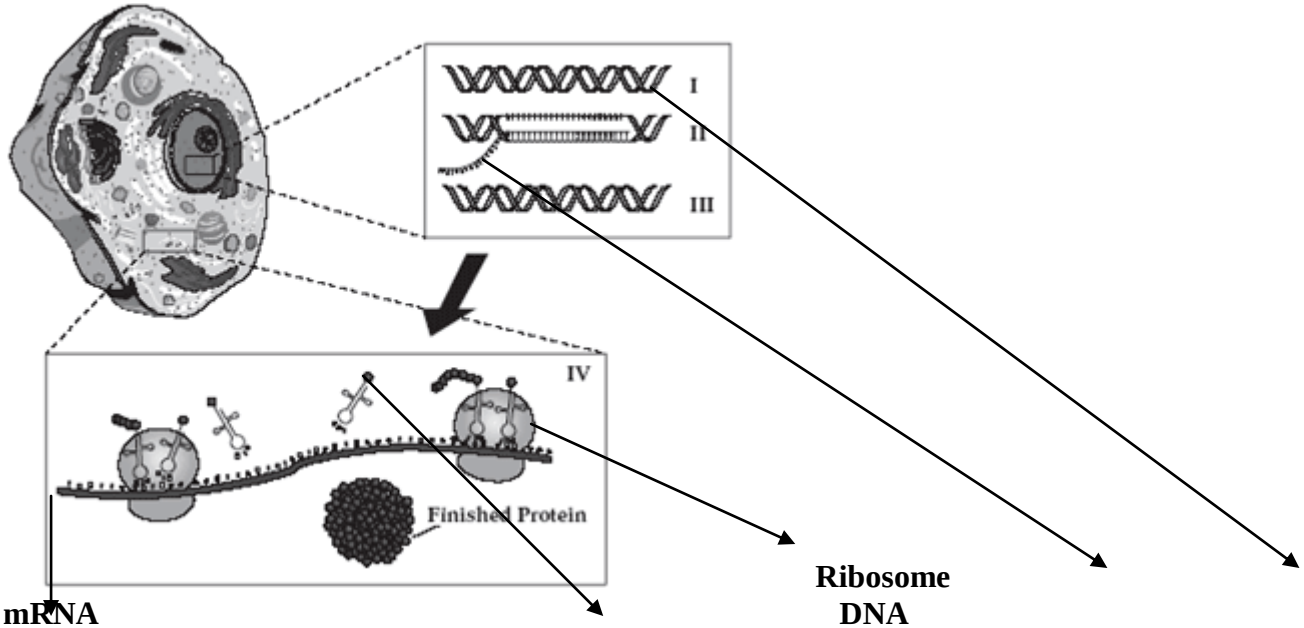
31. Explain how the mutations might have been caused in the diagram above.

_____
_____
_____

PROTEIN SYNTHESIS WORKSHEET

PART A. Read the following:

Protein synthesis is the process used by the body to make proteins. The first step of protein synthesis is called Transcription. It occurs in the nucleus. During transcription, mRNA transcribes (copies) DNA. DNA is "unzipped" and the mRNA strand copies a strand of DNA. Once it does this, mRNA leaves the nucleus and goes into the cytoplasm. mRNA will then attach itself to a ribosome. The strand of mRNA is then read in order to make protein. They are read 3 bases at a time. These bases are called codons. tRNA is the fetching puppy. It brings the amino acids to the ribosome to help make the protein. The 3 bases on tRNA are called anti-codons. Remember, amino acids are the building blocks for protein. On the mRNA strand, there are start and stop codons. Your body knows where to start and stop making certain proteins. Just like when we read a sentence, we know when to start reading by the capitalized word and when to stop by the period.



PART B. Answer the following questions on your paper:

1. What is the first step of protein synthesis? _____
2. What is the second step of protein synthesis?

3. Where does the first step of protein synthesis occur?

   _____

4. Where does the second step of protein synthesis occur?

   _____

5. Nitrogen bases are read _____ bases at a time.
6. The bases on the mRNA strand are called _____.
7. The bases on tRNA are called _____.
8. What is the start codon? _____
9. What are the stop codons? (Use your mRNA chart or pg. 298)

   _____

10. A bunch of amino acids attached together is called a

    _____.

PART C. Use your codon chart from the teaxt Book to determine the amino acid sequence. Remember to read through the strand and <u>ONLY</u> <u>start on AUG</u> and <u>STOP when it tells you to stop</u>. Follow example below:

Example:

DNA → AGA CGG TAC CTC CGG TGG GTG CTT GTC TGT ATC CTT CTC AGT ATC
mRNA → UCU GCC AUG GAG GCC ACC CAC GAA CAG ACA UAG GAA GAG UCA UAG
protein → start - glu – ala –thre – hist – asp –glu – threo - stop
acid acid

1. DNA → CCT CTT TAC ACA CGG AGG GTA CGC TAT TCT ATG ATT ACA CGG TTG CGA TCC ATA ATC
   mRNA →
   protein →

2. DNA → AGA ACA TAA TAC CTC TTA ACA CTC TAA AGA CCA GCA CTC CGA TGA ACT GGA GCA
   mRNA →
   protein →

3. DNA → TAC CTT GGG GAA TAT ACA CGC TGG CTT CGA TGA ATC CGT ACG GTA CTC GCC ATC
   mRNA →
   protein →

4. DNA → TAA ACT CGG TAC CTA GCT TAG ATC TAA TTA CCC ATC
   mRNA →
   protein →

5. DNA → CTA TTA CGA TAC TAG AGC GAA TAG AAA CTT ATC ATC
   mRNA →
   protein →

6. DNA → TAC CTT AGT TAT CCA TTG ACT CGA ATT GTG CGC TTG CTG ATC
   mRNA →
   protein →

7. DNA → ACC CGA TAC CTC TCT TAT AGC ATT ACA AAC CTC CGA GCG
   mRNA →
   protein →

8. DNA → TAC AGA CGG CAA CTC TGG GTG CTT TGT TCT CTT CTC AGT ATC
   mRNA →
   protein →

Circle the correct choice within the parenthesis for 1 -18.

1. (DNA/RNA) can leave the nucleus.

2. mRNA is made during (transcription/translation).

3. mRNA is made in the (cytoplasm/nucleus).

4. DNA is located in the (nucleus/cytoplasm)

5. (Translation/Transcription) converts DNA into mRNA.

6. (mRNA/rRNA) is used to carry the genetic code from DNA to the ribosomes.

7. (tRNA/rRNA) makes up the ribosome. Look in the book for this.

8. (DNA/RNA) uses uracil instead of thymine.

9. (RNA/amino) acids make up a protein.

11. Transcription takes place in the (nucleus/cytoplasm).

12. tRNA is used in (translation/transcription).

13. tRNA uses (anticodons/codons) to match to the mRNA.

14. Proteins are made at the (nucleus/ribosome).

15. (tRNA/mRNA) attaches the amino acids into a chain.

16. tRNA is found in the (nucleus/cytoplasm).

17. (Translation/Transcription) converts mRNA into a protein.

18. Translation takes place in the (cytoplasm/nucleus).

Fill the Diagram In

DNA

mRNA

tRNA

Amino
Acids

Replication, Transcription & Translation Thinking Questions

1. Draw a DNA nucleotide & an RNA nucleotide. Label each of the 3 major parts.

2. What are the three major differences between DNA & RNA?

   a)
   b)
   c)

3. What is the **point of DNA replication**? _____
4. When & where does **replication** occur? _____
5. What is the point of **transcription**? _____
6. What are three nucleotides together called on mRNA? (ie: ACA)_____
7. The mRNA codons can be used in a chart to find: _____
8. What molecule contains an anti-codon? _____
9. Why is this (answer to #13) molecule so important?
10. **Translation** takes place in the _____ on a _____.
11. What is the point of **translation**?

12. Transcription and translation together is the process of _____ _____.

13. What is any change in the DNA sequence called? _____

14. Any agent that causes a mutation would be called a _____.

15. What are some examples of things that cause mutations?

16. What are the two types of DNA or gene mutations? Give examples of each.
    A.

    B.

17. Which one of the two above is more destructive? Why?

18. What is the difference between a *gene mutation* & a *chromosome mutation*?

19. What are the types of chromosome mutations? Explain each. Include a Picture
    a.

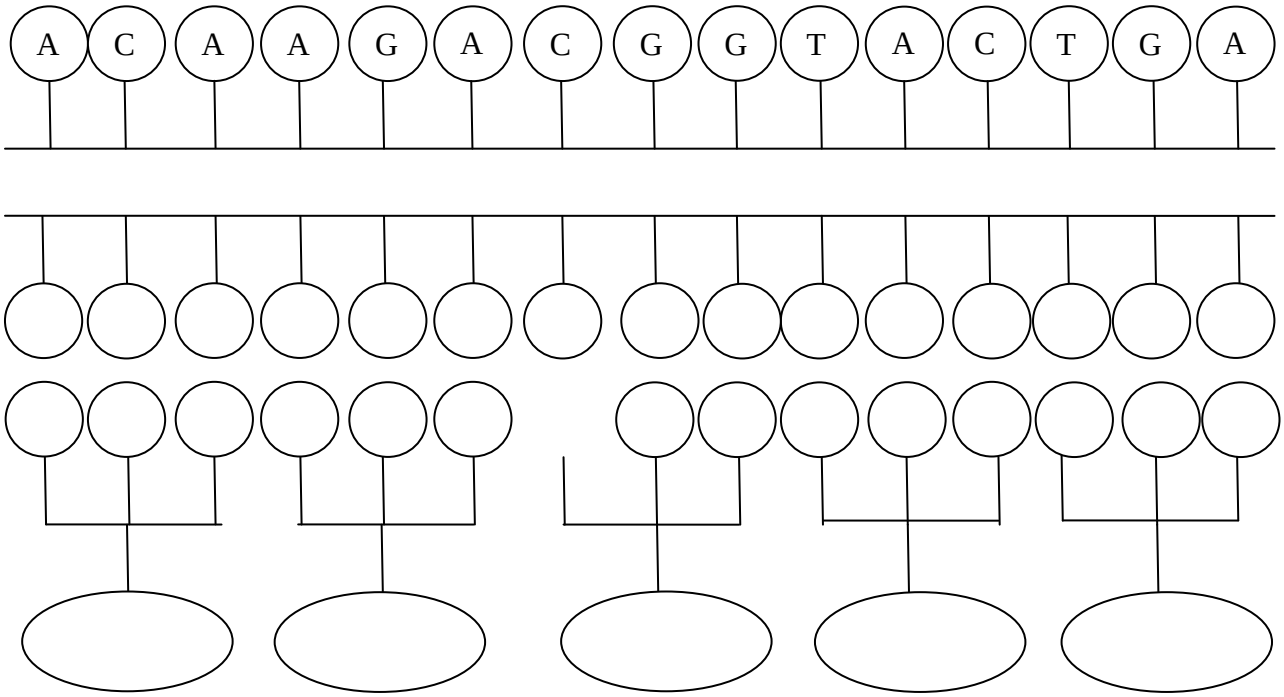
    b.

    c.

    d.

20. Are mutations always bad? Explain your answer.

21. Complete the figure below using the Genetic Code.



Chromosomal Mutations are deviations from the expected chromosomal number, or mutations in the structure of the chromosome, are inherited in predictable Mendelian fashion; they often result in dead organisms or substantial changes in phenotype. **Aneuploidy** is the gain or loss of one or more chromosomes from the diploid amount, resulting in conditions of **monosomy, trisomy, tetrasomy**. Studies of monosomy (Turner Syndrome XO) and trisomic disorders (Down's Syndrome) have increased our understanding of the delicate balance that must exist in order for normal development to occur.
When complete sets of chromosomes are added to the diploid number, **polyploidy** is created. These sets may have identical or diverse genetic origin. Large segments of the chromosome may be modified by **deletions or duplications**. **Deletions** may produce serious conditions such as Cri-du-chat Syndrome in humans. **Duplications** may be important as a source of redundant or unique genes, but this usually has no effect on health. **Inversions and translocations**, while altering the gene order along chromosomes, cause no net loss of genetic information. In an **inversion**, a sequence of genes is turned around. This does not affect health unless a critical gene sequence is physically disrupted. Most children with Chronic Myeloid Leukemia have a **translocation** or mixed up chromosome, in which the tip of chromosome 22 is attached to chromosome 9.
A change in chromosome number or in the arrangement of a chromosome region often results in **phenotypic variation or disruption of development of an organism**. Such phenotypic variations are passed to offspring in a predictable manner, resulting in many interesting genetic situations.

Gene Mutations affect a single gene by changing its base sequence, resulting in an incorrect, or nonfunctional, protein being made. A **substitution** mutation, occurs where one nucleotide base is replaced by another. These are often called "**point mutations"**, because a **single base** is changed, at one **point** in the gene.

1. A geneticist found that a particular mutation had no effect on the protein coded by a gene. What do you think is the most likely type of mutation in this gene? Why?

2. Name one amino acid that has more than one codon. Name an amino acid that has only one codon.

3. Look at the following sequence: THE FAT CAT ATE THE RAT. Delete the first H and regroup the letters in groups of three- write out the new groups of three. Does the sentence still make sense? What type of mutation is this an example of?

4. Given the following three mRNA sequences, TWO code for the same protein. Which two?

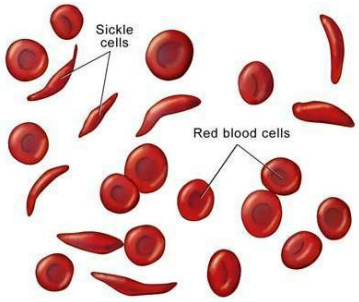
#1 AGU UUA GCA ACG AGA UCA

#2 UCG CUA GCG ACC AGU UCA

#3 AGC CUC GCC ACU CGU AGU

5. Below is the DNA base sequence for the normal protein for normal hemoglobin and the base sequence for (abnormal) sickle cell hemoglobin:

Normal GGG CTT CTT TTT
Sickle GGG CAT CTT TTT

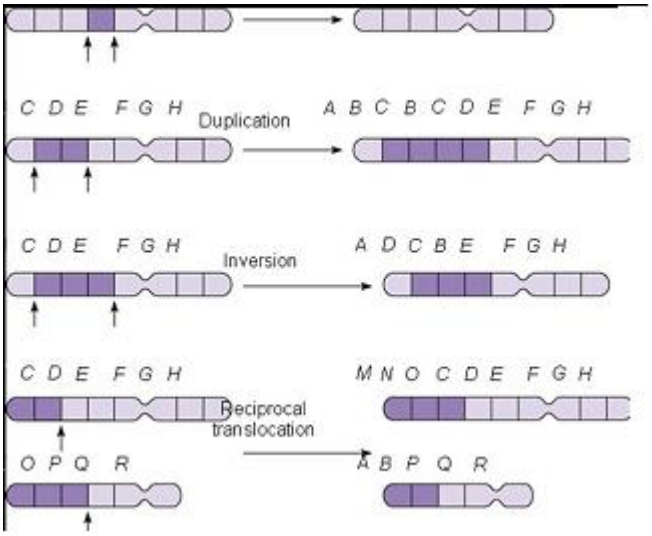


A. *Transcribe* and *translate* the normal and sickle cell DNA.

B. Identify this as a point or frameshift mutation. Explain.

C. If the base sequence read GGG CTT CTT AAA instead, would this result in sickle cell hemoglobin? Explain.

6. Label the following chromosomal mutations as duplication, translocation, deletion, and inversion.



7. Why are chromosome mutations potentially more serious than gene, point mutations?

8. MATCHING. Match the mutation with its description.

____ Translocation

____ Inversion

____ Deletion

____ Duplication

A). A portion of the chromosome is missing. Known disorders in humans include Cri du chat syndrome is due to a partial deletion of the short arm of chromosome number 5.
B). A portion of the chromosome is doubled, resulting in extra genetic material. Known human disorders include Charcot-Marie-Tooth disease type 1A which may be caused by duplication of the gene encoding peripheral myelin protein 22 (PMP22) on chromosome 17.
C). When a portion of one chromosome is transferred to another chromosome. Sometimes, parts of different chromosomes switch places (reciprocal exchange).
D). A portion of the chromosome has broken off, turned upside down and reattached, therefore the genetic material is backward.

9. Why do you think that an excess of genetic material is usually less harmful to health than a deficit?

10. **Original DNA Sequence**: T A C A C C T T G G C G A C G A C T

mRNA Sequence:

Amino Acid Sequence:

Mutated DNA Sequence #1: **T A C A T C T T G G C G A C G A C T**

What's the mRNA sequence? (Circle the change)

What will be the amino acid sequence?

Will there likely be effects?

What kind of mutation is this?

ASSIGNMENT: 6 Genetic Techniques

1. What is Karyotypimg?

2. What type of samples can be used for karyotyping? Which sampling technique is better and why?

3. 4. Expand FISH.
   5. Draw a flow chart to show the various steps of FISH.

4. What are auxotrophs? How will you raise an auxotrophic mutant?Write the procedure in pointwise manner.

5. What is conjugation. What is the disadvantage of conjugation.

_____

_____

_____

_____

Academic Session: 2018-19
First Term Examination
Subject - Biotechnology
M/2/1

Time: 3 Hrs. **MM – 70**

General Instructions:

The Question Paper has 4 sections A, B, C and D. Section A has 5 questions of 1 mark each, Section B has 10 questions of 2 marks each, Section C has 10 questions of 3 marks each and Section D has 3 questions of 5 marks.
The question paper has 2 printed sides and 28 questions.

Section A

1. Give the complementary sequence of: 5'ATTAGCTCGATAGATAT3'
2. Expand SCNT.
3. What is tissue engineering?
4. Which amino acid among the following will move away from water: Trp, Glu, Ser and Val.
5. What is a glycosidic bond?

Section B

6. Draw the general structure of an amino acid and define peptide bond.
7. Define coenzymes. Give the role of carbonic anhydrase in our body.
8. Describe the structure of haemoglobin. How is sickle cell haemoglobin formed?
9. Give the test to detect the presence of sugars in blood sample. Why does sucrose react differently.
10. What is bioprocess technology. List any two areas where this technology is used?
11. (i) Define fluorescence.
    (ii) Differentiate between intrinsic and extrinsic fluorescence.
12. a) Molecular weight of a protein is 55000 Da. Predict the number of amino acids in this protein.
    b) Name the scientist who showed that amino acids are linked by peptide bond.
13. How will you confirm the presence of:
    a) Nucleic acids among mixture of biomolecules
    b) DNA in a mixture of nucleic acids
14. a) State Beer- Lambarts law.
    b) Write the wavelength range of visible light.

15. Define monomeric protein and given an example of such a protein.

Section C

16. Draw a well labelled diagram of the components of a colorimrter.
17. How will you separate DNA from other cytoplasmic contents? Give the principle behind this technique.
18. What is Rhuemann's purple? How is it formed? What is its utility?

19. Draw dNTPs and show the phosphodiester bond.
20. How will you separate two proteins with identical molecular weight but differing in single amino acid.
21. Describe in a point wise manner the technique used to separate proteins on the basis of their molecular weights.
22. Differentiate between the three types of RNA on the basis of:
    (i) availability
    (ii) length
23. What is cell culture? List an application each of plant and animal cell culture.
24. Give reason:
    i. Proline does not give blue colour with ninhydrin
    ii. Spider silk is used to make bullet proof jackets
    iii. Myoglobin is a monomeric protein
25. Describe in detail the sequence strategy of a polypeptide. Draw the relevant diagram also.

Section D

26. Answer the following on the basis of your understanding of the structure of DNA:
    i. between two dNTPs
    ii. most predominant form of DNA
    iii. number of base pairs in human chromosomes.
    iv. function of histone
    v. no. of hydrogen bonds between AT and GC
    vi. what is antiparallel nature of DNA
    vii. type of helix in Z form of DNA

viii. length of human DNA

ix. specify the condition when A form of DNA is obtained?

27. Describe Mass Spectroscopy in detail.

28. a) What is centrifugation?

b) Describe the three basic types of centrifugation techniques.

c) How will you obtain the following using centrifugation:

i. Nucleus

ii. ribosomes

Academic Session: 2017-18
Annual Examination
Subject: Biotechnology
M/2/1

Time: 3 Hrs. **Max. Marks: 70**

General Instructions:

The Question Paper has 4 sections A, B, C and D. Section A has 5 questions of 1 mark each, Section B has 10 questions of 2 marks each, Section C has 10 questions of 3 marks each and Section D has 3 questions of 5 marks.
The question paper has 2 printed sides and 28 questions.

Section A

1. State the Beer Lambart's law.

2. What are Okazaki fragments?

3. Suggest the bacterial cell counting technique if the water sample is expected to have low cell number.

4, Name the organism on which Morgan worked. Also name the phenomenon that he observed.

5. What is biomedical engineering?

Section B

6. a) Differentiate between homogenisation and hypotonic treatment.
   b) Write any two methods to measure cell growth.

7. Diagrammatically show the various types of chromosome rearrangements.

8. Identify the type of mutation:
   a) AT-GC
   b) CG-AT
   c) TA-CG
   d) GC-CG

9. Describe RNA interference.

10. A 14 yr old boy was diagnosed with a recessive heredity disease due to which he developed increased sensitivity to uv light. Identify the disease and the cause.

11. Write a short note on Biosensors.

12. Answer the following on the basis of your knowledge about fluorescence

spectroscopy:
a) Dye used to emit red and orange light
b) Two important applications

13. Draw a well labelled diagram to show the components of a uv-visible spectrophotometer.

14. a) Differentiate between split genes and pseudogenes.
b) What is gene expression?

15. Draw a well labelled diagram of nucleosome showing histone subunits.

Section C

16. Differentiate between embryonic and adult stem cells on the basis of origin and differentiation.
17. Diagrammatically show photoreactivation repair.

18. a) How will you identify the presence of reducing sugars?
b) Give the contribution of Pehr Edmann
c) What is the function of restriction endonuclease?

19. a) Define plasmids
b) Give the genome size of:
i. Rice and wheat
ii. M13 and T7 phage

20. Draw a well labelled diagram of tRNA molecule.

21. Diagrammatically show the steps involved in the experiment performed by Hershey and Chase.
22. Write a short note on Ion Exchange Chromatography

23. a) Name the scientists who gave genetic code.
b) Explain:
i. Genetic code is unambiguous
ii. Third base degeneracy

24. Describe the principle of the technique and the stepwise procedure to study the protein profile of a cell.

25. a) Define apoptosis
b) Differentiate between humoral and cell mediated immunity.
c) What is transduction.

Section D

26. Describe FISH in detail.

27. What will happen to the carbohydrate metabolism in *E coli* if lactose is the only energy source available. Write the sequence of events in a point wise manner and draw the necessary diagram.

28. Give a detailed account of transcription in prokaryotes.