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Midterm I

Week 1

- ▷ What are the two central questions of physiology?
- ▷ Describe the different sub-disciplines of physiology.
- ▷ What is the Krogh principle? Explain what it means to physiology.
- ▷ Define the terms conformity and regulation and understand how they relate to physiological processes. Discuss examples.
- ▷ Define the term homeostasis. Understand the process of negative and positive feedback regulation.
- ▷ Describe how physiology changes with time in response to the external environment. Define the terms acclimation, adaptation, natural selection, and evolution.
- ▷ Describe the structure and chemical components of lipid membranes.
- ▷ What are the effects of low and high temperatures on membranes? How are membrane properties altered to offset these effects?
- ▷ Describe the five functional types of membrane proteins and their basic functions.
- ▷ What are the two primary roles of enzymes?
- ▷ Define the terms V_{\max} and K_m . Explain the factors that affect these reaction properties.
- ▷ Define activation energy. Understand the effect of enzyme catalysis on a reaction's energy of activation.
- ▷ What are the effects of substrate concentration on the rate of an enzymatic reaction? How does enzyme-substrate affinity affect the reaction rate?
- ▷ Why are enzymatic rates unresponsive to increases in substrate concentration above a physiologically relevant range?
- ▷ Understand why conformational change is a critical part of enzyme function.
- ▷ Define the term isozyme and understand how they can contribute to natural selection.
- ▷ Define and understand the process of allosteric modulation.

Week 2

- ▷ Define the terms transcription, translation, and post-translational processing. Understand the differences between rRNA and mRNA and introns and exons.
- ▷ Understand how to interpret information about the origin of physiological traits from a phylogenetic tree.
- ▷ Define the terms genome and genomics. Describe the methods, challenges, and major goals of genomics research.
- ▷ Describe an example for each major mechanism of gene modification, e.g. mutation accumulation, deletions, gene duplication.
- ▷ What does the phrase “from genotype to phenotype” mean? What are the limitations associated with this phrase?
- ▷ Define the terms transcriptome and transcriptomics. Describe the methods and challenges of transcriptomics research. How can the function of a gene’s expression be tested?
- ▷ Define the terms proteome and proteomics. Why is proteomics treated as a separate discipline rather than being lumped together with genomics and transcriptomics?
- ▷ What is two-dimensional gel electrophoresis? What kinds of data does it generate? How is it used in proteomics research?
- ▷ Define the term metabolomics. How does it differ from the other “omics” disciplines?
- ▷ Define the term epigenetics. Are epigenetic changes heritable from cell to cell? From parents to offspring? Explain.
- ▷ Identify the two major mechanisms of epigenetic change and their consequences on gene transcription.

Week 3

- ▷ Define and describe the different types of passive and active solute transport. Understand how and why they differ from each other.
- ▷ Define: equilibrium, concentration gradient, electrical gradient, electrochemical gradient, electrogenic, and electroneutral.
- ▷ Understand the forces imparted on ion movement as a result of reinforcing and opposing electrochemical gradients.
- ▷ Define the Fick diffusion equation and be able to use it to calculate a rate of diffusion.
- ▷ What are the major limitations of diffusion as a transport mechanism?
- ▷ What is a boundary layer and how does it impact diffusion?
- ▷ Describe the basic characteristics of the electrochemical environment for a typical animal cell. Na^+ and K^+ ion channels and the $\text{Na}^+ - \text{K}^+$ ATPase pump affect/regulate these characteristics?
- ▷ Describe the different types of gated ion channels and their function in ion transport.
- ▷ Understand the concept of potential energy stored in an electrochemical gradient.
- ▷ What are cotransporters and countertransporters?
- ▷ What are the major mechanisms that generate diversity in transporters and/or modulate their function? Provide examples for each.
- ▷ What are colligative properties? List and define the major colligative properties important to physiology.
- ▷ Define osmosis and understand how osmotic pressure is generated and measured.
- ▷ Define the terms hyperosmotic, isosmotic, and hyposmotic.
- ▷ Understand the different effects electrolytes and organic molecules have on osmotic pressure.
- ▷ Describe the mechanisms of water transport.
- ▷ How is cell volume affected by its environment?