

Unit 1: Matter and Energy in Organisms

Theme: Chemistry of Life

Big Idea: Systems of specialized cells within organisms help them perform the essential functions of life, which involve chemical reactions that take place between different types of molecules. This system has a hierarchical structure as related to their function. Within cells there are many molecules of different kinds which interact in carrying out the functions of the cell. Activity with different types of cells is regulated by enzymes.

Essential Questions for this Unit:

1. What are the basic characteristics of life that are common to all living things?
2. What are the patterns in the hierarchical organization of organisms from atoms to molecules and cells to tissues to organs to organ systems to organisms?
3. How does the structure and composition of the 4 major macromolecules contribute to their function in living systems?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
<p>Plus HS+B.L1U1.7 Develop and use models to illustrate the hierarchical organization of interacting systems that provide specific functions within multi-cellular organisms (plant and animal).</p> <p>Plus HS+B.L1U1.5 Analyze and interpret data that demonstrates the relationship between cellular function and the diversity of protein functions.</p>	<p>L1: Organisms are organized on a cellular basis and have a finite life span.</p> <ul style="list-style-type: none"> ● Systems of specialized cells within organisms help them perform the essential functions of life, which involve chemical reactions that take place between different types of molecules, such as water, proteins, carbohydrates, lipids, and nucleic acids. ● Multi-cellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. ● Activity within different types of cells is regulated by enzymes. 	<p>-I can develop a model to identify and describe the hierarchical organization of interacting systems (i.e., cells, tissue, organ, organ system, and organism) and processes (i.e., transport of fluids, motion) of body systems in multi-cellular organisms.</p> <p>-I can identify models that illustrate specific functions based on structure within multi-cellular organisms (plant and animal).</p> <p>-I can plan and carry out an investigation to show that the functions of enzymes are vital for life and serve a wide range of important roles in the body, such as aiding in digestion and metabolism.</p> <p>-I can analyze data to show that properties of enzymes include biological catalysts and speed up reactions although they are not changed in the reaction.</p>	<p>Summative Assessments: CANVAS Benchmark Tests APEX UNIT Tests Project</p> <p>Formative Assessments: APEX Lesson Quizzes</p> <p>Short Performance Assessment: • Activity: Identify the model that shows the correct labeling of cells, tissues, organs, and/or organ systems. • Extend: Identify the level of organization that includes each individual unit OR the groups of cells, tissues, organs shown in the model or diagram. (For Example: Which level of organization is represented by the tendon in the muscle diagram?)</p> <p>• Students develop a Spiral 3-D Model in which they identify and describe the relevant parts (e.g., organ system, organs, and their component tissues) and processes (e.g., transport of fluids, motion) of body systems in multi-cellular organism. In the model, students describe the relationships between components, including: 1.)The functions of at least two major body systems in terms of contributions to overall function of an organism;</p>	<ul style="list-style-type: none"> • APEX Lesson Assignments • CANVAS: supplementary lessons Web Quest: Building Blocks of Chemicals in Living Things – ws <p>Introduction to Biology-video & ws https://www.youtube.com/watch?v=7nKKoxnmTEA</p> <p>Introduction to Characteristics of Life: video & ws https://www.youtube.com/watch?v=juXLUo-sH6M</p> <p>Properties of Life video & ws https://www.youtube.com/watch?v=0NnFHY_STFQ</p> <p>From Cells to Organisms video & ws https://www.youtube.com/watch?v=MjYODcBqEXM</p> <p>Levels of Organization video & ws https://www.edumedia-sciences.com/en/media/931-from-the-cell-to-the-organism</p> <p>Cell Membrane & Construction of Molecules video & ws https://www.wisc-online.com/learn/career-clusters/life-science/ap16417/construction-of-the-cell-membrane-video</p> <p>Enzymes video & ws https://www.youtube.com/watch?v=ozdQ1mLXBQE https://www.youtube.com/watch?v=XTUm-75-PL4 https://www.youtube.com/watch?v=rI</p>	<p>Atom Molecule Organelle Cell Tissue Organ Organ system Organism Population Community Ecosystem Biosphere Unicellular multi-cellular Biomolecule Macromolecule Enzyme Reaction rate catalyst Water protein carbohydrate monosaccharide simple sugar disaccharide double sugar polysaccharide complex carbohydrate glycogen, insulin protein, enzymes, substrate, catalyst, lipid, fatty acid, glycerol nucleic acid</p>

			<p>2.) Ways the functions of two different systems affect one another; and</p> <p>3.) A system's function and how that relates both to the system's parts and to the overall function of the organism.</p> <p>H1ym916Fo https://www.youtube.com/watch?v=yk14dOOvwMk</p> <p>• LABSTER :</p> <ul style="list-style-type: none"> -4 Major Macromolecules -Effect of Particle Size on Reaction Rate -Enzymes and Liver 	nucleotide solvent, glucose, concentration, pH, temperature, activators, inhibitor, activation energy
Crosscutting Concepts			Science and Engineering Practices	
<p>Structure & Function:</p> <ul style="list-style-type: none"> • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. Structure and Function – Teacher Video https://thewonderofscience.com/videos/2017/12/10/ls1a-structure-and-function https://thewonderofscience.com/videos/2017/12/10/ccc6-structure-and-function <p>Systems & System Models:</p> <ul style="list-style-type: none"> • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. <i>Thinking in Systems-Simulating Systems</i>– Teacher Video: https://www.youtube.com/watch?v=XPcoFqgl_9U&t=45s <p>Stability & Change:</p> <ul style="list-style-type: none"> • Much of science deals with constructing explanations of how things change and how they remain stable. • Feedback (negative or positive) can stabilize or destabilize a system. 			<p>Developing & Using Models:</p> <ul style="list-style-type: none"> • Develop, revise, and use models to predict and support explanations of relationships between systems or between components of a system. • Use models (including mathematical and computational) to generate data to support explanations and predict phenomena, analyze systems, and solve problems • Evaluate merits and limitations of two different models of the same proposed tool, process, or system in order to select or revise a model that best fits the evidence or design criteria. <i>Developing and Using Models – Teacher Video:</i> https://thewonderofscience.com/videos/2017/12/10/sep2-developing-and-using-models <p>Planning & Carrying Out Investigations:</p> <ul style="list-style-type: none"> • Design and conduct an investigation individually and collaboratively, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. • Select appropriate tools to collect, record, analyze, and evaluate data. • Use investigations to gather evidence to support explanations or concepts. <p>Analyzing & Interpreting Data:</p> <ul style="list-style-type: none"> • Use tools, technologies, and/or models (e.g., computational, mathematical) to generate and analyze data in order to make valid and reliable scientific claims or determine an optimal design solution. • Consider limitations (e.g., measurement error, sample selection) when analyzing and interpreting data. 	
Anchoring Phenomenon			Investigative Phenomenon	
<p>Introduction to Biology https://www.youtube.com/watch?v=7L7x0BAqWis</p>			<p>Enzymes https://www.youtube.com/watch?v=Og5xAdC8EUI</p>	

Unit 1: Matter & Energy in Organisms

Theme: Cellular Basis of Life

Big Idea: Food provides materials and energy for organisms to carry out the basic functions of life and to grow. Green plants and some bacteria are able to use energy from the Sun to create complex food molecules (photosynthesis). Animals obtain energy by breaking down these molecules (cellular respiration) and are ultimately dependent on green plants as their source of energy.

Essential Questions for this Unit:

1. What is the Cell Theory?
2. What are the cell organelles and how do their structures relate to their functions?
3. How is energy converted within the process of both photosynthesis and cellular respiration?
4. How do cell structures enable a cell to carry out basic life processes?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
<p>Essential HS.L2U1.21 Obtain, evaluate, and communicate data showing the relationship of photosynthesis and cellular respiration.</p> <p>Plus HS+B.L2U1.8 Develop and use models to develop a scientific explanation that illustrates how photosynthesis transforms light energy into stored chemical energy and how cellular respiration breaks down macromolecules for use in metabolic processes.</p> <p>Plus HS+B.L1U1.4 Develop and use models to explain the interdependency and interactions between cellular organelles.</p>	<p>L1: Organisms are organized on a cellular basis and have a finite life span.</p> <ul style="list-style-type: none"> • Within cells there are many molecules of different kinds which interact in carrying out the functions of the cell. • In multi-cellular organism's cells communicate with each other by passing substances to nearby cells to coordinate activity. • A membrane around each cell plays an important part in regulating what can enter or leave a cell. <p>L2: Organisms require a supply of energy and materials for which they often depend on, and compete with, other organisms.</p> <ul style="list-style-type: none"> • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. • The sugar molecules thus formed contain carbon, hydrogen, and oxygen. • For example, aerobic (in the presence of oxygen) cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules 	<p>-I can explain the role of energy in cellular growth, development and repair using a model.</p> <p>-I can develop and use a model to explain the particular function of cell parts</p> <p>-I can create a model to explain the particular function of cell parts in terms of their contributions to overall cellular functions:</p> <ol style="list-style-type: none"> a. System 1: How photosynthesis transforms light energy into stored energy (i.e., light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen). b. System 2: How cellular respiration breaks down macromolecules for use in metabolic processes (i.e., the bonds of food molecules, with and without oxygen, are broken down to produce energy and release carbon dioxide). <p>-I can plan and carry out investigations to describe the relationship between the exchange of carbon between organisms and the environment.</p> <p>-I can use various models to describe the role of storing carbon in organisms as part</p>	<p>Summative Assessments: CANVAS Benchmark Tests APEX Quizzes / UNIT Tests Laboratory Experiment Report Project</p> <p>Formative Assessments: • Activity: Identify the model that shows the correct labeling of eukaryotic/prokaryotic cells. • Extend: Identify the function of each cell structure for plant/animal cell. (ie Which structure/function is represented by plants only?)</p> <p>Short Performance Assessments: 1. Photosynthesis Model Lab: https://docs.google.com/viewer?a=v&p_id=sites&srcid=bGluY29sb3RMTub3ludXN8c2NpZW5jZS13aXR0LW1ycy1hdXN0aW58Z3q6M2Y2NTIzMmNhNWMyYVU3Mg 2. Photosynthesis s/Cellular Respiration Cycle Activity: Create a model of the current photosynthesis/cellular respiration cycle, compare the molecules & the flows into & out of the plant. Students use physical materials and/or virtual media. Student groups share their models, critique each other's models focusing on evidence relating to accuracy, positive feedback relating to effective features, & constructive suggestions for improving models. 3. Air Plant Survival :</p>	<ul style="list-style-type: none"> • APEX Lesson Assignments • CANVAS: supplementary lessons and student email communication. Label the Parts of the Cell - ws Cell Label - ws <p>Inside the Living Cell: How Cells Obtain Energy – video & ws https://www.youtube.com/watch?v=xMn319zkZ2s Ask testable questions about how skin and muscle cells look different but are genetically identical.</p> <p>Photosynthesis and Respiration – video & ws http://www.youtube.com/watch?v=JEniph9mik4</p> <p>Cell Respiration – video & ws https://www.explorelarning.com/index.cfm?method=cResource.dspDetail&InteractIveCaseID=1&ResourceID=3064 https://az.pbslearningmedia.org/resource/668b15d0-cceb-4655-86e7-7c5eabc0c53c/cellular-respiration/</p> <p>Photosynthesis – video & ws https://www.explorelarning.com/index.cfm?method=cResource.dspDetail&InteractIveCaseID=11&ResourceID=3054</p>	<p>Photosynthesis Heliotropism respiration autotroph heterotroph aerobic anaerobic fermentation product reactant cellular respiration energy development repair atom, molecules cell form function prokaryotic eukaryotic nucleus Nuclear envelope Nucleolus chromatin centromere chromatid chromosome cell membrane cytoplasm ribosome rough/smooth er Golgi body, vacuole Mitochondria lysosome Centriole</p>

	<p>are broken and new compounds are formed that can transport energy to muscles.</p> <ul style="list-style-type: none"> Anaerobic (without oxygen) cellular respiration follows a different and less efficient chemical pathway to provide energy in cells. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy loss to the surrounding environment. 	<p>of the carbon cycle.</p> <p>-I can construct an explanation based on evidence that explains how energy inputs to cells occur either by photosynthesis or by taking in food.</p> <p>-I can combine elements or ideas to explain the interdependence and interactions between the chloroplast and mitochondria inputs and outputs</p>	<p>https://docs.google.com/document/d/1VAwiRT21-zowQ-RThvEt56t98NrfYRA0j_19DdKzYw/edit#heading=h.3hb5g37dibjf</p> <p>https://docs.google.com/document/d/1QFlqVATC3PV-8CaatF5Ka8m818r_LWEeeK01eRNHCqg/edit#</p> <p>4. Plants & Light Intensity: Plant and record the growth of several plants, each exposed to a different amount (duration and/or intensity) of light. Use Shamrock Video Phenomena: https://www.youtube.com/watch?v=iBW11QzbkiQ</p>	<p>https://az.pbslearningmedia.org/resource/5622b106-46eb-4d9f-aa03-775ffa45f04d/photosynthesis-crash-course-biology-8/</p> <p>PS & Van Helmont Experiment– video & ws https://www.youtube.com/watch?v=wXLqTn6gqqs</p> <p>Air Plants - No Soil Needed– video & ws https://thewonderofscience.com/phenomenon/2018/5/13/air-plants-no-soil-needed</p>	<p>microtubule Microfilament cytoskeleton chloroplast Chlorophyll cell wall cellulose fibers DNA Organelle</p>
Crosscutting Concepts			Science and Engineering Practices		
<p>Systems & System Models:</p> <ul style="list-style-type: none"> Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. <p>Structure & Function:</p> <ul style="list-style-type: none"> Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. <p>Energy & Matter:</p> <ul style="list-style-type: none"> The total amount of energy and matter in closed systems is conserved. Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. <p><i>Organization for Matter & Energy Flow in Organisms – Teacher Video:</i> https://thewonderofscience.com/videos/2017/12/10/ls1c-organization-for-matter-and-energy-flow-in-organisms</p> <p><i>Matter & Energy Teacher Video:</i> https://thewonderofscience.com/videos/2017/12/10/cc5-matter-and-energy</p>			<p>Developing & Using Models:</p> <ul style="list-style-type: none"> Use multiple types of models to represent and support explanations of phenomena, and move flexibly between model types based on merits and limitations. Develop, revise, and use models to predict and support explanations of relationships between systems or between components of a system. Use models (including mathematical and computational) to generate data to support explanations and predict phenomena, analyze systems, and solve problems. <p><i>Developing and Using Models – Teacher Video:</i> https://thewonderofscience.com/videos/2017/12/10/sep2-developing-and-using-models</p> <p>Planning & Carrying Out Investigations:</p> <ul style="list-style-type: none"> Design an investigation individually and collaboratively and test designs as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. 		
Anchoring Phenomenon			Investigative Phenomenon		
<p>Why Do Sunflowers Follow the Sun? https://thewonderofscience.com/phenomenon/2018/6/15/why-do-sunflowers-follow-the-sun</p> <p>How Do Sunflowers face the Sun? https://www.youtube.com/watch?v=9RBktO4RK8s</p>			<p>Putting on Mass – Just How Do Trees Grow? – Van Helmont http://pulse.pharmacy.arizona.edu/10th_grade/dawn_new/science/putting_mass.html</p>		

Unit 2: Homeostasis and Cell Function in Organisms

Theme: Cell Transport

Big Ideas: A membrane around each cell plays an important part in regulating what can enter or leave a cell.

Essential Questions for this Unit:

1. How does a cell maintain homeostasis both within itself and as part of a multi-cellular organism?
2. How does the structure of the cell membrane aid in its functions of protection, recognition, and transport?
3. Why are both passive and active transport processes important in cell membranes?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
<p>Essential HS.L1U1.20 Ask questions and/or make predictions based on observations and evidence to demonstrate how cellular organization, structure, and function allow organisms to maintain homeostasis. (Note: Focus phenomena being homeostasis.)</p> <p>Plus HS+B.L1U1.6 Develop and use models to show how transport mechanisms function in cells.</p> <p>Plus HS+B.L1U1.4 Develop and use models to explain the interdependency and interactions between cellular organelles.</p>	<p>L1: Organisms are organized on a cellular basis and have a finite life span.</p> <ul style="list-style-type: none"> ● Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. ● Outside that range (e.g., at a too high or too low external temperature, with too little food or water available), the organism cannot survive. ● Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. 	<p>-I can analyze data to ask question s about how mechanisms affect homeostasis (positive and negative feedback).</p> <p>-I can analyze data to plan and carry out an investigation to predict the relationship of positive or negative feedback to the change of the internal conditions of an organism</p> <p>-I can collect data that explains how changes in the external environment of a living system cause changes in the internal environment (homeostasis).</p>	<p>Summative Assessments: CANVAS Benchmark Tests APEX UNIT Tests Research Report: Develop a model to show how the pancreas regulates blood sugar to include inputs and outputs that will raise and lower blood sugar.</p> <p>Formative Assessments: APEX Lesson Quizzes</p> <p>Quarterly Performance Assessment: <u>Lab Experiment</u> Part 1: Students will predict the relationship of positive or negative feedback to the change of the internal conditions of an organism –</p> <ul style="list-style-type: none"> ● Explain how to collect data that will determine if standing on your head affects heart rate. <p>Develop an investigation plan and describe the data that will be collected and the evidence to be derived from the investigation. <u>Variables Affecting Heart Rate Responses</u> Part 2: Students will carry out an investigation and analyze data <u>Student choice: Select 1</u></p>	<ul style="list-style-type: none"> ● APEX Lesson Assignments ● CANVAS: supplementary lessons: Article-The Science of Sweat Keeping Cool: The Science of Sweat / Live Science What is Homeostasis? – video/ws https://www.youtube.com/watch?v=quQr6X1Q58I ● After reading accounts of individuals that have fallen through the ice and survived after being submerged for extended time, identify variables that would be helpful to collect data on to further understand why the individuals survived. Positive & Negative Feedback– video https://www.youtube.com/watch?v=Clv3SkF_Eaq ● After watching the rate of a contractile vacuole in a paramecium, construct an explanation for why the rate increases when pure water is placed in its environment. Naked Egg and Osmosis– video/ws https://www.youtube.com/watch?v=SrON0nEEWmo&t=106s Porpoises Control their Heart Rate https://www.youtube.com/watch?v=t61wYGR1A8k Graph: Heart Rate of a Diving Weddell Seal Deep Diving Mammals – video/ws <i>Using the information in the video</i> 	<p>cell membrane homeostasis permeable semi-permeable transport ions macromolecule active transport passive transport diffusion osmosis concentration solvent Solute solution equilibrium facilitated diffusion endocytosis phagocytosis pinocytosis exocytosis isotonic hypertonic hypotonic hydrophobic hydrophilic membrane protein lipid bilayer intrinsic factor extrinsic factor feedback mechanism, positive feedback negative feedback endothermic exothermic</p>

			<ul style="list-style-type: none"> • Conduct an experiment on the effects of putting your foot into ice water on heart rate, collect data and explain the reasoning for the pattern in heart rate you see. • Conduct an investigation to test the effects of jumping jacks on several components of the temperature regulation system. <p>Optional Topic: Root Development in Response to Water Levels</p>	<p><i>and the data above, create (illustrate) a model that explains the feedback mechanism that maintains a porpoise's internal conditions, allowing it to survive at various depths in the ocean.</i></p> <p>•LABSTER: -Osmosis -Active Transport -Passive transport -From a designed experiment, determine the effect of different concentrations of salt water has on regulating water content in lettuce cells. Identify the controlled variables, dependent, and independent variables.</p>	
Crosscutting Concepts			Science and Engineering Practices		
<p>Cause & Effect:</p> <ul style="list-style-type: none"> • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. <p>Stability & Change:</p> <ul style="list-style-type: none"> • Much of science deals with constructing explanations of how things change and how they remain stable. • Feedback (negative or positive) can stabilize or destabilize a system. <p>Systems & System Models:</p> <ul style="list-style-type: none"> • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models 			<p>Asking Questions & Defining Problems:</p> <ul style="list-style-type: none"> • Ask questions that arise from careful observation of phenomena, models, theory, or unexpected results. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. <p>Planning & Carrying Out Investigations:</p> <ul style="list-style-type: none"> • Design an investigation individually and collaboratively and test designs as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. • Design and conduct an investigation individually and collaboratively, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. • Select appropriate tools to collect, record, analyze, and evaluate data. • Design and conduct investigations and test design solutions in a safe and ethical manner including considerations of environmental, social, and personal impacts. • Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables. • Use investigations to gather evidence to support explanations or concepts. 		
Anchoring Phenomenon			Investigative Phenomenon		
<p>Alligators Survive in Ice https://thewonderofscience.com/phenomenon/2018/7/5/alligators-survive-in-ice</p>			<p>Porpoises Control their Heart Rate https://www.youtube.com/watch?v=t61wYGR1A8k</p>		