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| **4. E Energy** |
| Students who demonstrate understanding can:  **a. Construct a simple explanation for the relationship between energy and motion.** [Clarification Statement: Examples could be that a faster ball will make a louder sound when it hits the wall than a slower one or a fast car has more energy than a slow car.] [Assessment Boundary: No attempt is made to give a precise definition of energy.]  **b. Carry out investigations to provide evidence that energy is transferred from place to place by sound, light, heat, electric currents, interacting magnets, and moving or colliding objects.** [Assessment Boundary: Quantitative measurements of energy are beyond the scope of assessment.]  **c. Obtain and communicate information for how technology allows humans to concentrate, transport , and store energy for practical use.** [Clarification Statement: Examples could be batteries in electrical devices, power grids, or gasoline stations.]  **d. Design and construct a device that converts energy from one form to another using given design criteria.** [Clarification Statement: Examples of devices could be a windmill, watermill, alarm circuit, bell, or solar oven.]  **e. Design and test a solution to a problem that utilizes the transfer of electric energy in the solution using given design constraints.** [Clarification Statement: Examples of solutions could be a flashlight, electric motor, or doorbell.]  **f. Develop a model using examples to explain differences between renewable and non-renewable sources of energy.** [Assessment Boundary: Should not include climate change.]  **g. Construct simple explanations for how forces on an object cause the object to change its energy.** [Clarification Statement: Examples of explanations could include how an unbalanced force is required to put an object in motion or stop the motion of an object.] |

**NEXT GENERATION SCIENCE STANDARDS - MATTER & ENERGY IN ECOSYSTEMS**

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| **5.MEE Matter and Energy in Ecosystems** |
| Students who demonstrate understanding can:  **a. Construct models of food webs to explain the interrelationship among plants, animals, and fungi within ecosystems.**  **b. Use models to trace the cycling of particles of matter between the air and soil and among plants, animals, and microbes.** [Assessment Boundary: The emphasis is on students applying the particle model to explain how matter cycles; it does not include the chemistry of metabolism.]  **c. Use models to describe how decomposition eventually returns (recycles) some materials back to the soil for plants to use.**  **d. Ask questions about how food provides animals with the materials they need for body repair and growth and is digested by animals to release the energy they need to maintain body warmth and allow for motion.**  **e. Obtain and communicate information tracing the source of energy for burning fuel or digesting food back to energy from the sun that was captured by plants through a chemical process.**  **f. Use models to communicate that plants obtain matter to grow chiefly from the air and water, and energy to grow from the sun.** [Assessment Boundary: Details of photosynthesis are not included.]  **g. Plan and carry out investigations to determine the role of light in plant growth.** [Assessment Boundary: Details of photosynthesis are not included.]  **h. Design and construct a model to describe the interactions of systems within an ecosystem in terms of the flow of energy, cycling of matter, and the conditions for a healthy ecosystem.** [Clarification Statement: Examples of a healthy ecosystem are ones in which multiple species of different types are able to meet their needs or no new invasive species are introduced.] |

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| **MS.LS-MEOE Matter and Energy in Organisms and Ecosystems** |
| Students who demonstrate understanding can:  **a. Develop an explanation for the role of photosynthesis in the cycling of matter and flow of energy on Earth.** [Assessment Boundary: Limited to the explanation related to water, carbon dioxide, and light energy being used to produce sugars and release oxygen NOT the chemical equation for photosynthesis.]  **b. Investigate the cycling of matter among living and nonliving parts of ecosystems to explain the flow of energy and conservation of matter.** [Clarification Statement: Investigations are qualitative observations of the cycling of water, carbon, and oxygen in the environment.]  **c. Use models to explain the transfer of energy into, out of, and within ecosystems.** [Assessment Boundary: Only light, chemical, and thermal energy need to be addressed with an emphasis that the total amount of energy does not change.]  **d. Construct and communicate models of food webs that demonstrate the transfer of matter and energy among organisms within an ecosystem.** [Clarification Statement: Models of food webs should include producers, consumers and decomposers.]  **e. Use evidence to support an explanation that matter is conserved when molecules from food react with oxygen in the environment and cycle repeatedly between living and non-living components of ecosystem.**  **f. Use evidence to support arguments that changing any physical or biological component of an ecosystem may result in shifts in the populations of species in the ecosystem.** |

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| **MS.LS-GDRO Growth, Development, and Reproduction of Organisms** |
| Students who demonstrate understanding can:  **a. Use evidence to support an explanation of how environmental and genetic factors affect the growth of organisms.** [Clarification Statement: The emphasis is on the impact of factors in terms of cause and effect, not the mechanism (e.g., abundant food leads to more significant growth, offspring of large breeds of dogs are larger than the offspring of small dogs).]  **b. Investigate and present evidence that plants continue to grow throughout their life through the production of new plant matter via photosynthesis.** [Assessment Boundary: Reproduction is not treated in any detail here, for more specifics of grade level see DCI LS3.A.]  **c. Use models to construct an explanation of how the genetic contribution from each parent through sexual reproduction results in variation in offspring and how asexual reproduction results in offspring with identical genetic information.** [Assessment Boundary: The emphasis is on the impact of gene transmission in reproduction, not the mechanism of the gene interactions.]  **d. Plan and conduct investigations to gather evidence for the relationship among specialized plant structures, specific animal behaviors, and the successful reproduction of the plant.** [Clarification Statement: Examples of evidence of successful reproduction of plants could include placement of stamen and bees gathering nectar, hard shells on pine nuts and squirrels burying nuts.]  **e. Use empirical evidence to support an argument for how characteristic animal behaviors affect the probability of successful reproduction.** [Clarification Statement: Examples of animal behaviors could include birds building nests to protect young, brown trout spawning in late fall when predators are less active.]  **f. Provide explanations of how changes (mutations) to genes, which are located on chromosomes, affect specific inherited traits resulting in harmful, beneficial, or neutral effects.**  **g. Provide an explanation for the relationship among changes (mutations) to genes, changes to the formation of proteins, and the effect on the structure and function of the organism and thereby traits.**  **h. Communicate explanations of ways technologies enable humans to influence the inheritance of certain traits in plants and animals.** [Clarification Statement: Examples of human influence could be breeds of cattle for various purposes, disease resistant crops, genetically modified organisms.] |

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| **HS.LS-MEOE Matter and Energy in Organisms and Ecosystems** |
| Students who demonstrate understanding can:  **a. Construct a model to support explanations of the process of photosynthesis by which light energy is converted to stored chemical energy.** [Clarification Statement: Models may include diagrams and chemical equations. The focus should be on the flow of matter and energy through plants.] [Assessment Boundary: Limited to the inputs and outputs of photosynthesis and chemosynthesis, not the specific biochemical steps involved.]  **b. Construct an explanation of how sugar molecules that contain carbon, hydrogen, and oxygen are combined with other elements to form amino acids and other large carbon-based molecules.** [Clarification Statement: Explanations should include descriptions of how the cycling of these elements provide evidence of matter conservation.] [Assessment Boundary: Focus is on conceptual understanding of the cycling of matter and the basic building blocks of organic compounds, not the actual process.]  **c. Use a model to explain cellular respiration as a chemical process whereby the bonds of food molecules and oxygen molecules are broken and bonds in new compounds are formed that result in a net transfer of energy.** [Assessment Boundary: Limited to the conceptual understanding of the inputs and outputs of metabolism, not the specific steps.]  **d. Evaluate data to compare the energy efficiency of aerobic and anaerobic respiration within organisms.** [Assessment Boundary: Limited to a comparison of ATP input and output.]  **e. Use data to develop mathematical models to describe the flow of matter and energy between organisms and the ecosystem.** [Assessment Boundary: Use data on energy stored in biomass that is transferred from one trophic level to another.]  **f. Communicate descriptions of the roles of photosynthesis and cellular respiration in the carbon cycle specific to the carbon exchanges among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.**  **g. Provide evidence to support explanations of how elements and energy are conserved as they cycle through ecosystems and how organisms compete for matter and energy.** [Clarification Statement: Elements included can include carbon, oxygen, hydrogen, and nitrogen.] |

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| **MS.PS-CR Chemical Reactions** |
| Students who demonstrate understanding can:  **a. Develop representations showing how atoms regroup during chemical reactions to account for the conservation of mass.** [Assessment Boundary: Representations should not involve bonding energy or valence electrons. Balancing equations are also not employed here.]  **b. Generate and revise explanations from the comparison of the physical and chemical properties of reacting substances to the properties of new substances produced through chemical reactions to show that new properties have emerged.** [Assessment Boundary: Comparison and analysis should not involve statistical techniques.]  **c. Construct explanations of energy being released or absorbed when simpler molecules are combined into complex molecules or complex molecules are broken down to simpler molecules.** [Clarification Statement: Simple molecules can include H2O and CO2, and complex molecules can include C6H12O6 in photosynthesis.] [Assessment Boundary: Further details of the photosynthesis process are not addressed.]  **d. Develop models to represent the movement of matter and energy in the cycling of carbon.** [Clarification Statement: Examples of the movement of matter and energy could include the cycling from carbon in the atmosphere to carbon in living things.] [Assessment Boundary: Further details of the photosynthesis process are not addressed.] |