| **Required Course Numbers** | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test Content Categories** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Tasks of Teaching Science** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| To define the practice-based content knowledge required to teach the student-level content domain, this part of the framework highlights the critical tasks that elementary science teachers engage in as they work with students, curriculum, and instruction. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **I. Scientific Instructional Goals, Big Ideas, and Topics** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A. Selecting or sequencing age-appropriate, grade-level instructional goals or big ideas for a topic |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B. Identifying the big idea or instructional goal of an instructional activity |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C. Choosing which science ideas or instructional activities are most closely related to a particular instructional goal |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D. Linking science ideas to one another and to particular activities, models, and representations within and across lessons |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **II. Scientific Investigations and Demonstrations** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A. Selecting investigations or demonstrations that facilitate understanding of disciplinary core ideas, scientific practices, or crosscutting concepts |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B. Evaluating investigation questions for quality (e.g., testable, empirical) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C. Determining the variables, techniques, or tools that are appropriate for use by students to address a specific investigation question |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D. Critiquing scientific procedures, data, observations, or results for their quality, accuracy, or appropriateness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E. Evaluating and selecting media for engaging students in virtual investigations not possible in firsthand situations |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| F. Supporting students in generating questions for investigation or identifying patterns in data and observations |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **III. Scientific Resources (texts, curriculum materials, journals, and other print and media-based resources)** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A. Evaluating instructional materials and other resources for their ability to sufficiently address scientific concepts; engage students with relevant phenomena; develop and use scientific ideas; promote students’ thinking about phenomena, experiences, and knowledge; provide a sense of purpose; take account of students’ ideas; and assess student progress |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **IV. Student Ideas (including common misconceptions, alternate conceptions, and partial conceptions)** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A. Analyzing student ideas for common misconceptions regarding intended scientific learning |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B. Selecting diagnostic items and eliciting student thinking about scientific ideas and practices to identify common student misconceptions and the basis for those misconceptions |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C. Developing or selecting instructional moves, approaches, or representations that provide evidence about common student misconceptions and help students move toward a better understanding of the idea, concept, or practice |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D. Identifying the connections between students’ talk and work, and scientists’ talk and work |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **V. Scientific Language, Discourse, Vocabulary, and Definitions** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A. Selecting scientific language that is precise, accurate, grade-appropriate, and illustrates key scientific concepts |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B. Anticipating scientific language and vocabulary that may be difficult for students |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C. Supporting and critiquing students’ participation in and use of verbal and written scientific discourse and argumentation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D. Modeling the use of appropriate verbal and written scientific language in critiquing arguments or explanations, in describing observations, or in using evidence to support a claim, etc. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **VI. Scientific Explanations (includes claim, evidence, and reasoning)** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A. Critiquing student-generated explanations or descriptions for their generalizability, accuracy, precision, or consistency with scientific evidence |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B. Selecting explanations of natural phenomena that are accurate and accessible to students |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **VII. Scientific Models and Representations (analogies, similes, metaphors, simulations, illustrations, diagrams, data tables, performances, videos, animations, graphs, and examples)** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A. Evaluating or selecting scientific models and representations that predict or explain scientific phenomena or address instructional goals |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B. Engaging students in using, modifying, creating, and critiquing scientific models and representations that are matched to an instructional goal |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C. Evaluating student models or representations for evidence of scientific understanding |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D. Generating or selecting diagnostic questions to evaluate student understanding of specific models or representations |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E. Evaluating student ideas about what makes for good scientific models and representations |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Content Topics** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| This list details the science topics critical for elementary students to master with their associated performance expectations. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **I. Earth and Space Sciences (30%)** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **A. Earth’s Place in the Universe** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. The universe and its stars |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. use observations of the Sun, Moon, and stars to describe patterns that can be predicted |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. support an argument that the apparent brightness of the Sun and stars is due to their relative distances from Earth |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Earth and the Solar System |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. make observations at different times of year to relate the amount of daylight to the time of year |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. The History of the Planet Earth |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. use information from several sources to provide evidence that Earth events can occur quickly or slowly |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **B. Earth’s Systems** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Earth’s Materials and Systems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Plate Tectonics and Large-Scale System Interactions |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. develop a model to represent the shapes and kinds of land and bodies of water in an area |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. analyze and interpret data from maps to describe patterns of Earth’s features |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. The Roles of Water in Earth’s Surface Processes |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. obtain information to identify where water is found on Earth and that it can be solid or liquid |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. describe and graph the amounts and percentages of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4. Weather and Climate |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. use and share observations of local weather conditions to describe patterns over time |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. represent data in tables and graphical displays to describe typical weather conditions expected during a particular season |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. obtain and combine information to describe climates in different regions of the world |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5. Biogeology |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C. Earth and Human Activity** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Natural Resources |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Natural Hazards |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Human Impacts on Earth Systems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **II. Life Sciences (35%)** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **A. From Molecules to Organisms: Structures and Processes** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Structure and Function |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Growth and Development of Organisms |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Organization for Matter and Energy Flow in Organisms |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. use observations to describe patterns of what plants and animals (including humans) need to survive |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. support an argument that plants get the materials they need for growth chiefly from air and water |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4. Information Processing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **B. Ecosystems: Interactions, Energy, and Dynamics** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Interdependent Relationships in Ecosystems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. plan and conduct an investigation to determine whether plants need sunlight and water to grow |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. develop a model to describe the movement of matter among plants, animals, decomposers, and the environment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Cycles of Matter and Energy Transfer in Ecosystems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. develop a model to describe the movement of matter among plants, animals, decomposers, and the environment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Ecosystem Dynamics, Functioning, and Resilience |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4. Societal Interactions and Group Behavior |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. construct an argument that some animals form groups that help members survive |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C. Heredity: Inheritance and Variation of Traits** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Inheritance of Traits and Variation of Traits |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. use evidence to support the explanation that traits can be influenced by the environment |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **D. Biological Evolution: Unity and Diversity** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Evidence of Common Ancestry and Diversity |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Natural Selection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Adaptation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4. Biodiversity and Humans |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. make observations of plants and animals to compare the diversity of life in different habitats |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **III. Physical Sciences (35%)** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **A. Matter and Its Interactions** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Structure and Properties of Matter |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. plan and conduct an investigation to describe and classify different kinds of materials by their observable properties |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| d. develop a model to describe that matter is made of particles too small to be seen |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| e. measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| f. make observations and measurements to identify materials based on their properties |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Chemical Reactions |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. conduct an investigation to determine whether the mixing of two or more substances results in new substances |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **B. Motion and Stability: Forces and Interactions** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Forces and Motion |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| d. make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Types of Interactions |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| d. define a simple design problem that can be solved by applying scientific ideas about magnets |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| e. support an argument that the gravitational force exerted by Earth on objects is directed down |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C. Energy** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Definition of Energy, Conservation of Energy and Energy Transfer |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. use evidence to construct an explanation relating the speed of an object to the energy of that object |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. ask questions and predict outcomes about the changes in energy that occur when objects collide |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| d. apply scientific ideas to design, test, and refine a device that converts energy from one form to another |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Relationship between Energy and Forces |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. ask questions and predict outcomes about the changes in energy that occur when objects collide |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Energy in Chemical Processes and Everyday Life |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. apply scientific ideas to design, test, and refine a device that converts energy from one form to another |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the Sun |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **D. Waves and Their Application in Technologies for Information Transfer** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Wave Properties |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Electromagnetic Radiation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. make observations to construct an evidence-based account that objects can be seen only when illuminated |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| c. develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Information Technologies and Instrumentation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| a. use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b. generate and compare multiple solutions that use patterns to transfer information |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **IV. Engineering, Technology, and the Application of Science** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **A. Defining and Delimiting an Engineering Problem** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **B. Developing Possible Solutions** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C. Optimizing the Design Solution** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |