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| **AP Biology** | **Curriculum Map**  **Cellular Communication**  http://www.jeffersontownship.org/Portals/0/Images/Logos/hornet.jpg | | | |
| Textbook Resources:  **Chapter 11, 43, 45, 46, 48, 49, 50** | | Month(s):  **November-December** | Time Frame:  **12 days (9/3 block)** | Assessment:  **Reading Quizzes**  **Unit Test** |
| **Learning Targets** | | | **Support Text** | **Bozeman Podcasts** |
| **EK 2.D.1: All biological systems from cells and organisms to populations, communities and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy.** | | | | |
| 1. Cell activities are affected by interactions with biotic and abiotic factors.    * + - Cell density        - Biofilms | | | **External Signals**  Chapter 11.1 (p.206-210) | [Cell Communication](http://www.bozemanscience.com/037-cell-communication)  [Mechanisms of Timing & Control](http://www.bozemanscience.com/025-mechanisms-of-timing-and-control) |
| **EK 3.D.1: Cell communication processes share common features that reflect a shared evolutionary history.** | | | | |
| 1. Communication involves transduction of stimulatory or inhibitory signals from other cells, organisms or the environment. | | | **Cell Signaling**  Chapter 11.1 (p.206-210) | [Cell Communication](http://www.bozemanscience.com/037-cell-communication)  [Evolution of Cell Communication](http://www.bozemanscience.com/036-evolutinary-significance-of-cell-communication) |
| 1. Correct and appropriate signal transduction processes are generally under strong selective pressure. | | |
| 1. In single-celled organisms, signal transduction pathways influence how the cell responds to its environment.    * + - Use of chemical messengers by microbes to communicate with other nearby cells and to regulate specific pathways in response to population density (quorum sensing)        - Response to external signals by bacteria that influences cell movement | | |
| 1. In multicellular organisms, signal transduction pathways coordinate the activities within individual cells that support the function of the organism as a whole.    * + - Epinephrine stimulation of glycogen breakdown in mammals | | |
| **EK 3.D.2: Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling.** | | | | |
| 1. Cells communicate by cell-to-cell contact.  * Immune cells interact by cell-cell contact, antigen-presenting cells, helper T-cells and killer-T cells. | | | **Cell Signaling**  Chapter 11.1 (p.206-210)  **Helper T Cells**  Figure 43.16 (p.941)  **Regulation of Fluid Retention**  Figure 44.19 (p.969)  **Chemical Synapse**  Figure 48.15 (p.1055) | [Cell Communication](http://www.bozemanscience.com/037-cell-communication)  [Signal Transduction in Pathways](http://www.bozemanscience.com/032-signal-transmission-and-gene-expression)  [Endocrine System](http://www.bozemanscience.com/endocrine-system) |
| 1. Cells communicate over short distances by using local regulators that target cells in the vicinity of the emitting cell.  * Quorum sensing in bacteria * Neurotransmitters | | | **Cell Signaling**  Chapter 11.1 (p.206-210)  **Neurotransmitters**  Chapter 48.4  (p.1057-1060) | [Cell Communication](http://www.bozemanscience.com/037-cell-communication) |
| 1. Signals released by one cell type can travel long distances to target cells of another cell type.    1. Endocrine signals are produced by endocrine cells that release signaling molecules, which are specific and can travel long distances through the blood to reach all parts of the body.  * Antidiuretic hormone (ADH) * Insulin * Testosterone * Estrogen | | | **ADH Response**  Chapter 44.5 (p.969)  **Insulin & Glucagon**  Chapter 45.2  (p.982-983)  **Hormonal Control of Reproduction**  Chapter 46.4  (p.1008-1011) | [Osmoregulation](http://www.bozemanscience.com/osmoregulation)  [Reproductive System](http://www.bozemanscience.com/reproductive-system) |
| 1. Cells communicate over short distances by using local regulators that target cells in the vicinity of the emitting cell.  * Plant immune response | | | **Plant Immune Response**  Chapter 39.5 (p.845-847) | [Plant & Animal Defense](http://www.bozemanscience.com/023-plant-and-animal-defense) |
| **EK 3.D.3: Signal transduction pathways link signal reception with cellular response.** | | | | |
| 1. Signaling begins with the recognition of a chemical messenger, a ligand, by a receptor protein. 2. Different receptors recognize different chemical messengers, which can be peptides, small chemicals or proteins, in a specific one-to-one relationship. 3. A receptor protein recognizes signal molecules, causing the receptor protein’s shape to change, which initiates transduction of the signal.    * + G-protein receptors      + Ligand-gated ion channels      + Receptor tyrosine kinases | | | **Reception**  Chapter 11.2 (p.210-214) | [Signal Transduction in Pathways](http://www.bozemanscience.com/032-signal-transmission-and-gene-expression) |
| 1. Signal transduction is the process by which a signal is converted to a cellular response. 2. Signaling cascades relay signals from receptors to cell targets, often amplifying the incoming signals, with the result of appropriate responses by the cell. 3. Second messengers are often essential to the function of the cascade.  * Cyclic AMP (cAMP)  1. Many signal transduction pathways include protein modifications and phosphorylation cascades in which a series of protein kinases add a phosphate group to the next protein in the cascade sequence.    * 1. Protein modifications      2. Phosphorylation cascades | | | **Transduction**  Chapter 11.3 (p.214-218)  **Cyclic AMP**  Chapter 11.3 (p.216-217) |
| **EK 2.E.1: Timing and coordination of specific events are necessary for the normal development of an organism, and these events are regulated by a variety of mechanisms.** | | | | |
| 1. Programmed cell death (apoptosis) plays a role in the normal development and differentiation.    * + - Morphogenesis of fingers and toes        - Immune function        - *C. elegens* development | | | **Apoptosis**  Chapter 11.5  (p.223-225) | n/a |
| **EK 3.D.4: Changes in signal transduction pathways can alter cellular response.** | | | | |
| 1. Conditions where signal transduction is blocked or defective can be deleterious, preventative or prophylactic.  * Cholera * Effects of neurotoxins, poisons, pesticides | | | **Cyclic AMP & Cholera**  Chapter 11.3 (p.216-217) | [Effects of Changes in Pathways](http://www.bozemanscience.com/039-effects-of-changes-in-pathways) |
| **EK 2.D.4: Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.** | | | | |
| 1. Invertebrates and vertebrates have multiple, nonspecific immune responses. 2. Invertebrate immune systems have nonspecific response mechanisms, but they lack pathogen-specific defense responses. 3. Vertebrate immune systems have nonspecific and non-heritable defense mechanisms against pathogens. | | | **Innate Immunity**  Chapter 43.1  (p. 930-935)  **Cell Mediated vs. Humoral Response**  Chapter 43.3  (p. 940-946) | [Immune System](http://www.bozemanscience.com/immune-system)  [Plant & Animal Defense](http://www.bozemanscience.com/023-plant-and-animal-defense) |
| 1. Mammals use specific immune responses triggered by natural or artificial agents that disrupt dynamic homeostasis. 2. The mammalian immune system includes two types of specific responses: cell mediated and humoral. 3. In the cell-mediated response, cytotoxic T cells, a type of lymphocytic white blood cell, “target” intracellular pathogens when antigens are displayed on the outside of the cells. 4. In the humoral response, B cells, a type of lymphocytic white blood cell, produce antibodies against specific antigens. 5. Antigens are recognized by antibodies to the antigen. 6. Antibodies are proteins produced by B cells, and each antibody is specific to a particular antigen. 7. A second exposure to an antigen results in a more rapid and enhanced immune response. | | |
| 1. Plants have multiple, nonspecific immune responses.  * Plant defenses against pathogens include molecular recognition systems with systemic responses; infection triggers chemical responses that destroy infected and adjacent cells, thus localizing the effects. | | | **Plant Immune Response**  Chapter 39.5  (p.845-847) | [Plant & Animal Defense](http://www.bozemanscience.com/023-plant-and-animal-defense) |
| **EK 3.E.2: Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.** | | | | |
| 1. Different regions of the vertebrate brain have different functions.  * Vision * Hearing * Muscle movement * Abstract thought and emotions * Cerebrum, brainstem, and cerebellum * Right and left cerebral hemispheres | | | **Organization of the Nervous System**  Chapter 49.1  (p.1062-1072) | [The Brain](http://www.bozemanscience.com/the-brain) |
| 1. The neuron is the basic structure of the nervous system that reflects function. 2. A typical neuron has a cell body, axon and dendrites. Many axons have a myelin sheath that acts as an electrical insulator. 3. The structure of the neuron allows for the detection, generation, transmission and integration of signal information. 4. Schwann cells, which form the myelin sheath, are separated by gaps of unsheathed axon over which the impulse travels as the signal propagates along the neuron. | | | | **Neuron Structure**  Figure 48.4 (p.1047)  **Action Potentials**  Chapter 48.3  (p.1050-1054)  **Neurotransmitters**  Chapter 48.4  (p.1057-1060) | [Nervous System](http://www.bozemanscience.com/nervous-system) | |
| 1. Transmission of information between neurons occurs across synapses. 2. In most animals, transmission across synapses involves chemical messengers called neurotransmitters.  * Acetylcholine * Epinephrine * Dopamine * Serotonin * GABA  1. Transmission of information along neurons and synapses results in a response. 2. The response can be stimulatory or inhibitory. | | | |

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| **Vocabulary** | | | | | |
| ADP/ATP | Cholera | GDP/GTP | Long-distance signaling | Phosphodiesterase | Second messenger |
| Acetylcholine | Cyclic AMP (CAMP) | Growth factor | Mating factor | Phosphorylation cascade | Sensor |
| Acetylcholinesterase | Cytotoxic T-cell | GTPase | Mechanoreceptor | Photoreceptor | Serotonin |
| Afferent pathway | Direct contact | Hormone | Motor cortex | Positive feedback | Shmoo projection |
| Adenylyl cyclase | Dopamine | Hormone-receptor complex | Myelin sheath | Progesterone | Signal transduction pathway |
| Antigen/antibody | Effector | Humoral immune response | Negative feedback | Proteases | Somatic |
| Apoptosis | Efferent pathway | Hypothalamus | Node of Ranvier | Protein kinase | Somatosensory cortex |
| Autonomic | Endorphins | Inhibitory neurotransmitter | Norepinephrine | Protein phosphatases | Stimulus |
| B cell | Epinephrine | Insulin/glucagon | Nucleases | Quorum sensing | Sympathetic nervous system |
| Brainstem | Estradiol | Interneuron | Occipital lobe | Reception | Target protein |
| Cell-mediated immune response | Excitatory neurotransmitter | Intracellular reception | Parasympathetic nervous system | Receptor tyrosine kinase (RTK) | Temporal lobe |
| Central nervous system | Formin | LH/FSH | Parathyroid/PTH | Reflex | Thalamus |
| Cerebellum | Frontal lobe | Ligand | Parietal lobe | Relay protein | Transcription factor |
| Cerebrum | G-protein coupled receptor | Ligand-gated ion channel | Peripheral nervous system | Response | Transduction pathway |
| Chemoreceptor | GABA | Local signaling | Phosphate group | Schwann cell |  |