|  |  |
| --- | --- |
| **AP Biology** | **Curriculum Map** **Cellular Structure & Transport**http://www.jeffersontownship.org/Portals/0/Images/Logos/hornet.jpg |
| Textbook Resources:**Chapters 6 & 7** | Month(s):**October-November** | Time Frame:**15 days (11/4 block)** | Assessment:**Reading Quizzes****Unit Test** |
| **Learning Targets** | **Support Text** | **Bozeman Podcasts** |
| **EK 2.B.3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.** |
| Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.1. Internal membranes facilitate cellular processes by minimizing competing interactions and by increasing surface area where reactions can occur.
2. Membranes and membrane-bound organelles in eukaryotic cells localize (compartmentalize) intracellular metabolic processes and specific enzymatic reactions.
	* + Endoplasmic reticulum
		+ Mitochondria
		+ Chloroplasts
		+ Golgi apparatus
		+ Nuclear envelope
3. Archaea and Bacteria generally lack internal membranes and organelles and have a cell wall.
 | **Eukaryotic vs. Prokaryotic**Chapter 6.2 (p.98-99)Fig 6.8 (p.100-101)**Prokaryotic Structure**Chapter 27.1 (p.556-560) | [Archaea](http://www.bozemanscience.com/archaea)[Bacteria](http://www.bozemanscience.com/bacteria)[Eukarya](http://www.bozemanscience.com/eukarya)[Compartmentalization](http://www.bozemanscience.com/017-compartmentalization) |
| **EK 2.A.3: Organisms must exchange matter with the environment to grow, reproduce and maintain organization.** |
| 1. Surface area-to-volume ratios affect a biological system’s ability to obtain necessary resources or eliminate waste products.
2. As cells increase in volume, the relative surface area decreases and demand for material resources increases; more cellular structures are necessary to adequately exchange materials and energy with the environment. These limitations restrict cell size.
	* + Root hairs
		+ Cells of the alveoli
		+ Cells of the villi
		+ Microvilli
3. The surface area of the plasma membrane must be large enough to adequately exchange materials; smaller cells have a more favorable surface area-to-volume ratio for exchange of materials with the environment
 | **SA:V Ratio**Chapter 6.2 (p.98-99) | [Why Are Cells Small?](http://www.bozemanscience.com/why-are-cells-small) |
| **EK 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.** |
| 1. Ribosomes are small, universal structures comprised of two interacting parts: ribosomal RNA and protein. In a sequential manner, these cellular components interact to become the site of protein synthesis where the translation of the genetic instructions yields specific polypeptides.
 | **Ribosomes**Chapter 6.3 (p.102-104) | [Cellular Organelles](http://www.bozemanscience.com/043-cellular-organelles)[Endosymbiosis](http://www.bozemanscience.com/endosymbiosis) |
| 1. Endoplasmic reticulum (ER) occurs in two forms: smooth and rough.
2. Rough endoplasmic reticulum functions to compartmentalize the cell, serves as mechanical support, provides site-specific protein synthesis with membrane-bound ribosomes and plays a role in intracellular transport.
3. In most cases, smooth ER synthesizes lipids.
 | **Endomembrane System**Chapter 6.4 (p.104-109) |
| 1. The Golgi complex is a membrane-bound structure that consists of a series of flattened membrane sacs (cisternae).
	1. Functions of the Golgi include synthesis and packaging of materials (small molecules) for transport (in vesicles), and production of lysosomes.
 |
| 1. Lysosomes are membrane-enclosed sacs that contain hydrolytic enzymes, which are important in intracellular digestion, the recycling of a cell’s organic materials and programmed cell death (apoptosis). Lysosomes carry out intracellular digestion in a variety of ways.
 |
| 1. A vacuole is a membrane-bound sac that plays roles in intracellular digestion and the release of cellular waste products. In plants, a large vacuole serves many functions, from storage of pigments or poisonous substances to a role in cell growth. In addition, a large central vacuole allows for a large surface area to volume ratio.
 |
| 1. Mitochondria specialize in energy capture and transformation.
2. Mitochondria have a double membrane that allows compartmentalization within the mitochondria and is important to its function.
 | **Mitochondria & Chloroplasts**Chapter 6.5 (p.109-110) |
| 1. Chloroplasts are specialized organelles found in algae and higher plants that capture energy through photosynthesis.
	1. The structure and function relationship in the chloroplast allows cells to capture the energy available in sunlight and convert it to chemical bond energy via photosynthesis.
 |
| **EK 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.** |
| 1. Structural evidence supports the relatedness of all eukaryotes.
	* + - Cytoskeleton (a network of structural proteins that facilitate cell movement, transport, morphological integrity and organelle transport)
* Membrane-bound organelles (mitochondria and chloroplasts)
* Endomembrane systems
 | **The Cytoskeleton**Chapter 6.6 (p.112-118)**Endomembrane System**Chapter 6.4 (p.104-109) | [Endosymbiosis](http://www.bozemanscience.com/endosymbiosis) |
| **EK 4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.** |
| 1. Organisms have areas or compartments that perform a subset of functions related to energy and matter, and these parts contribute to the whole.
2. At the cellular level, the plasma membrane, cytoplasm and, for eukaryotes, the organelles contribute to the overall specialization and functioning of the cell.
 | **Structure & Function in Animal Tissues**Figure 40.5 (p.856-858) | [Compartmentalization](http://www.bozemanscience.com/017-compartmentalization)[Cellular Specialization](http://www.bozemanscience.com/044-cellular-specialization)[Cellular Variation](http://www.bozemanscience.com/052-cellular-variation)[Organ Systems](http://www.bozemanscience.com/045-organ-systems) |
| **EK 2.B.1: Cell membranes are selectively permeable due to their structure.** |
| 1. Cell membranes separate the internal environment of the cell from the external environment.
 | **Fluid Mosaic Model**Chapter 7.1 (p.125-130)**Membrane Permeability**Chapter 7.2 (p.131-132)**Cell Junctions**Chapter 6.7 (p.120-121) | [Cell Membranes](http://www.bozemanscience.com/015-cell-membrane) |
| 1. Selective permeability is a direct consequence of membrane structure, as described by the fluid mosaic model.
2. Cell membranes consist of a structural framework of phospholipid molecules, embedded proteins, cholesterol, glycoproteins and glycolipids.
3. Phospholipids give the membrane both hydrophilic and hydrophobic properties. The hydrophilic phosphate portions of the phospholipids are oriented toward the aqueous external or internal environments, while the hydrophobic fatty acid portions face each other within the interior of the membrane itself.
4. Embedded proteins can be hydrophilic, with charged and polar side groups, or hydrophobic, with nonpolar side groups.
5. Small, uncharged polar molecules and small nonpolar molecules, such as N2, freely pass across the membrane. Hydrophilic substances such as large polar molecules and ions move across the membrane through embedded channel and transport proteins. Water moves across membranes and through channel proteins called aquaporins.
 |
| 1. Cell walls provide a structural boundary, as well as a permeability barrier for some substances to the internal environments.
	1. Plant cell walls are made of cellulose and are external to the cell membrane.

 2. Other examples are cells walls of prokaryotes and fungi. | **Cell Wall**Chapter 6.7 (p.118-119)**Cell Junctions**Chapter 6.7 (p.120-121) |
| **EK 2.B.2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.** |
| 1. Passive transport does not require the input of metabolic energy; the net movement of molecules is from high concentration to low concentration.
2. Passive transport plays a primary role in the import of resources and the export of wastes.
3. Membrane proteins play a role in facilitated diffusion of charged and polar molecules through a membrane.
	* + Glucose transport
		+ Na+/K+ transport
4. External environments can be hypotonic, hypertonic or isotonic to internal environments of cells.
 | **Passive Transport**Chapter 7.3 (p.132-135)**Water Potential**Chapter 36.2 (p.769-771) | [Osmosis Demo](http://www.bozemanscience.com/osmosis-demo)[Diffusion & Osmosis LAB](http://www.bozemanscience.com/ap-bio-lab-1-diffusion-osmosis)[Osmosis Walkthrough LAB](http://www.bozemanscience.com/osmosis-lab-walkthrough)[Osmoregulation](http://www.bozemanscience.com/osmoregulation/?rq=osmoregulation)[Transport Across Cell Membranes](http://www.bozemanscience.com/016-transport-across-cell-membranes)[Interstitial Fluid](http://www.bozemanscience.com/interstitial-fluid)[Water Potential](http://www.bozemanscience.com/water-potential) |
| 1. Active transport requires free energy to move molecules from regions of low concentration to regions of high concentration.
2. Active transport is a process where free energy (often provided by ATP) is used by proteins embedded in the membrane to “move” molecules and/or ions across the membrane and to establish and maintain concentration gradients.
3. Membrane proteins are necessary for active transport.
 | **Active Transport**Chapter 7.4 (p.135-138) |
| 1. The processes of endocytosis and exocytosis move large molecules from the external environment to the internal environment and vice versa, respectively.
2. In exocytosis, internal vesicles fuse with the plasma membrane to secrete large macromolecules out of the cell.
3. In endocytosis, the cell takes in macromolecules and particulate matter by forming new vesicles derived from the plasma membrane.
 | **Bulk Transport**Chapter 7.5 (p.138-139)Figure 7.22 |
| **EK 2.C.1: Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.** |
| 1. Negative feedback mechanisms maintain dynamic homeostasis for a particular condition (variable) by regulating physiological processes and returning the changing conditions back to its target set point.
* Water retention by the kidneys
* Plant response to water limitation
 | **Regulation of Fluid Retention**Figure 44.19 (p.969)**Plants & Drought**Chapter 39.4 (p.843)**Transpiration**Chapter 36 (p.775-778) | [Transpiration LAB](http://www.bozemanscience.com/ap-bio-lab-9-transpiration/?rq=transpiration) |
| **EK 3.E.2: Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.** |
| 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) | [The Nervous System](http://www.bozemanscience.com/science-videos/2011/9/14/041-the-nervous-system.html?rq=the%20nervous%20system) |
| 1. Action potentials propagate impulses along neurons.
2. Membranes of neurons are polarized by the establishment of electrical potentials across the membranes.
3. In response to a stimulus, Na+ and K+ gated channels sequentially open and cause the membrane to become locally depolarized.
4. Na+/K+ pumps, powered by ATP, work to maintain membrane potential.
 |
| 1. Disruptions at the molecular and cellular level affect the health of the organism.
2. Physiological responses to toxic substances
* Monarch butterfly toxin and Na+/K+ pump
 |
| **EK 4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.** |
| 1. Organisms have areas or compartments that perform a subset of functions related to energy and matter, and these parts contribute to the whole.
2. At the cellular level, the plasma membrane, cytoplasm and, for eukaryotes, the organelles contribute to the overall specialization and functioning of the cell.
3. Within multicellular organisms, specialization of organs contributes to the overall functioning of the organism.
	* + - Exchange of gases
			- Circulation of fluids
			- Digestion of food
			- Excretion of wastes
 | **Structure & Function in Animal Tissues**Figure 40.5 (p.856-858) | [Cellular Specialization](http://www.bozemanscience.com/044-cellular-specialization)[Respiratory System](http://www.bozemanscience.com/respiratory-system)[Digestive System](http://www.bozemanscience.com/digestive-system)[Osmoregulation](http://www.bozemanscience.com/osmoregulation/?rq=osmoregulation) |

|  |
| --- |
| **Vocabulary** |
| eukaryotic | cytoplasm | intercellular junctions | pinocytosis | tight junctions |  |
| active transport | cytoskeleton | ligand-gated ion channel | plasma membrane | transmembrane proteins |  |
| adenosine triphosphate (ATP) | desmosomes | lysosomes | pressure potential | transport proteins |  |
| adhesion proteins | dialysis | microfilaments | prokaryotic | tubulin |  |
| bound ribosome | endocytosis | microtubules | receptor proteins | vacuoles |  |
| carbohydrate side chains | exocytosis | mitochondria | receptor-mediated endocytosis | vesicles |  |
| cell wall | facilitated transport | nucleolus | recognition proteins | voltage-gated ion channel |  |
| centrioles | flagellum | organelles | rough endoplasmic reticulum | water potential |  |
| channel proteins | fluid-mosaic model | osmosis | simple diffusion |  |  |
| chitin | free ribosome | outer mitochondrial membrane | smooth endoplasmic reticulum |  |  |
| chloroplast | gap junctions | passive transport | sodium-potassium pump |  |  |
| chloroplasts | Golgi bodies | peripheral proteins | solute |  |  |
| cholesterol | inner mitochondrial membrane | phagocytosis | solute potential |  |  |
| cilia | integral proteins | phospholipid bilayer | surface area to volume ratio |  |  |