

UPDATED: 15-08-2023 at 7:59PM

BIO201 FINAL TERM- 100%

SUBJECTIVE GUESS PAPER

2023 CELL BIOLOGY

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0341-7547044

SUBJECTIVE

What is primary culture?

Primary culture refers to the stage of the culture after the cells are isolated from the tissue and proliferated under the appropriate conditions until they occupy all of the available substrate (i.e., reach confluence). After the first subculture, the primary culture becomes known as a cell line or subclone.

Pure culture:

A pure culture is a controlled laboratory environment containing only one species of microorganism, ensuring genetic uniformity for research, identification, and industrial applications.

Name 5 major growth promoting oncogenes?

RAS, 2= MYC, 3= EGFR, 4= BRAF, 5= ABL

How DNA is packaged in Cell.

DNA is tightly packed up to fit in the nucleus of every cell. As shown in the animation, a DNA molecule wraps around histone proteins to form tight loops called nucleosomes. These nucleosomes coil and stack together to form fibers called chromatin.

Function of TH1 and TH2:

TH1 activates cell-mediated immunity; TH2 stimulates humoral immunity. Both coordinate immune responses and regulate inflammation and allergies. TH1 cells mainly help activate macrophages and cytotoxic T cells, whereas TH2 cells mainly help activate B cells.

Function of ERGIC3:

ERGIC3, an ER-Golgi intermediate compartment protein, aids in protein trafficking and glycosylation, ensuring proper folding and transport of cargo between endoplasmic reticulum and Golgi apparatus in cells.

What are the types of MHC molecules?

Major Histocompatibility Complex (MHC) has two main classes: MHC-I presents intracellular antigens to CD8+ T cells, while MHC-II displays extracellular antigens to CD4+ T cells, crucial for immune recognition.

Define Laminar flow cabinet principle and function?

Function: Provides sterile working area where cells can be handled without worrying about contamination.

Principal: In a laminar flow hood the air is passed through a HEPA (High Efficiency Particulates Air) filter which removes all airborne contamination to maintain sterile conditions. ... Now the sterile air flows into the working (flasking) area where you can do all your flasking work without risk of contamination.

How T cells are activated:

Antigen-presenting cells (APCs) like dendritic cells display antigens via MHC molecules. T cell receptor binding to antigen-MHC complex, along with co-stimulation, triggers T cell activation for immune response.

What take place at synapse in neuromuscular system.

At the neuromuscular synapse, an action potential in the motor neuron triggers calcium influx, leading to acetylcholine release. Acetylcholine binds to receptors on muscle cells, initiating muscle contraction.

Write the stage of metaphase:

Metaphase is a stage of cell division where chromosomes align at the cell's equator, guided by spindle fibers. Ensures proper chromosome segregation during mitosis/meiosis for genetic stability.

Steps of RNA processing?

The eukaryotic pre-mRNA undergoes extensive processing before it is ready to be translated.

1= 5' Capping. 2= 3' Poly-A Tail. 3= Pre-mRNA Splicing. 4= Discovery of Introns. 5= Intron Processing.

Differentiate in hormonal immunity and cellular immunity:

Hormonal immunity involves antibodies produced by B cells to neutralize pathogens in bodily fluids. Cellular immunity engages T cells to recognize and destroy infected cells directly, critical for intracellular pathogens and cancer surveillance.

Differentiate between DNA and RNA:

Feature	DNA	RNA
Structure	Double-stranded helix	Usually single-stranded
Sugar	Deoxyribose	Ribose
Bases	Adenine, Thymine, Cytosine, Guanine	Adenine, Uracil, Cytosine, Guanine
Function	Genetic information storage	Various roles: messenger, ribosomal, etc.
Location	Found in the nucleus	Found in the nucleus and cytoplasm
Types	Only one main type (genomic DNA)	Several types (mRNA, tRNA, rRNA, etc.)
Stability	More stable due to thymine base	Generally less stable

Write strategies of transcription regulation:

Transcription regulation involves enhancers, silencers, transcription factors, and epigenetic modifications. Modulating promoter accessibility, RNA polymerase binding, and elongation control gene expression for cellular functions and responses.

Write a note on clonal selection.

Clonal selection is a central concept in immune response. Antigen-specific lymphocytes are activated, proliferate into identical clones, and differentiate to combat the recognized pathogen, ensuring tailored immunity.

What is the role of cAMP kinesis in structural movement:

Cyclic AMP (cAMP) is a second messenger that triggers protein kinase A (PKA) activation. PKA phosphorylates specific proteins, influencing their structure and function. This dynamic phosphorylation-driven structural alteration regulates processes like cell motility, muscle contraction, and synaptic plasticity, facilitating movement and physiological responses.

Difference between mitosis and meiosis:

Mitosis divides one cell into two genetically identical diploid cells, crucial for growth and repair. Meiosis generates four genetically diverse haploid cells, facilitating sexual reproduction and maintaining genetic diversity.

How protein transfer into mitochondria.

Proteins enter mitochondria through the translocase complexes. Precursor proteins, guided by targeting sequences, interact with translocases in outer and inner membranes, facilitating their import into specific mitochondrial compartments.

Paracrine signaling

Paracrine signaling is a form of cell-to-cell communication in which a cell produces a signal to induce changes in nearby cells, altering the behavior of those cells.

Why cell is important;

Cells provide structure and function for all living things, from microorganisms to humans. Scientists consider them the smallest form of life. Cells house the biological machinery that makes the proteins, chemicals, and signals responsible for everything that happens inside our bodies.

Define Genetic engineering?

Genetic engineering is the process of manually adding new DNA to an organism. The goal is to add one or more new traits that are not already found in that organism.

Autonomous Cell Growth factors:

RAS family (KRAS, NRAS, HRAS), MYC, EGFR, BRAF, PI3K, SRC, ABL

Sheep cloning:

Sheep cloning, like Dolly the sheep, involves transferring the nucleus of a somatic cell into an enucleated egg, generating a genetically identical clone through somatic cell nuclear transfer (SCNT).

Physical parameter for enzymatic reaction:

Enzymatic reactions are influenced by factors like temperature, pH, substrate concentration, and enzyme concentration. These physical parameters affect enzyme activity, reaction rate, and efficiency in biological processes.

Properties of prokaryotic cell:

Prokaryotic cells lack a true nucleus and membrane-bound organelles, have a simple structure, small size, and are found in bacteria and archaea. They contain genetic material in the form of a single circular chromosome.

What is the receptor region:

The receptor region is a specialized part of a cell or organism that contains specific receptors, which are proteins or molecules that bind to external signals, allowing the cell to respond to its environment.

What is the N-terminal signaling and Function of n terminal signaling of ER:

N-terminal signaling refers to a signal sequence present at the N-terminus of a newly synthesized protein. In the context of the endoplasmic reticulum (ER), this signal guides the protein to the ER for proper folding, modification, and targeting to specific cellular compartments or secretion outside the cell.

Properties of immune system:

The immune system is a complex network of cells, tissues, and organs that defends the body against pathogens and foreign substances. It exhibits specificity, memory, diversity, self-tolerance, and the ability to distinguish self from non-self antigens.

Cytotoxic and helper T Cell difference:

Cytotoxic T cells (also known as CD8+ T cells) directly attack and destroy infected or abnormal cells. Helper T cells (CD4+ T cells) aid in the immune response by secreting cytokines, stimulating B cells and cytotoxic T cells, and enhancing immune coordination.

Function of ERGIC53:

ERGIC53 (Endoplasmic Reticulum-Golgi Intermediate Compartment 53) is a protein involved in the retrograde transport of certain cargo proteins from the Golgi apparatus back to the endoplasmic reticulum, ensuring their proper localization and functioning within the cell. The ERGIC53 protein serves as a receptor for packaging some secretory proteins into COPII coated vesicles.

Properties of cell membrane:

The cell membrane, also known as the plasma membrane, is a semipermeable barrier that surrounds the cell, separating its internal contents from the external environment. It is composed of a phospholipid bilayer with embedded proteins. The membrane regulates the passage of substances in and out of the cell, maintaining homeostasis. It allows the selective transport of molecules, facilitates cell signaling, cell adhesion, and recognition. Additionally, the cell membrane is dynamic, capable of changing its fluidity and composition to adapt to various cellular needs.

Uv sterilization:

UV sterilization also known as UV disinfection or ultraviolet germicidal irradiation (UVGI) UV sterilization is a disinfection method that utilizes ultraviolet (UV) light to inactivate or destroy microorganisms by damaging their DNA or RNA. and proteins, causing a microorganism to be unable to multiply. Ultraviolet (UV) radiation, under certain conditions, serves as an excellent sterilant. Bacteria, yeasts, molds and viruses are readily inactivated, provided the cells are accessible to a sufficient UV dose. The biocidal effectiveness of UV radiation emitted from three different lamps was determined.

Types of oncogenes:

Oncogenes are genes that, when mutated or activated, contribute to the development of cancer. There are several types of oncogenes, including receptor tyrosine kinases (e.g., HER2), cytoplasmic tyrosine kinases (e.g., ABL), GTP-binding proteins (e.g., RAS), transcription factors (e.g., MYC), and cell cycle regulators (e.g., CDK4). These genes promote cell growth, inhibit apoptosis, and disturb normal cellular processes, leading to uncontrolled cell proliferation and tumor formation, making them important targets for cancer therapies.

Regulatory region:

The regulatory region, also known as the regulatory sequence or promoter region, is a specific segment of DNA located upstream of a gene. It plays a crucial role in controlling the gene's

transcription and expression by binding to transcription factors and other regulatory proteins. The regulatory region determines when and where the gene is activated or repressed, ensuring precise regulation of gene expression in response to various cellular signals and environmental cues. Regulation of gene expression is an essential feature of all living organisms and viruses.

What are the main functions of ER?

The main functions of the endoplasmic reticulum (ER) include protein synthesis, folding, and modification, lipid metabolism, calcium storage, and detoxification of drugs and toxins. The ER plays a vital role in maintaining cellular homeostasis and ensuring proper functioning of the cell.

Difference between T cells and B cells?

T cells mature in the thymus and respond to antigens presented by other cells, directly attacking infected or abnormal cells. B cells mature in the bone marrow and produce antibodies that bind to antigens, helping to neutralize pathogens and marking them for destruction. Both play crucial roles in the adaptive immune system's defense against infections and diseases.

What are the components of PCr?

Phosphocreatine (PCr) consists of three components: a creatine molecule, a phosphate group, and a high-energy bond between them. PCr serves as a rapidly mobilizable reserve of phosphate groups to regenerate ATP during high-intensity muscle contractions.

Discuss the step of mitosis:

Mitosis involves several steps:

1. **Interphase**: DNA replication occurs.
2. **Prophase**: Chromatin condenses into visible chromosomes.
3. **Prometaphase**: Nuclear envelope breaks down, spindle fibers attach to chromosomes.
4. **Metaphase**: Chromosomes align at the equator.
5. **Anaphase**: Sister chromatids separate and move to opposite poles.
6. **Telophase**: Nuclear envelopes reform, chromosomes decondense.
7. **Cytokinesis**: Cell divides into two daughter cells.

What are adult stem cells their benefits and therapeutic use?

Adult stem cells are undifferentiated cells found in various tissues of the body. They possess the potential to differentiate into specialized cell types. Beneficial and therapeutic uses include tissue regeneration and repair, such as in bone marrow transplants for blood-related disorders, treatment of degenerative diseases like Parkinson's, and repairing damaged tissues in conditions like heart disease or spinal cord injuries. Adult stem cells offer promising avenues for personalized medicine and regenerative therapies to improve patients' health and quality of life.

What is the lytic complement system?

The lytic complement system is a part of the immune system that helps destroy pathogens by forming membrane attack complexes. These complexes puncture target cells, leading to their lysis and elimination.

Role of rod cells:

Rod cells are photoreceptor cells in the retina responsible for night and peripheral vision. They detect dim light, providing black-and-white vision and aiding in detecting motion and shapes in low-light conditions.

Define Cryoprotectant and give one example:

A cryoprotectant is a substance that protects biological materials from damage caused by freezing temperatures. It prevents the formation of ice crystals that can harm cells during cryopreservation. An example is glycerol, commonly used in laboratories to protect cells, tissues, and organs when frozen for storage or transportation.

Give names of 5 sub classes of human IgG:

Four human IgG subclasses (IgG1, IgG2, IgG3, and IgG4), having $\gamma 1$, $\gamma 2$, $\gamma 3$, and $\gamma 4$ heavy chains, respectively. IgG5 is not well-established subclass.

Define the following give an example: 1= Incomplete dominance, 2= Co dominance, 3= Epistasis.

Incomplete dominance: Inheritance pattern where neither allele completely dominates over the other, resulting in an intermediate phenotype. For example, in snapdragons, a red and white allele blend to produce pink flowers.

Co-dominance: Both alleles are expressed simultaneously, leading to the appearance of both traits in the phenotype. An example is the ABO blood group system, where A and B alleles are co-dominant, resulting in AB blood type.

Epistasis: One gene's expression masks or modifies the effect of another gene. For instance, in coat color of mice, the gene controlling pigment production (B) can be influenced by another gene (A) that determines whether pigment will be deposited in the hair, leading to various coat colors.

Functions of signaling system:

The signaling system in living organisms coordinates communication between cells, regulates physiological processes, facilitates cell growth and differentiation, maintains homeostasis, enables rapid responses to stress, and contributes to adaptation, memory, and learning.

Differentiate between confluent monolayer and post confluent stage.

A confluent monolayer is a layer of cells in a culture that has reached full coverage of the growth surface without overlapping or forming multiple layers. At this stage, cells are in contact with each other but do not overlap. In contrast, the post-confluent stage occurs when cells continue to grow after reaching confluency. This results in multilayered growth, where cells stack on top of each other, leading to reduced cell-to-cell contact and altered cellular behavior, which can affect experimental outcomes in cell culture studies.

Regulator proteins and their types:

Any protein that influences the regions of a DNA molecule that are transcribed by RNA polymerase during the process of transcription. These proteins, which include transcription factors, therefore help control the synthesis of proteins in cells.

Types: The major regulatory thin-filament-associated proteins are tropomyosin (TM) and caldesmon (CaD), which associate with 14 actin monomers in ratios 2:1 (13).

Homotypic and heterotypic fusion:

Homotypic fusion involves the merging of membrane-bound structures of the same type, such as the fusion of vesicles with the same vesicle population or the fusion of two similar organelles like endoplasmic reticulum (ER) tubules with other ER tubules. This process contributes to organelle growth and maintenance.

Heterotypic fusion occurs between different membrane-bound structures. An example is the fusion of endosomes with lysosomes, enabling the delivery of material for degradation and recycling. Such fusions play vital roles in cellular trafficking and membrane compartmentalization.

Write five names of growth promotor oncogenes?

1= Ras, 2= Myc, 3= HER2 (Human Epidermal Growth Factor Receptor 2), 4= EGFR (Epidermal Growth Factor Receptor), 5= Bcl-2 (B-cell lymphoma 2).

Define Endocytosis and phagocytosis and pinocytosis and Exocytosis?

Endocytosis is a cellular process in which cells internalize molecules or particles from the external environment by forming vesicles from the plasma membrane. **Phagocytosis** is a specific type of endocytosis where cells engulf large solid particles, such as pathogens or cellular debris. **Pinocytosis**, another type of endocytosis, involves the non-specific uptake of fluids and dissolved solutes by forming small vesicles. **Exocytosis** is a cellular process where vesicles containing cellular materials fuse with the cell membrane, releasing their contents outside the cell. It is essential for secretion and cell communication.

How &-blocker effect the function of adrenaline?

Beta-blockers block the beta-adrenergic receptors in cells, reducing their response to adrenaline (epinephrine). This results in decreased heart rate, blood pressure, and contractility, counteracting the effects of adrenaline and providing therapeutic benefits in conditions like hypertension and certain heart conditions.

Which phase of cell division is opposite to enter phase and how ?

The phase of cell division opposite to the enter phase (G1 phase) is the Exit phase (G0 phase). In G0 phase, cells temporarily or permanently stop dividing and become quiescent or differentiated, not actively progressing through the cell cycle.

Components of Cellular Membrane?

The principal components of the cell membrane are:

1= Lipids 2= Phospholipids 3= Cholesterol 4= Proteins 4= carbohydrate groups that are attached to some of the lipids and proteins.

Structure of antibody?

Antibodies, also known as immunoglobulins, have a Y-shaped structure composed of four polypeptide chains: two heavy chains and two light chains. The tips of the Y-shaped arms contain antigen-binding sites that recognize and bind to specific foreign substances, facilitating immune responses.

Describe immune system?

The immune system is a complex network of cells, tissues, and organs that work together to defend the body against harmful pathogens, foreign invaders, and abnormal cells, protecting the body from diseases and infections.

Describe the two signalling functions of N-terminal ER signal sequence of a soluble protein?

The N-terminal ER signal sequence of a soluble protein has two signalling functions:

1= It directs the protein to the ER membrane, 2= It serves as a start-transfer signal (or start-transfer peptide) that opens the pore.

Mitochondria function:

Mitochondria function as the powerhouse of the cell, producing ATP through cellular respiration. They play a role in energy generation, cell apoptosis, and cellular signaling pathways in eukaryotic cells.

Regulators proteins and their two elements:

Regulator proteins control various cellular processes. Two key elements are:

1= Transcription factors: Bind to DNA, modulating gene expression.

2= Kinases: Add phosphate groups to proteins, regulating their function through phosphorylation.

These proteins govern essential functions like cell signaling, cell cycle regulation, and gene expression, ensuring proper cellular coordination.

Purine and pyrimidine:

Purines and pyrimidines are nitrogenous bases found in DNA and RNA, the genetic material of living organisms. Purines, such as adenine and guanine, have a double-ring structure, while pyrimidines, like cytosine, thymine (in DNA), and uracil (in RNA), possess a single-ring structure.

CaM kinase II involve in muscular movement:

1. CaM kinase II is a calcium/calmodulin-dependent protein kinase found in muscles.
2. It is activated by an increase in intracellular calcium during muscle contraction.
3. Upon activation, it phosphorylates target proteins involved in muscle function.
4. CaM kinase II regulates muscle contraction and relaxation processes.
5. Dysregulation of CaM kinase II activity can lead to muscle-related disorders and diseases.

Lectin pathway complement system regulation:

The lectin pathway is a part of the complement system that recognizes and binds to certain carbohydrates on the surface of pathogens. Regulatory proteins, like C1 inhibitor, protect host cells from complement activation, preventing excessive immune responses. Proper regulation ensures a balanced and controlled immune response without harming healthy cells.

What is loading dye and why it is used in agarose gel electrophoresis?

Loading dye is a solution containing tracking dyes used in agarose gel electrophoresis. It adds color and density to the DNA or RNA samples, making them visible during gel loading and migration. The dyes also help monitor the progress of electrophoresis and determine the size of nucleic acid fragments. For example: bromophenol blue and xylene cyanol.

What are PCR applications?

1) DNA Fingerprinting 2) Genotyping 3) Genomic Cloning 4) Gene expression studies 5) Drug discovery 6) classification of organisms etc

Role of lipid:

Lipids play crucial roles in the body, serving as a source of energy, forming cell membranes, facilitating nutrient absorption, supporting hormone production, and acting as signaling molecules in cellular processes.

Function of Golgi apparatus:

The Golgi apparatus modifies, sorts, and packages proteins and lipids received from the endoplasmic reticulum. It plays a key role in intracellular transport and secretion of proteins to their appropriate destinations.

Standard PCR reagents:/ Main components of PCR/ requirements of PCR:

1= DNA, 2= Primers R-F, 3= Taq Polymerase, 4= Buffer Taq, 5= Mgcl₂, 6= dNTPs, 7= Water.

Write a note on PCR:

PCR, or Polymerase Chain Reaction, is a widely used technique in molecular biology for amplifying specific DNA sequences. It enables the rapid and efficient production of millions of copies of a target DNA segment. The process involves three main steps: denaturation, where the DNA template is heated to separate the double-stranded DNA; annealing, where specific primers bind to the DNA template; and extension, where DNA polymerase synthesizes new DNA strands. PCR has revolutionized various fields, including genetics, forensics, and diagnostics, allowing for the detection of diseases, identification of genetic variations, and cloning of DNA. Its speed, sensitivity, and specificity make PCR an invaluable tool in modern molecular research.

Define Cell cycle:

The cell cycle is a series of events in a cell's life, involving growth, replication of DNA, and division, resulting in the formation of two daughter cells with identical genetic information.

Write a short note on transcription:

Transcription is a crucial process in gene expression, where the genetic information encoded in DNA is transcribed into RNA. It occurs in the nucleus, where RNA polymerase binds to a specific DNA region called the promoter and synthesizes a complementary RNA strand based on the DNA template. This newly formed RNA, known as messenger RNA (mRNA), carries the genetic code to the ribosomes in the cytoplasm for translation into proteins, facilitating various cellular functions and processes.

What are the importers, symporters and antiporters. how we can differentiate them:

Importers, symporters, and antiporters are types of transport proteins involved in moving molecules across cellular membranes. **Importers facilitate** the unidirectional transport of specific molecules. **Symporters simultaneously** transport two different molecules in the same direction, utilizing the energy generated by the electrochemical gradient of one molecule. **Antiporters transport** two different molecules in opposite directions, harnessing the energy from concentration gradients or membrane potential.

To differentiate them, consider the direction and coupling of transported molecules. Importers transport a single molecule in one direction, symporters transport two molecules in the same direction, and antiporters transport two molecules in opposite directions. The direction and energy coupling mechanism distinguish these transporters and their roles in cellular transport processes.

Types of meiosis I:

Meiosis I involves two types of cell divisions:

1= Prophase I - homologous chromosomes pair up, undergo crossing-over, and spindle fibers form.

2= Metaphase I, Anaphase I, Telophase I - homologous chromosomes align, separate, and two haploid daughter cells are produced.

What is the gel electrophoresis

Gel electrophoresis is a laboratory technique used to separate and analyze molecules, such as DNA, RNA, or proteins, based on their size and charge. The molecules are loaded onto a gel matrix and subjected to an electric field, causing them to migrate through the gel. Smaller molecules move faster and are separated from larger ones, allowing researchers to visualize and study them.

Types of RNA and function:

Types of RNA include:

1. **Messenger RNA (mRNA):** Carries genetic information from DNA to ribosomes for protein synthesis.
2. **Transfer RNA (tRNA):** Transfers amino acids to ribosomes during protein synthesis.
3. **Ribosomal RNA (rRNA):** A component of ribosomes that catalyzes protein synthesis.
4. **Small nuclear RNA (snRNA):** Involved in RNA splicing during gene expression.

Write the role of protein in living organisms:

Proteins play a crucial role in living organisms. They serve as structural components, providing support and shape to cells, tissues, and organs. Proteins are involved in enzymatic reactions, catalyzing metabolic processes. They participate in cell signaling, transmitting signals within and between cells. Proteins contribute to immune function, acting as antibodies to defend against pathogens. They transport molecules across cell membranes and within the bloodstream. Additionally, proteins are involved in gene expression, regulating the transcription and

translation processes. Overall, proteins perform diverse functions essential for the proper functioning and survival of organisms.