

[←](#) Bio Question

Mid question answer

1.

a. Define biological engineering.

Biological engineering is a biology-based engineering discipline that integrates life sciences with engineering in the advancement and application of fundamental concepts of biological systems from molecular to ecosystem levels.

b. Clearly state the value of biology knowledge for computer science students.

We are biological entities so we should know how our body functions. As computer engineer, we should know how technology impacts our bodies. We can use the environment for technology by understanding the surroundings. As biotechnology is rapidly growing we can use our ability in this sector by knowing biology-based knowledge.

3. Ecosystems and evolution are intertwined. Use an example to clarify.

In biology, evolution is the change of characteristics of a species over several generations. On the other hand, the ecosystem is a community of both living & non-living entities of a particular region, where the living organisms interact with each other and maintain the ecological system.

Because of the changes in the environment, all species have to cope up with that situation. But it will be difficult for the current generation of species. But after some generations, all newborn species will have some physical changes than the previous to adapt to the environment. Thus the ecosystem will change also. Ecological processes, such as species interactions and environmental changes, can influence evolutionary change. Greater biodiversity in ecosystems, species, and individuals leads to greater stability.

For example, the world is becoming warmer day by day. For that reason, the habitable place for penguins also decreases rapidly. So the penguin has to move to a warmer place. After some generations of penguins, researchers have seen some penguins have less fur than others & the numbers are increasing rapidly.

4. Identified the main distinctions between an engineer and a scientist.

The difference between an engineer and a scientist can be categorized into 3 categories: **Phylogeny, motivation, and methods.**

There are 4 phases in **phylogeny** among them, **1) Random phase, 2) Descriptive phase, 3) Quantitative phase, and 4) Control phase.**

The random phase and descriptive phase are related to the field of science and engineering contributing mainly to the control phase. In the qualitative phase, the overlap occurs between engineering and science.

The major source of motivation for engineers comes in the final products as a result of their efforts. On the other hand, scientist is often motivated by the subject they study as they feel empathy for their subject and are interested in the subject.

The main difference between the two is that scientists alter their subject to discover new scientific knowledge and engineers make changes to improve the performance of their products.

5. Mention the fields in modern biology where you can apply machine learning.

Machine learning is a type of AI that allows computer applications to become more accurate at predicting outcomes. In modern biology, ML can be implemented. Here are some fields,

1. Identifying gene coding regions. **Gene**
2. Functional annotation **Function**
3. Microarray Data analysis **Array**
4. Pathway analysis **Path**
5. Proteomics **Pro**

6. Name three environment-friendly ideas that can be implemented as business models.

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also cheap), bacteria filter, microfiber, etc.

2. Using biodegradable waste for fertilizer: Making fertilizer using biodegradable waste will reduce the usage of chemical fertilizer. So importing chemical fertilizer will be reduced rapidly. Also, it is safe for our environment.

3. Concave mirror solar cooker: It's normally a use of a concave mirror which centralizes all the sun rays into a point. So that point's temperature becomes hot enough that it can boil water within a minute. So it reduces the usage of fuel and saves energy.

7. How a degraded ecosystem affects the ecosystem core? Give a logical explanation.

The ecosystem is a structural and functional unit of ecology where the living organisms interacts and the surrounding environment. Generally, ecosystem degradation is a process that removes or reduces the durability of ecosystem processes and biodiversity. As we know greater biodiversity in ecosystems, species, and individuals leads to greater stability, this lack of biodiversity can cause less stability in the future generation and lead to a weak ecosystem.

8. Suppose you have a pond where you want to grow fish. Can you design a biorobot that can potentially help you to reduce the expenditure on manpower? Is that possible to use your expertise in this case?

I would like to design a biorobot that can observe the state of fish and the pond's environment.

In fish farming, we need to ensure the optimal environmental condition for fish by reducing stress levels, ensuring enough food, and so on. On the other hand, we need to keep a constant temperature of the pond. So, my idea about the biorobot is to measure the temperature and notify the user through mobile devices. Moreover, It will observe the health condition of fishes in the pond so that if a fish become attacked by a disease then it will be informed. Thus my biorobot can reduce the expenditure on manpower.

9. Do you think you would be able to give your input as a computer engineer in tissue engineering? Design a probable project in that area with a few words

Tissue engineering refers to creating functional human tissue from cells in a laboratory. Its main goal of it is to cure by replacing or repairing tissues that fail due to disease, genetic errors, or injury. There are mainly four factors: the right cell, the right environment, proper biomolecules, and external and internal forces to influence development.

As computer engineers, we can make a simulation project that will simulate the whole process of tissue culturing and estimate a result. The four factors will be given as input to the simulation. By simulating the accuracy of the result can be measured. Moreover, we can introduce 3d printing here.

10. How you would differentiate “organ-on-a-chip” and “tissue engineering” as both of these techniques are used to give you new organs?

Body fluid-like materials that can flow on either side of the membrane, provide a functional representation of the real organ

11. Can you design a project in the field of Brain and Neuroscience using your own background? Explain briefly about the project and how you can implement your expertise there.

I would like to introduce a project that sends and receives information between a brain and a computer.

Our brain is the sensitive part of our body. It controls almost every part of our body by an electrical signal through neurons. Neurons are attached to every part of our body and control our every movement. I would like to design a chip that records and decode the electrical signal to the chip. This can help to know what a brain is going to do.

As this project is a connection between the brain and technology which means paralyzed people can easily operate their phones and computer through their brains. Its main purpose is to communicate with computers through brains.

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Cell Structure & Function

1. Clarify why eukaryotic cells have flexible cell membranes:

They have flexible cell membranes due to the phospholipid bilayer. The phospholipid bilayer consists of two components: Hydrophilic Head and Hydrophobic tails.

The phospholipid molecules are able to move around within the layers and give the cell membrane flexibility.

Cell walls are not present in animal cells. That's why animal cells are not as rigid as other cells surrounded by cell walls like plant cells. So, animal cells, therefore, have more flexibility than plant cells.

2. Recognize the differences between prokaryotic and eukaryotic cells:

Prokaryotic	Eukaryotic
Prokaryotic cells have no nucleus	Eukaryotic cells have a true nucleus
They all are single-celled microorganisms like bacteria.	Eukaryotic are all structured with so many cells
The cell size ranges from 0.1 to 0.5 μm in diameter.	The cell size ranges from 10-100 μm in diameter.
They reproduce asexually.	They reproduce sexually as well as asexually.
Prokaryotic have a cell wall	Animals don't have a cell wall but plants have.
Cell division occurs through binary fission	Cell division occurs through mitosis

3. Which organelle in the cell produces energy?

Mitochondria organelle in the cell produces energy.

We can't survive without mitochondria, the organelles that need the most power in human cells. It is known as "powerhouses of the cell," which is necessary for the cell's survival and functioning. Through a series of chemical reactions, mitochondria break down glucose into an energy molecule known as adenosine triphosphate (ATP).

For example - as the heart is constantly pumping blood around the body, it needs a rich supply of oxygen and glucose. There are more mitochondria found in heart cells because this means we are able to produce enough energy to keep it functioning efficiently.

4. Describe how nutrients are transported across cell membranes.

A cell membrane is a semi-permeable membrane present in all cells. It allows the outward and inward movement of molecules across it. Nutrients, such as sugars or amino acids, must enter the cell, and certain products of metabolism must leave the cell. Such molecules diffuse passively through protein channels in facilitated diffusion or are pumped across the membrane by transmembrane transporters. The movement of molecules across the plasma membrane takes place by diffusion, osmosis, active transport, phagocytosis (cell eating), and pinocytosis (cell drinking).

Passive transport does not require energy molecules and happens when a funnel opens in the membrane, letting molecules flow through.

The cell membrane is present below the cell wall in plant cells and the outermost membrane in an animal cell. It is composed of phospholipids, proteins, carbohydrates, and cholesterol.

5. Compare the vacuoles of animals and plants.

Animal Cell	Plant Cell
Animals have small-sized vacuoles.	Large vacuole is present in a plant cell.

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They assist in the endocytosis and exocytosis processes.	They also maintain the rigidity and turgidity of the cell.
They are temporary structures.	They are permanent structures.

6. Which organelle do you think is most important for the living world? Write down the functions of that certain organelle.

Of all organelles, the nucleus is considered as the most important organelle for the living world.

The nucleus is the controlling unit of every organelle. The nucleus keeps the cell lively by controlling the biological work of a cell that's why it is called the soul center of a cell. It also actively participates in mitosis and meiosis cell division. Moreover, the control of heredity also happens through the nucleus. The chromatin fiber inside the nucleus encloses the genetic material within them. During cell division, these threads coil themselves to form a structure that is called a chromosome.

7. Which organelle works in biogenesis? Mention its functions.

A new organelle is made by biogenesis. Endoplasmic Reticulum works in biogenesis.

Its main function is to form the supporting framework of the cell. It serves as a pathway for the distribution of the material from one part of the cell to the other. Due to the presence of ribosomes - proteins and lipids are synthesized on a rough endoplasmic reticulum that helps regenerate cell membrane that process is called biogenesis.

8. Do you think cell membrane works in transportation? Briefly explain the procedure involved in it.

The cell membrane consists of a lipid bilayer that is semi-permeable. The lipid bilayer acts as a barrier to the passage of molecules and ions into and out of the cell. Cell membranes contain various membrane transport proteins, each of which is responsible for transferring a particular solute or class of solutes across the membrane. There are two major ways that molecules can be moved across a membrane, 1) Active and 2) Passive transport. Passive transport like diffusion uses no energy, while active transport requires energy(ATP) to get done. Moreover, the transportation process is also done by diffusion and osmosis. Diffusion is mainly of 2 types: 1) Simple diffusion and 2) Facilitated Diffusion.

In simple diffusion, the substance passes between the phospholipids. Gases, hydrophobic molecules, and small polar uncharged molecules can diffuse through phospholipid bilayers. Larger polar molecules and charged molecules cannot. Facilitated diffusion is the diffusion of solutes through transport proteins in the plasma membrane.

9. Do you think mitochondrion allows transportation through it? If so, discuss the process briefly.

Mitochondrion allows transportation through it.

Mitochondria are the principal site of ATP synthesis in the cell, but they also contain many metabolic enzymes. Mitochondria must also transport small metabolites across their membranes. Mitochondrial ADP/ATP carriers transport ADP into the mitochondrial matrix for ATP synthesis, and ATP out to fuel the cell.

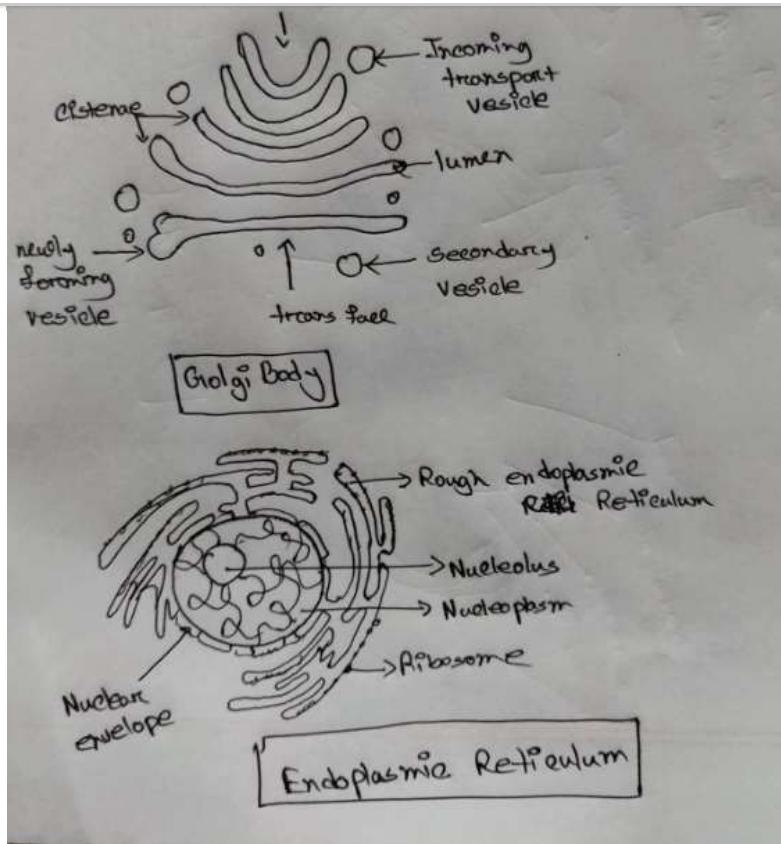
At the inner mitochondrial membrane, a high-energy electron is passed along an electron transport chain.

10. Show a pictorial view of the differences, as well as similarities between Golgi bodies and the endoplasmic reticulum.

Similarities-

Both consist of membrane-enclosed fluid-filled sacs. Both ER and Golgi apparatus is involved in the formation of the endomembrane system of the cell. They are made up of flattened, membranous, fluid-filled sacs called cisternae.

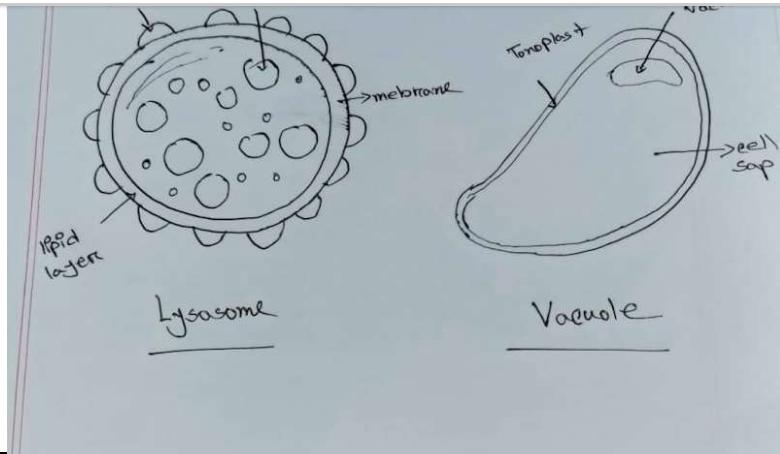
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Endoplasmic Reticulum	Golgi Bodies
Cell organelles that exist as a network of vesicles and tubules	Cell organelles exist as an arrangement of a few fluid-filled dishes
Largest organelles present in the eukaryotic cells	It is smaller compared to the endoplasmic reticulum
ER has ribosomes on its surface	Golgi apparatus does not contain ribosomes.
Synthesizes lysosomal hydrolases	Produces lysosomes
There are two sub-compartments – rough ER and smooth ER	There are no sub-compartments.
Rough ER density is high near the nucleus & rest of the ER continues with the nuclear envelope.	Golgi apparatus is not associated with the nucleus.

12. Sketch the differences, as well as similarities between Lysosomes and Vacuoles.

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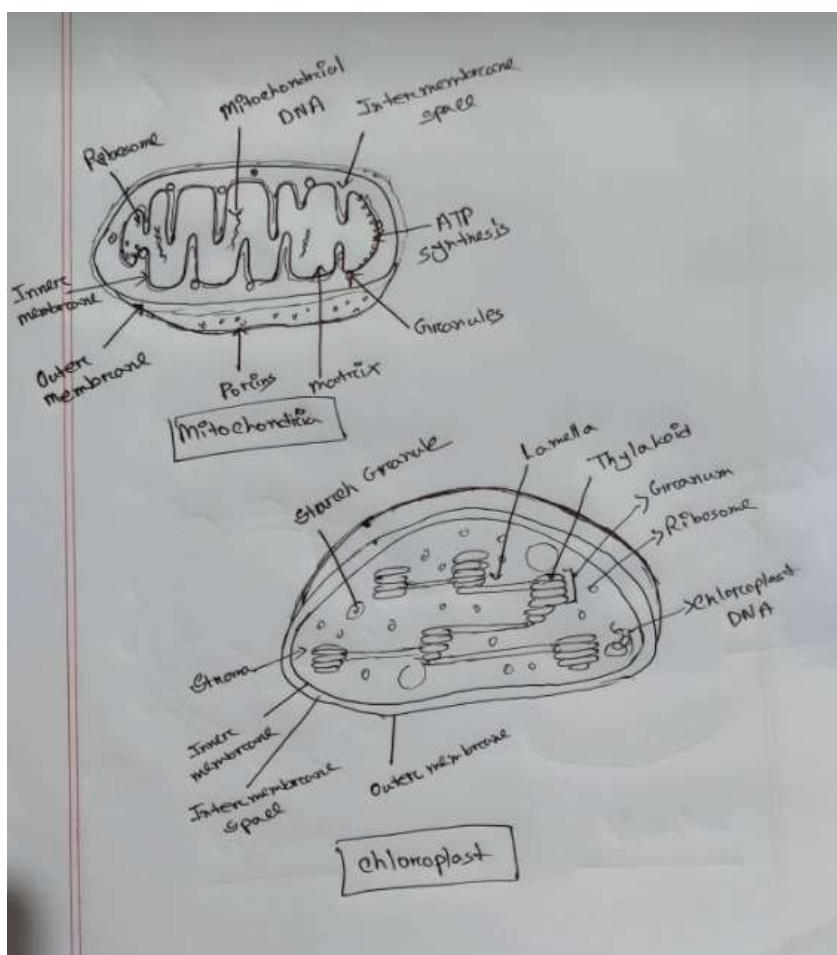


Similarities-

Both lysosome and vacuole are cell organelles. Both are surrounded by a membrane. Both are present in eukaryotic cells & are used for storage.

Dissimilarities-

Lysosomes are membrane-bound organelles that contain hydrolytic enzymes. The vacuole is a membrane-bound space found in animal and plant cells that contain, sap, water, excretory substances, etc. Lysosomes can be present in large numbers in a cell. Several small vacuoles are present in animal cells & large in plant cells.



13. Give a pictorial view of the differences between mitochondrion and chloroplast.

Mitochondria	Chloroplast

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cellular respiration.	photosynthesis takes place.
Consumes oxygen.	Releases oxygen.
Energy is released by breaking down organic food producing carbon dioxide and water.	Stores energy and uses carbon dioxide and water to produce glucose.
Mitochondrion, membrane-bound organelle found in the cytoplasm of almost all eukaryotic cells.	Present in green plants and green algae.

11. Mention the functions of the substance you think prevents the cell from shrinking.

Isotonic solutions prevent the cell from shrinking.

A solution is isotonic when its mole concentration is the same as that of the other solution means solutions have equal concentrations of solute and solvent. Here it provides the free movement of water across the membrane. The cell neither gains, else lose water which helps to prevent the cell from shrinking.

The cytoskeleton is the substance that prevents cells from shrinking.

The fundamental functions of the cytoskeleton are involved in modulating the shape of the cell, providing mechanical strength and integrity, enabling the movement of cells .

14. Name the functions of the organelle you think necessary for cell division.

Centrosomes are the organelle that is necessary for cell division. Mainly the centrioles that are part of the centrosome are the most important part of cell division.

They form asters and organize the formation of spindle fibers during cell division. Moreover, They are involved in the formation of cilia, flagella, and axial filament in sperms.

15. Which organelle works in the aging process? Mention its characteristics.

There are three types of lysosomes among them Autolysosomes (Autophagic lysosomes) work in the aging process. These are formed by the union of primary lysosome and worn-out cell organelles. They are also called suicidal bags as they destroy old and nonfunctional cells.

16. Do you think transportation is possible through Lysosomes' membrane?

Yes, transportation is possible through lysosomes. Lysosomes are membrane-bound organelles responsible for the transport and degradation of intracellular and extracellular cargo. The intracellular motion of lysosomes is both diffusive and active. Active transport of the enlarged lysosomes is not affected by the increased lysosome diameter.

Cell division

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Specifically, meiosis creates new combinations of genetic material in each of the four daughter cells. These new combinations result from the exchange of DNA between paired chromosomes. Such exchange means that the gametes produced through meiosis exhibit an amazing range of genetic variation.

2. Show a pictorial view of the phases where you might have the probabilities of the tumor, or in some cases cancer.

3. Do you think some genetic disorder can be carried through all the gametes from Meiosis? Give details in a sample diagram.

4. Mention the relations between aneuploidy and down syndrome.

5. Mention the relations between aneuploidy and polyploidy.

6. (a) Suppose you have a Persian cat with a variation of the dark brown eye, which is a dominant trait, and another one of light brown eyes. In the second generation what would be the percentage of dark brown eyes?

(b) If you had the genotype ratio of pure dark brown, mixed dark brown, and pure light brown to be 1:2:1, can you trace the parents' traits?

7. Mention the differences, as well as similarities between phenotype and genotype with proper examples.

8. Structural unit of living organisms. What are the three basic units needed to form a cell? [Hint: nucleus, cytoplasm, membrane]

9. Clarify the importance of checkpoints.

10. Mention where the nuclear envelope dissolves and forms in mitosis.

11. Differentiate the anaphase of meiosis 1 and mitosis.

12. Why is there no interphase in meiosis 2? In which phase most of the cells remain?

13. What happened in the S phase in meiosis 2?

14. Explain Interphase.

Question 14 answer:

The interphase is the longest phase in the cell cycle. The phase is called the preparatory phase and here the cell growth and DNA duplicates.

G1 phase:

- 1) Here the cell grows as the cell is metabolically active.
- 2) Here all cell organelles duplicate in this phase.
- 3) Building blocks that are required for the next phase are made in this phase
- 4) But DNA replication does not occur here.

S phase:

- 1) Here the most crucial part of the cell, the nucleus, along with some genetic material, was synthesized. Moreover, it takes up the charge of DNA replication.
- 2) Besides DR, centrosomes also get duplicated in this phase.

G2 phase:

- 1) In the G2 phase, the cell actually grows more
- 2) Here the cell also grows more protein and organelles.
- 3) The most important function is the phase that prepares the cell for the next phase means the M phase

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~~meiosis 1, the cell undergoes through the S phase so the cell duplicates, as well as the DNA, are also replicated. So in meiosis 2, there is no need for interphase. So there are no functions of the S phase in meiosis 2.~~

Question 12 answer:

Meiosis has 2 successive stages: reduction division and mitotic division. In reductive division known as meiosis 1, the cell undergoes through the G₁, S, and G₂ phases so the cell duplicates chromosome, other organelles, and enzymes as well as the DNA, are also replicated. So in meiosis 2, there is no need for interphase.

In interphase, most of the cells spend most of their time. Interphase is the phase where the cell obtains nutrients, grows, and replicates the DNA.

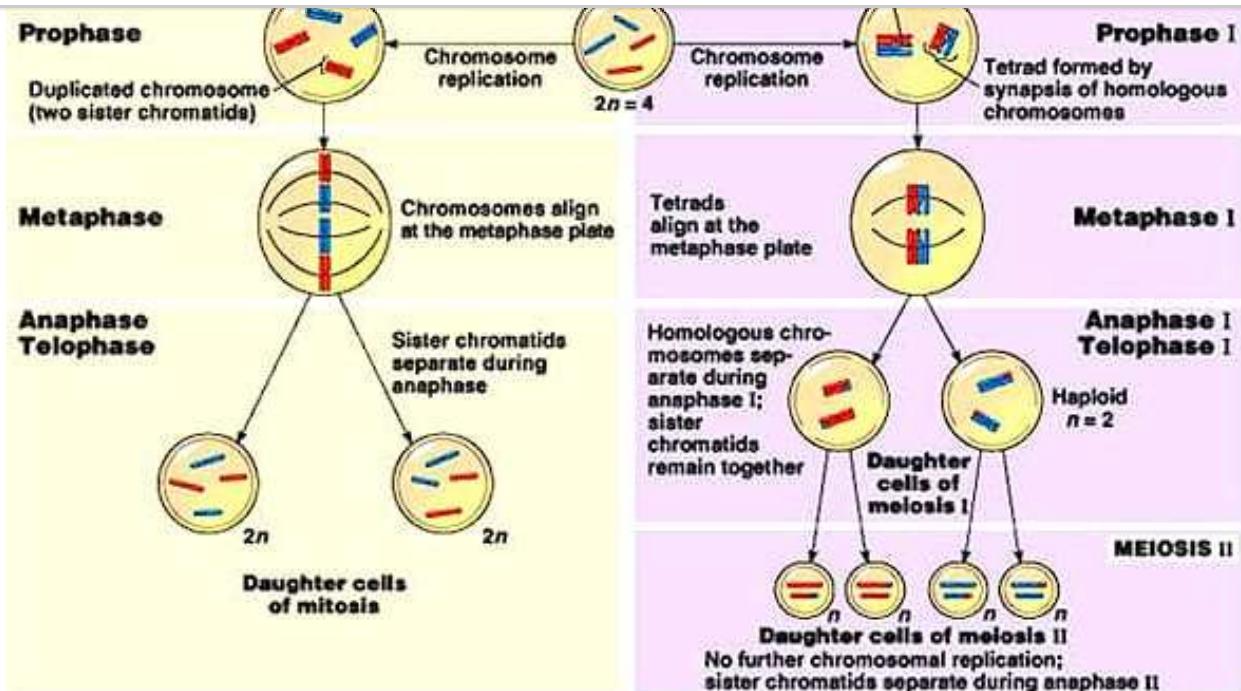
Question 11 answer:

Difference of anaphase of meiosis and mitosis:

Meiosis	Mitosis
Here 2 homologous chromosomes move to the reverse poles. The sub-phase occurs twice.	Chromosomes are long and slender. Homologous chromosomes separate.
It has two steps. Anaphase I and Anaphase II.	It has only one step.
The centromere does not divide, only the homologous chromosome divides while chromatids are attached to centromeres.	Centromere of every chromosome divides. The chromatids moving to one pole cannot be distinguished from those moving to the reverse pole.
Chromosomes of every bivalent pair divide while the sister chromatids stay together.	Here centromere splits and chromatids separate. Chromosomes move apart to the opposite poles.

Pictorial View:

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Question 10 answer:

The nuclear envelope of metazoa breaks down at the onset of mitosis and reassembles at the end of mitosis. That means at Prophase the nuclear envelope starts to dissolve and at the end of mitosis - Telophase the nuclear envelope reforms again.

Question 9 answer:

The checkpoints are the stage in which the cell examines the external and internal cues and decides whether it is applicable for moving forward of division. There are mainly two checkpoints: the G1 and G2 phases.

G1 checkpoints check mainly the cell size, nutrients, and growth factors and G2 checkpoint checks the DNA damage and DNA replication completeness.

Question 8 answer:

DNA & RNA

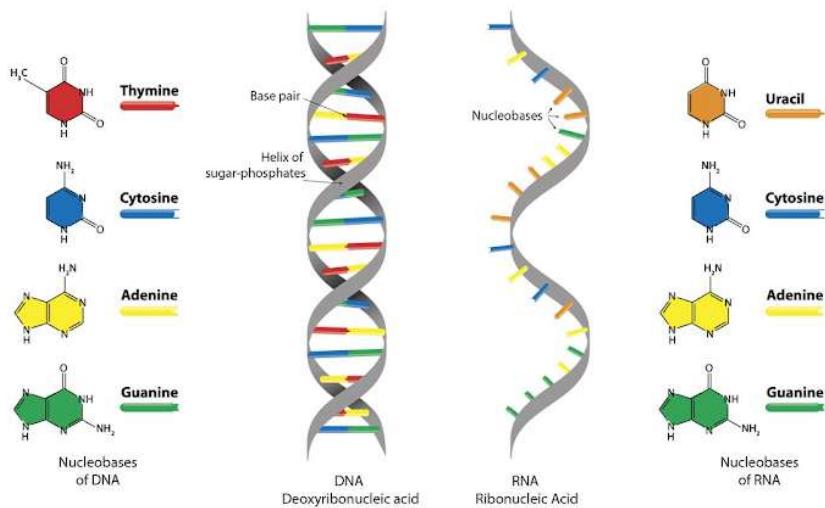
1. Mention the differences, as well as similarities between DNA and RNA.

Similarities:

1. - DNA and RNA, are made up of monomers called nucleotides.
2. - DNA and RNA both contain pentose sugars.
3. - DNA and RNA both have 3 nitrogenous bases: Adenine, Cytosine, and Guanine.
4. - DNA and RNA both have a phosphate group in their nucleotides. Sometimes called phosphoric acid.
5. - They both have the base pair of Guanine and Cytosine.
6. - They are both necessary for the cell to produce proteins.

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DNA	RNA
It is a double-stranded molecule	It is a single-stranded molecule
It is formed of long chains of nucleotides	It is formed of a shorter chain of nucleotides
It is more stable	In the ribose backbone, the hydroxyl groups make the molecules less stable
Sugar is Deoxyribose	Sugar part is Ribose.
The complementary base pairing of adenine is thymine	The complementary base pairing of adenine is uracil
DNA replicates on its own, it is self-replicating.	RNA does not replicate on its own.
DNA stores the genetic material of an organism	While RNA conveys messages.



3. Mention the characteristics of the genetic code.

The genetic code can be defined as a set of rules where the information encoded in genetic materials is translated into proteins by living cells. This code defines how codons select the amino acids that will be added during protein synthesis.

Genetic code is the sequence of nucleotides in DNA and RNA that determines the amino acid sequence of proteins.

The characteristics of genetic code is stated below:

1. Degeneracy of genetic code.
2. Non-overlapping.
3. Universality.
4. Triplet in nature.
5. Comma-less.
6. Non-ambiguous.

(D NUN CT)-shortcut

4. Name the possible combinations of genetic code where only one pyrimidine is fixed in the first position of triplets

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- ... Histidine
 2. Leucine
 3. Tyrosine
 4. Cysteine
 5. Tryptophan
 6. Proline
 7. Histidine
 8. Glutamine
 9. Arginine

5. Do you think RNA could be your genetic material? Give logic behind your answer.

Yes RNA could be my genetic material. RNA is a molecule with a long chain of nucleotides. RNA could be a genetic material because it is able to generate its replica as well as it is stable. Moreover, RNA can directly code for the synthesis of proteins and hence can easily express the characters.

RNA is the first genetic material in cells because RNA is capable of both storing genetic information and catalyzing chemical reactions. Essential life processes like metabolism, translation, splicing, etc.

6. What codons can you have after fixing Adenine in the first place and Cytosine and Uracil in the second place?

We can get three types of codon:

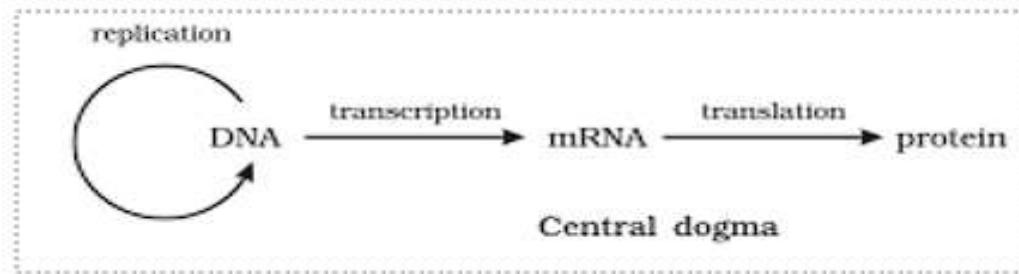
1. Isoleucine
2. Methionine
3. Threonine

7. How do you think a DNA of some meters can be fitted inside a cell of nm scale?

The negatively charged DNA is packaged by the positively charged histone octamer. A structure called nucleosome is formed. The DNA is packed in the chromatin of eukaryotes.

DNA is tightly packed up to fit in the nucleus of every cell. DNA molecules wrap around histone proteins to form tight loops called nucleosomes. These nucleosomes coil and stack together to form fibers called chromatin.

8. Sketch a diagram for the central dogma of life.



9. Is there any significance of a nucleotide? Give proper reasons.

Nucleotides are essential for the replication of DNA and transcription of RNA in rapidly dividing stages. They are also essential for providing cellular energy like ATP and GTP.

10. How many base pairs of a 2.2m long DNA has?

In a human cell with 46 chromosomes in its nucleus, there are approximately 6.4 billion base pairs. Each of these base pairs has a length of about 0.34 nm. Thus, the length of the total amount of DNA in a diploid cell would have a length of about 2.2 m.