AP Biology
Cell Communication and Cell Cycle

Topic 4.1 Cell Communication

Enduring Understanding IST-3 Cells communicate by generating, transmitting, receiving, and responding to chemical signals.	
Learning Objective	**Essential Knowledge**
IST-3.A Describe the ways that cells can communication with one another.	**IST-3.A.1** Cells communicate with one another through direct contact with other cells or from a distance via chemical signaling – a. Cells communicate by cell-to-cell contact
IST-3.B Explain how cells communicate with one another over short and long distances.	**IST-3.B.1** Cells communicate over short distances by using local regulators that target cells in the vicinity of the signal-emitting cell – a. Signals released by one cell type can travel long distances to target cells of another cell type.

Topic 4.2 Introduction to Signal Transduction

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Learning Objective	**Essential Knowledge**
IST-3.C Describe the components of a signal transduction pathway.	**IST-3.C.1** Signal transduction pathways link signal reception with cellular responses. **IST-3.C.2** Many signal transduction pathways include protein modification and phosphorylation cascades.
IST-3.D Describe the role of components of a signal transduction pathway in producing a cellular response.	**IST-3.D.1** Signaling begins with the recognition of a chemical messenger – a ligand – by a receptor protein in a target cell – a. The ligand-binding domain of a receptor recognizes as specific chemical messenger, which can be a peptide, a small chemical, or protein, in a specific one-to-one relationship. b. G protein-coupled receptors are an example of a receptor protein in eukaryotes. **IST-3.D.2** Signaling cascades relay signals from receptors to cell targets, often amplifying the incoming signals, resulting in the

	appropriate responses by the cell, which could include cell growth, secretion of molecules, or gene expression – a. After the ligand binds, the intracellular domain of a receptor protein changes shape, initiating transduction of the signal. b. Second messengers (such as cyclic AMP) are molecules that relay and amplify the intracellular signal. c. Binding of ligand-to-ligand gated channels can cause the channel to open or close.

Topic 4.3 Signal Transduction

Enduring Understanding IST-3 Cells communicate by generating, transmitting, receiving, and responding to chemical signals.	
Learning Objective	**Essential Knowledge**
IST-3.E Describe the role of the environment in eliciting a cellular response.	**IST-3.E.1** Signal transduction pathways influence how the cell responds to its environment.
IST-3.F Describe the different types of cellular responses elicited by a signal transduction pathway.	**IST-3.F.1** Signal transduction may result in changes in gene expression and cell function, which may alter phenotype or result in programmed cell death (apoptosis).

Topic 4.4 Changes Signal Transduction Pathways

Enduring Understanding IST-3 Cells communicate by generating, transmitting, receiving, and responding to chemical signals.	
Learning Objective	**Essential Knowledge**
IST-3.G Explain how a change in the structure of any signaling molecule affects the activity of the signaling pathway.	**IST-3.G.1** Changes in signal transduction pathways can alter cellular response – a. Mutations in any domain of the receptor protein or in any component of the signaling pathway may affect the downstream components by altering the subsequent transduction of the signal. b. Chemicals that interfere with any component of the signaling pathway may activate or inhibit the pathway.

Topic 4.5 Feedback

Enduring Understanding ENE-3 Timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental clues.	
Learning Objective	**Essential Knowledge**
ENE-3.A Describe positive and/or negative feedback mechanisms.	**ENE-3.A.1** Organisms use feedback mechanisms to maintain their internal environments and respond to internal and external environmental changes.
ENE-3.B Explain how negative feedback helps to maintain homeostasis.	**ENE-3.B.1** Negative feedback mechanisms maintain homeostasis for a particular condition by regulating physiological processes. If a system is perturbed, negative feedback mechanisms return the system back to its target set point. These processes operate at the molecular and cellular levels.
ENE-3.C Explain how positive feedback affects homeostasis.	**ENE-3.C.1** Positive feedback mechanisms amplify responses and processes in biological organisms. The variable initiating the response is moved farther away from the initial set point. Amplification occurs when the stimulus is further activated, which, in turn, initiates additional response that produces system change.

Topic 4.6 Cell Cycle

Enduring Understanding IST-1 Heritable information provides continuity for life.	
Learning Objective	**Essential Knowledge**
IST-1.B Describe the events that occur in the cell cycle.	**IST-1.B.1** In eukaryotes, cells divide and transmit genetic information via two highly regulated processes. **IST-1.B.2** The cell cycle is a highly regulated series of events for the growth and reproduction of cells – a. The cell cycle consists of sequential stages of interphase (G1, S, G2), mitosis, and cytokinesis. b. A cell can enter a stage (G0) where it no longer divides, but it can reenter the cell cycle in response to appropriate cues. Non-dividing cells may exit the cell cycle or be held at a particular stage in the cell cycle.

IST-1.C Explain how mitosis results in the transmission of chromosomes from one generation to the next.	**IST-1.C.1** Mitosis is a process that ensures the transfer of a complete genome from a parent cell to two genetically identical daughter cells – a. Mitosis plays a role in growth, tissue repair, and asexual reproduction. b. Mitosis alternates with interphase in the cell cycle. c. Mitosis occurs in a sequential series of steps (prophase, metaphase, anaphase, telophase)

Topic 4.7 Regulation of Cell Cycle

Enduring Understanding IST-1 Heritable information provides continuity for life.	
Learning Objective	**Essential Knowledge**
IST-1.D Describe the role of checkpoints in regulating the cell cycle.	**IST-1.D.1** A number of internal controls or checkpoints regulate progression through the cycle. **IST-1.D.2** Interactions between cyclins and cyclin-dependent kinases control the cell cycle.
IST-1.E Describe the effects of disruptions to the cell cycle on the cell or organism.	**IST-1.E.1** Disruptions to the cell cycle may result in cancer and/or programmed cell death (apoptosis).