

MCDB 1150-Introduction to Molecular and Cellular Biology: Course Learning Goals

After completing an introductory MCDB course, students should be able to:

1. Explain what makes living organisms unique among the complex systems we are familiar with, in terms of how they process information, matter, and energy, and indicate whether both living and non-living things obey the same laws of chemistry and physics.
2. Contrast the features that distinguish viruses, bacterial cells, and eukaryotic cells from each other.
3. Explain the theory of evolution through variation and natural selection, and cite evidence that it is an ongoing process affecting our daily lives.
4. Recognize structures of the four major classes of building-block molecules (monomers) that make up cellular macromolecules and membranes.
5. Describe how the properties of water affect the three-dimensional structures and stabilities of macromolecules, macromolecular assemblies, and lipid membranes.
6. Distinguish between equilibrium, non-equilibrium, and steady-state biochemical systems using flow diagrams, and indicate which of these systems can explain the homeostasis that living organisms exhibit.
7. Outline the flow of matter and energy in the processes by which organisms fuel growth and cellular activities, and explain how these processes conform to the laws of thermodynamics.
8. Explain how an enzyme increases the rate of a biochemical reaction in terms of thermodynamics and molecular interactions.
9. Explain how coupled reactions allow an energetically favorable process (e.g. ATP hydrolysis) to drive an energetically unfavorable process (e.g. phosphodiester bond formation).
10. Explain the importance of membranes in compartmentalizing cellular activities and describe the essential functions that are carried out by the major organelles in a eukaryotic cell.
11. Using diagrams, describe in general terms how the information in a gene is stored, accessed for expression of a specific protein, replicated, and transmitted to daughter cells.
12. Describe the general mechanism by which chemical signals from outside a cell are transduced across the cell membrane to influence cell behavior and gene expression.

13. Explain in general terms how different types of cells in the same organism can produce different proteins, even though all cells carry the same DNA sequence information.
14. Explain the roles of the soma and the germ line in the life cycle of a typical multicellular organism.
15. Describe, using diagrams, the process of meiosis, and explain how it contributes to genetic diversity.
16. Given a well-designed scientific experiment, identify the positive and negative controls and explain their purpose.
17. Analyze and draw conclusions from numerical and graphical data.
18. Explain the difference between a hypothesis and a theory.