EVOLUTION

Multiple molecular mechanisms, including DNA damage and errors in replication, lead to the generation of random mutations. These mutations create new alleles that can be inherited via mitosis, meiosis, or cell division.

Mutations and epigenetic modifications can impact the regulation of gene expression and the structure and function of the gene product. If mutations affect phenotype and/or the structure and/or regulation can result in different types of cells depending on its location, and may alter phenotype.

Developmental Biology

Principles: All living organisms share a common ancestor. Species evolve over time, and new species can arise, when allele frequencies change due to natural selection, gene flow, and genetic drift.

The structure of a cell’s genetic material, membrane, organelles, cytoskeleton, and polarity impacts its function.

Physiological functions are often compartmentalized into different cells, tissues, organs, and systems, which have structures that support specialized activities.

The size, shape, and physical properties of organs and organisms all affect function. The ratio of surface area to volume is particularly critical for structures that exchange materials and heat.

The structure of molecules or molecular arranging may be similar in common ancestry or selection for similar function.

Structure constrains function in phylogeny; specialization for an organ's or organism's local and/or cell lineage.

Cell energy cannot be created or destroyed, but can be changed from one form to another. Energy captured by primary producers is necessary to support the evolution of efficient use of resources within constraints.

Energy captured by primary producers is stored as chemical energy. This stored energy can be converted into ATP for immediate use in the cell.

Energy captured by primary producers is stored as chemical energy. Each trophic level in the food chain also uses negative feedback to control its own population size and to maintain ecosystem stability.

Ecosystems are not isolated and they respond to change in many different ways. As a result of environmental changes, species may maintain homeostasis through negative feedback mechanisms that use negative feedback; others have adaptations that allow them to acclimate to environmental variation.

BIOLOGICAL SCALE

Most cases, genetic information flows from DNA to RNA to protein but there are important exceptions.

Information stored in DNA is expressed as RNA and proteins. These genes products impact anatomical structures and physiological function.

Individuals transmit genetic information to their offspring; some alleles confer higher fitness than others in a particular environment.

Organisms have sophisticated mechanisms for sensing changes in the internal or external environment. They use chemical, electrical, or other forms of signaling to coordinate responses at the cellular, tissue, organ, and/or system level.

The signals that a cell receives depend on its location, and can change through time. As a result, different types of cells express different genes, even though they contain the same DNA.

Sensory expression and protein activity are regulated by intracellular and extracellular signaling molecules. Signal transduction pathways are crucial in relaying these signals.

Genes interact with their environment; some alleles confer higher fitness than others in a particular environment.

A gene's functionality is dependent on its translation, which is a process that converts the genetic code in DNA into functional protein.

The synthesis and breakdown of molecules is highly regulated. Biochemical pathways usually involve multiple reactions catalyzed by enzymes that lower free energy resulting from exergonic reactions or drive biochemical reactions to occur in the cell.

Under the influence of biochemical reactions and other constraints, physiological processes are nearly 100% efficient.

Due to the inefficiency of biochemical reactions and other constraints, physiological processes are nearly 100% efficient.

Chemical elements are involved in a wide variety of metabolic processes. They are essential for life, and can be transferred among the abiotic and biotic components of an ecosystem; changes in the amount and distribution of chemical elements can impact the ecosystem.

For MORE INFORMATION:

We used a grassroots approach to generate the BioCore Guide. We began with faculty ideas and engaged in an iterative process that incorporated feedback from over 240 biologists and biology educators at a diverse range of academic institutions throughout the U.S. The final validation step demonstrated strong national consensus, with over 90% of respondents agreeing with the importance and scientific accuracy of the statements.