Cell Physiology - Seminar Topics I

(8.10.2026 from 18:00-19:30 I group Library room 104)

Course: Physiology, 2nd year, Medicine (MD programmed)

Format: 10-minute student presentation + 5 min discussion

Required reading: Silverthorn, Human Physiology: An Integrated Approach (chapters indicated per topic) or Guyton.

Topic 1 Compartmentation: Cellular Organization and Epithelial Barriers

Core question: How does physical separation of body compartments make physiological regulation possible?

Key terms: extracellular/intracellular fluid, tight junction, desmosome, gap junction, connexon, transporting epithelium, membrane polarity, cytoskeleton, organelle.

Silverthorn reading: **Compartmentation: Cells and Tissues (Ch. 3),** plus **the fluid-compartment section of Membrane Dynamics (Ch. 5).**

Discussion questions: Why must a transporting epithelium have different proteins in the apical and basolateral membranes? Which junction type would you expect to dominate in cardiac muscle, and why?

Topic 2 Membrane Transport: From Simple Diffusion to Active Pumps

Core question: What determines whether a solute crosses a cell membrane, and at what energetic cost?

Key terms: concentration gradient, electrochemical gradient, facilitated diffusion, symport/antiport, transport maximum, phagocytosis/endocytosis/exocytosis, receptor-mediated endocytosis, vesicular transport.

Silverthorn reading: Membrane Dynamics (Ch. 5), transport sections; Fick's law is introduced in the diffusion section of the same chapter.

Discussion questions: Why is intestinal glucose uptake called secondary active transport if no ATP is used by SGLT itself? Predict the effect of ouabain on intestinal glucose absorption and justify the answer mechanistically.

Topic 3 - Osmosis, Tonicity and Cell Volume Regulation

Core question: Why do cells change volume, and how do we predict the direction of water movement?

Key terms: osmolarity, osmolality, tonicity, osmotic pressure, penetrating solute, osmotic equilibrium, hypertonic/hypotonic/isotonic, hyperosmotic/hypoosmotic.

Silverthorn reading: Membrane Dynamics (Ch. 5) - osmosis and tonicity sections; the "Osmosis and Tonicity" problem-solving boxes are the best preparation material.

Discussion questions: Is a 300 mOsM urea solution isosmotic and isotonic to a cell? Explain. Can a hyperosmotic solution ever be hypotonic?

Topic 4 The Resting Membrane Potential and the Origin of Electrical Signals

Core question: How does unequal ion distribution across a membrane become an electrical signal?

Key terms: membrane potential difference, equilibrium potential, Nernst equation, Goldman-Hodgkin-Katz equation, leak channel, electrochemical gradient, depolarization/hyperpolarization.

Silverthorn reading: Membrane Dynamics (Ch. 5) -"The Resting Membrane Potential"; extended in Neurons: Cellular and Network Properties (Ch. 8).

Discussion questions: If extracellular K^+ rises from 4 to 7 mM, which way does the resting potential move and what happens to excitability? Why does changing extracellular Na^+ have little effect on the resting potential of most cells?

Topic 5 Cell-to-Cell Communication and Signal Transduction

Core question: How does an extracellular signal become an intracellular response, amplified and precisely targeted?

Key terms: ligand, receptor specificity, signal transduction, second messenger, amplifier enzyme, adenylyl cyclase, phospholipase C, protein kinase, down-regulation, agonist/antagonist.

Silverthorn reading: Communication, Integration, and Homeostasis (Ch. 6); supporting material on protein–ligand binding in Molecular Interactions (Ch. 2).

Discussion questions: One hormone molecule can trigger millions of product molecules where exactly does amplification occur? Why can the same second messenger (Ca^{2+}) produce contraction in one cell and secretion in another?

The discussion questions provided are examples; each group consists of 5–4 people presenting a given topic.

Assessment guidance for students (optional handout text)

- Use maximum 8–10 slides; one core figure per concept, redrawn or annotated in your own words.

- State at least one quantitative value per topic (osmolarity, E_K, ion concentrations, etc.).

- **Close with one clinical correlation and one question for the group.**

- Cite the chapter and edition of Silverthorn used or other book Guyton

Sources

1. **Silverthorn, D. U. Human Physiology: An Integrated Approach. Pearson Education.**

- 8th edition, 2019 (ISBN 978-0-13-460519-7)

- 7th edition, 2016 (ISBN 978-0-321-98122-6)

- 9th / Global editions are also in use; chapter titles for the cell-physiology block are stable across these editions.

2. Chapters used for the topics above, as titled in Silverthorn:

- Ch. 2 Molecular Interactions (protein–ligand binding, supporting material for Topic 5)

- Ch. 3 Compartmentation: Cells and Tissues (Topic 1)

- Ch. 5 Membrane Dynamics (Topics 1–4)

- Ch. 6 Communication, Integration, and Homeostasis (Topic 5)

- Ch. 8 Neurons: Cellular and Network Properties (extension of Topic 4)

Note regarding accuracy: The titles above and the chapter assignments correspond to the structure of the Silverthorn textbook, but page numbers and figure numbers vary between editions, which is why I have intentionally omitted them. **You can also use Guyton Book with the same topics.**