CHAPTER 9
RECEPTOR RESPONSES AND MEMBRANE POTENTIALS

CHAPTER OVERVIEW: This chapter covers the electrical activity associated with cell membranes in terms of the movements of ions. Electrical potentials are defined and explained within the context of charge differences across living membranes. The cellular mechanisms responsible for the existence and maintenance of each of the types of membrane potentials are discussed. The phases of the action potential are described in some detail. External stimuli are characterized based on the type and/or magnitude of the response potential they evoke in the cell.

OUTLINE (two or three fifty-min. lectures):
Seeley, A&P, 5/e

Chapt. Object.	Topic Outline, Chapter 9, 5/e	Figures & Tables	Transparency Acetates
1	I. Chemical Signals , p. 249	Fig. 9.1, p.249	TA-158
	1. Receptor Specificity for Communication Between Cells		
	a. Membrane-Bound Receptors	Fig. 9.2a, p.250	TA-158
	b. Intracellular Receptors	Fig. 9.2b, p.250	
2	A. Ligands and Membrane-Bound Receptors		
3	1. Receptors That Directly Alter		
4	Membrane Permeability		
5	a. Ligand-Gated Ion Channels	Fig. 9.3, p.250	TA-159
	2. Receptors That Synthesize Intracellular Mediator Molecules	Fig. 9.5, p.251	TA-161
	a. First-Messenger Molecules	Fig. 9.6, p.250	TA-162
	b. Intracellular Mediators (Second Messengers); cGMP	Predict Quest. 1 Fig. 9.7, p.254 Table 9.1, p.253	TA-163
	3. Receptors and the Function of G Proteins	Fig. 9.4, p.251	TA-160
	a. G Proteins (Three Subunits)	Fig. 9.6, p.252	TA-162
	1) cAMP	Fig. 9.6, p. 252	
	2) Adenylyl Cyclase: cAMP to ATP		
	3) DAG and IP_3		
	4) Cyclic GMP		
		Fig. 9.8, p. 255	TA-164
	4. Receptors That Phosphorylate Intracellular Proteins		
6	B. Ligands and Intracellular Receptors	Fig. 9.9, p. 255	TA-165
	1. Cytoplasmic & Nuclear Receptors Interact with DNA	Fig. 9.10, p.257 Predict Quest. 2	TA-166
	II Electric Signals, p. 256		

	1. Action Potentials		
7, 8	A. Concentration Differences Across the Plasma Membrane	Table 9.3, p.258	
	1. The Sodium-Potassium Exchange Pump	Fig. 9.11, p.258	TA-167
14	2. Permeability Characteristics of the Plasma Membrane	Fig. 9.12, p.259	TA-168
	3. Nongated Ion Channels (Always Open)		
	4. Gated Ion Channels		
	a. Voltage-Gated Ion Channels		
	b. Ligand-Gated Ion Channels		
	c. Other Gated Ion Channels		
9	B. The Resting Membrane Potential (RMP)	Fig. 9.13, p.260	TA169
10	1. Establishment of the Resting Membrane	Table 9.4, p.261	
11	Potential		
	a. Due to Outflow of K^+	Fig. 9.14, p.260	TA-170
	b. Potential Difference Across Membrane	Fig. 9.15, p.261	TA-171
	2. Changing the Resting Membrane Potential	Predict Quest. 3 Predict Quest. 4	
	a. Depolarization		
	b. Hyperpolarization		
	C. Electrically Excitable Cells	Fig. 9.16, p.262 Predict Quest. 5	TA-172
12	1. Local Potential	Table 9.5, p.264	
13, 15	a. Graded	Fig. 9.17a, p.263	TA-173
	b. Summate	Fig. 9.17b, p.263	
	d. Temporal Summation	Predict Quest. 6	
	2. Action Potentials	Table 9.6, p.264	
	a. Threshold Potential	Fig. 9.18, p.264	TA-173
	b.All-or-None Principle	Fig. 9.19, p.265	TA-174
	1) Depolarization Phase	Fig. 9.20a, p.266	TA-175
	2) Repolarization Phase	Fig. 9.20b, p.266	
	3) Afterpotential	Predict Quest. 7 Clinical Focus, p.267	
16	3. Refractory Period		
17	a. Absolute Refractory Period	Fig. 9.21, p.267	TA-121
18	b. Relative Refractory Period	Predict Quest. 8	
19	4. Propagation of Action Potentials	Fig. 9.22, p.268	TA-9.22
20	a. Along Membrane of One Cell		
	b. From Cell to Cell		

1) Chemical Synapses and Neurotransmittrers	Fig. 9.23a, p.265 Fig. 9.23b, p.265	TA-178
2) Gap Junctions	Table 9.6, p.264	
5. Action Potential Frequency	Fig. 9.24, p.271	
a. Action Potential Frequency Defined	Predict Quest. 9 Predict Quest. 10	
b. Substhreshold Stimulus	Fig. 9.25, p.271	
c. Threshold Stimulus		
d. Maximal Stimulus		
e. Supramaximal Stimulus		
f. Submaximal Stimulus		
6. Accommodation		
a. Without Accommodation - Frequency Proportional to Stimulus Strength		
b. With Accommodation - Frequency Proportional to Changes in Stimulus Strength		

IMPORTANT CONSIDERATIONS: This set of topics is crucial to the understanding of muscle and nerve cell functioning and so is worth the time invested in ensuring that students are able to explain these events. The logical break is between the general cell and membrane properties responsible for the resting membrane potential and the characteristics of other potentials in excitable cells. Students with weaker backgrounds in chemistry will need assistance as they attempt to visualize what is happening and exactly where the events are occurring.

SEE INSTRUCTOR'S MANUAL AND COURSE SOLUTIONS MANUAL FOR ADDITIONAL RESOURCES.