Standard PS.9

PS.9	The student will investigate and understand the characteristics of transverse waves. Key concepts include a) wavelength, frequency, speed, amplitude, crest, and trough; b) the wave behavior of light; c) images formed by lenses and mirrors; d) the electromagnetic spectrum; and e) technological applications of light.

Essential Understandings	Essential Knowledge, Skills, and Processes
• Concave and convex lenses refract light. ~~Concave~~Convex lenses converge light. ~~Convex~~ Concave lenses diverge light. • Diffraction is when light waves strike an obstacle and new waves are produced. • Interference takes place when two or more waves overlap and combine as a result of diffraction.	

Standard BIO.3

BIO.3 The student will investigate and understand relationships between cell structure and function. Key concepts include
a) evidence supporting the cell theory;
b) characteristics of prokaryotic and eukaryotic cells;
c) similarities between the activities of the organelles in a single cell and a whole organism;
d) the cell membrane model; and
e) the impact of surface area to volume ratio on cell division, material transport, and other life processes.

Essential Understandings	Essential Knowledge and Skills
The concepts developed in this standard include the following: • ~~The c~~Cell theory is the unifying theme in biology because it emphasizes the similarity of all living things. ~~The traditional c~~Cell theory states that 1) living things are composed of one or more cells; ~~and that cells come from other cells by the process of cell reproduction;~~ 2) cells are the basic units of structure and function of all living things; and 3) ~~cells contain specialized structures to perform functions necessary for life~~new cells arise from pre-existing cells. • The development of ~~the~~ cell theory was accelerated by the ability to make observations on a microscopic level. The development and refinement of magnifying lenses and light microscopes made the observation and description of ~~microscopic organisms and~~ living cells possible. • Continued advances in microscopy allow~~ed~~ observation of cell organelles and ultrastructure. Current technology allows the observation of cellular processes underlying both cell structure and function. • ~~As a result of additional study and the integration of studies of cell life functions, a modern cell theory has been developed. The modern cell theory, in addition to the tenants of the traditional cell theory, states 1) energy flow (metabolism and biochemistry) occurs within cells; 2) cells contain hereditary information (DNA) that is passed from cell to cell during cell division; and 3) all cells are basically the same in chemical composition in organisms of similar species.~~ • Cell structure and chemistry ~~is~~ are ~~one of the~~ ways in which organisms differ from each other. The diversity that exists ranges from simple prokaryotic cells to complex multicellular organisms.	In order to meet this standard, it is expected that students will • describe the key events leading to the development of the cell theory. • compare and contrast characteristics of prokaryotic and eukaryotic cells. • compare and contrast the activities of an organelle in a single cell and a whole organism. • identify the following essential cell structures and their functions - the nucleus (contains DNA; site where RNA is made) - ribosome (site of protein synthesis) - mitochondrion (site of cell respiration) - chloroplast (site of photosynthesis) - endoplasmic reticulum (transports materials through the cell) - Golgi (site where cell products are packaged for export) - lysosome (contains digestive enzymes) - cell membrane (controls what enters and leaves the cell) - cell wall (provides support) - vacuole (storage of material) - cytoplasm (contains organelles and site of many chemical reactions) - centriole (organizes spindle fibers in animal cells) - cytoskeleton • describe how the selective permeability of the cell membrane affects the life of a cell. • describe processes associated with movement across the membrane for diffusion, facilitated diffusion, osmosis, and active transport.

Standard LS.2

LS.2 The student will investigate and understand that all living things are composed of cells. Key concepts include
a) cell structure and organelles;
b) similarities and differences between plant and animal cells;
c) development of cell theory; and
d) cell division.

Essential Understandings	Essential Knowledge, Skills, and Processes
The concepts developed in this standard include the following: • The structure of a cell organelle is suited to the function carried out by that organelle. Division of labor within a cell is essential to the overall successful function of the cell. • Similarities and differences in plants and animals are evident at the cellular level. Plant and animal cells contain some of the same organelles and some that differ. • ~~The original c~~Cell theory includes the following components: all living things are composed of cells; cells are the smallest unit (structure) of living things that can perform the processes (functions) necessary for life; and living cells come only from other living cells. ~~(Although it is appropriate for students at this level to understand the three points of the original cell theory, an exploration of the revised cell theory should be reserved for high school Biology.)~~ • The development of ~~the original~~ cell theory can be attributed to the major discoveries of many notable scientists. The development of ~~the~~ cell theory has been dependent upon improvements in the microscope technologies and microscopic techniques throughout the last four centuries. • Continuing advances in microscopes and instrumentation have increased the understanding of cell organelles and their functions. Many of these organelles can now be observed with a microscope (light, electron). • Cells go through a life cycle known as the cell cycle. The phases of the cell cycle are interphase, mitosis, and cytokinesis. (Although it is appropriate for students at this level to learn to recognize the stages of the cell cycle and mitosis, an exploration of the individual stages of meiosis may be reserved for high school Biology.)	In order to meet this standard, it is expected that students will • distinguish among the following: cell membrane, cytoplasm, nucleus, cell wall, vacuole, mitochondrion, endoplasmic reticulum, and chloroplast. • correlate the structures of cell organelles with their functions. • compare and contrast examples of plant and animal cells, using the light microscope and images obtained from other microscopes. • describe and sequence the major points in the development of the cell theory. • identify the three components of the ~~original~~ cell theory. • sequence the steps in the cell cycle, including the phases of mitosis. • differentiate between the purpose of mitosis and meiosis. • design an investigation from a testable question related to animal and plant cells. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. An example of such a question is: "Do onion cells vary in shape or structure depending on where they are found in the plant?"