NERVOUS TISSUE MODULE - LESSON NOTE-TAKING GUIDE

Lesson 2: The Electrical Storm – Understanding Neural Excitability
Module: Nervous Tissue **Lesson:** 2 of 4 **Mini-Lectures Required:** Voltage and Channels, Local Potentials, Action Potentials, Refractory Periods **Focus:** Resting potential, EPSPs/IPSPs, action potential generation, refractory periods
Textbook Chapter: _____ **Pages:** _____ **Date Completed:** _____ **Study Time:** _____ hours **Review Dates:** 1. _____ 2. _____ 3. _____

Part 1: Essential Vocabulary

Check off each term as you can define and explain it:

- ☐ voltage
- ☐ resting potential
- ☐ depolarization
- ☐ repolarization
- ☐ hyperpolarization
- ☐ threshold
- ☐ action potential
- ☐ local (graded) potentials
- ☐ EPSPs (excitatory postsynaptic potentials)
- ☐ IPSPs (inhibitory postsynaptic potentials)
- ☐ summation (temporal and spatial)
- ☐ sodium-potassium pump
- ☐ leak channels
- ☐ ligand-gated channels
- ☐ voltage-gated channels
- ☐ all-or-nothing principle
- ☐ absolute refractory period

- ☐ relative refractory period
- ☐ ions (sodium, potassium)
- ☐ concentration gradient
- ☐ ATP

Part 2: Core Concepts

Explain each concept in your own words:

Concept 1: Maintaining Resting Potential Requires Energy

Explain why neurons must constantly burn ATP to maintain -70 mV resting potential. What happens during Sarah's cortical spreading depression when her neurons shift to -60 mV?

Concept 2: Local Potentials Build to Action Potentials

How do thousands of small EPSPs and IPSPs summate at the axon hillock to determine whether a neuron fires? Calculate how many +5 mV EPSPs would be needed to reach threshold from -70 mV.

Concept 3: Refractory Periods Are Protective Features

Why can't a neuron fire backward? Why do refractory periods limit how fast neurons can fire? How might prolonging refractory periods help treat Sarah's migraines?

Part 3: Diagram Analysis

Complete these diagram tasks:

☐ Draw a graph showing all phases of an action potential (resting, threshold, depolarization, repolarization, hyperpolarization)

☐ Label which ion channels are open at each phase (Na+ channels, K+ channels)

☐ Show EPSPs summing to reach threshold vs. IPSPs preventing threshold

☐ Mark absolute and relative refractory periods on an action potential graph

☐ Illustrate the sodium-potassium pump moving 3 Na+ out and 2 K+ in

Part 4: Meeting Learning Objectives

After completing this lesson, I can:

☐ Explain how resting potential is established and maintained

☐ Distinguish between graded potentials (EPSPs/IPSPs) and action potentials

☐ Describe step-by-step action potential generation with channel activity

☐ Compare absolute and relative refractory periods and explain their importance

Part 5: Critical Thinking & Application

Sarah's Clinical Scenario:

During Sarah's cortical spreading depression, her neurons massively depolarize to +30 mV, then hyperpolarize to -90 mV (well below normal resting at -70 mV). This creates a wave of hyperactivity followed by silence. Explain why neurons hyperpolarized at -90 mV cannot fire again immediately, even with strong stimulation. How does this "wave" pattern create her visual aura that spreads slowly at 3 mm/min across her visual cortex?

Practice Question:

A neuron's resting potential is at -70 mV. It receives 5 EPSPs of +5 mV each and 2 IPSPs of -3 mV each. What will be the membrane potential after summation?A. -51 mV (reaches threshold, fires action potential)B. -45 mV (above threshold, fires action potential)C. -63 mV (below threshold, no action potential)D. -70 mV (no change)

Your answer and calculation:

KEY TAKEAWAY

What are the three most important things you learned in this lesson?