ARIZONA SCIENCE TEST

**Science High School**
**Performance Level Descriptors (PLDs)**

| | Minimally Proficient | Partially Proficient | Proficient | Highly Proficient |
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| **Physical Science Core Ideas/Claims** | | | | |
| P1<br>All matter in the Universe is made of very small particles. | ● identify subatomic particles of atoms<br>● identify elements, ions, and molecules<br>● Identify conservation of mass in reactions<br>● identify ethical, social, economic, or political effects of chemistry-related technologies | ● describe the electric charges of the subatomic particles in atoms<br>● describe how electrons can be shared or transferred<br>● identify factors that affect reaction rates<br>● describe ethical, social, economic, and/or political implications of chemistry-related technologies | ● demonstrate the relationship of atomic structures to placement in the periodic table<br>● demonstrate the role of electrons in the formation of ions, molecules, and compounds<br>● understand that reaction rates depend on molecular collisions<br>● differentiate between positive and negative ethical, social, economic, and/or political effects of chemistry-related technologies | ● evaluate or predict how changes to atomic structures alter properties<br>● evaluate conditions regarding electron activity in the formation of molecules<br>● predict the outcomes of reactions based on factors that affect molecular collisions<br>● critique or predict the effects of chemistry-related technologies |
| P2<br>Objects can affect other objects at a distance. | ● identify gravitational, electric, and magnetic forces | ● distinguish the effects of distance on the strength of gravitational, electric, and magnetic fields | ● demonstrate factors that influence the strength of gravitational, electric, and magnetic fields | ● predict how field strength is affected by different distances for gravitational, electric, and magnetic fields |
| P3<br>Changing the movement of an object requires a net force to be acting on it. | ● identify changes in an object's motion<br>● identify products engineered to involve motion | ● distinguish between constant motion and acceleration<br>● select math concepts applied to objects in everyday situations | ● demonstrate the role of force in situations that lead to changes in motion, using Newton's Laws<br>● apply math concepts to explain how force is used in useful objects | ● evaluate situations to predict the cause or result of an object's motion, using Newton's Laws<br>● predict outcome when changes are made to forces acting on everyday objects |

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| P4<br>The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event. | ● identify or define energy in different forms<br>● identify benefits of energy usage<br>● identify characteristics of waves | ● distinguish different forms of energy<br>● differentiate effects of transfer of different energy resources in society<br>● describe the relationship between frequency, wavelength, and speed of waves | ● apply the conservation of energy principle to account for energy changes<br>● demonstrate effects of energy usage/transfer involving different energy resources on society<br>● understand the effects different media have on wave characteristics, including in technological applications | ● evaluate or construct explanations to describe conservation of energy<br>● critique or revise explanations or predict outcome of energy usage/transfer involving different energy resources on society<br>● predict wave behavior in different media, including behavior in technological applications |

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| **Earth and Space Science Core Ideas/Claims** | | | | |
| E1<br>The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and its climate. | ● identify the sun as the source of both weather and climate<br>● identify changes in matter that occur in Earth's internal and external systems<br>● identify theories about the role of energy and matter in geologic changes over time<br>● identify impact of human activity on natural resources | ● differentiate between weather and climate<br>● describe the role of energy in changes that can occur in Earth's external and internal systems<br>● compare theories about the role of energy and matter in geologic changes over time<br>● describe effects of human activity on climate, natural resources, and/or natural hazards | ● demonstrate how energy from the sun affects weather patterns and climate<br>● demonstrate the role of energy and matter in changes in Earth's internal and external systems<br>● evaluate theories about the role of energy and matter in geologic changes over time<br>● describe the interrelatedness of human activity, natural resources, natural hazards, and climate | ● predict how changes in Earth's atmosphere affect weather and climate<br>● evaluate or revise explanations of factors that cause changes in Earth's internal and external systems<br>● evaluate changes in Earth's surface based on theories about the role of energy and matter in geologic changes over time<br>● evaluate or predict outcomes of human activity on natural resources, hazards, or climate |
| E2<br>The Earth and our solar system are a very small part of one of many galaxies within the Universe. | ● identify fuel source for stars<br>● identify gravity as the relevant force in planetary motion<br>● identify the scale used for galactic distances<br>● describe the origin of the universe | ● describe the life cycle of a star<br>● describe planetary orbital paths in terms of gravitational force<br>● describe methods for measuring the expansion of the universe | ● demonstrate the role of nuclear fusion in a star's life cycle<br>● demonstrate how gravitational forces impact the evolution of planetary motion, structure, atmospheres, moons, and rings<br>● demonstrate the origin, expansion, and scale of the universe based on astronomical evidence | ● predict energy and/or starlight changes based on nuclear changes<br>● predict effects of other bodies' gravitational force on planetary motion and features<br>● evaluate evidence for origin, expansion, and/or scale of the universe |

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| **Life Science Core Ideas/Claims** | | | | |
| L1<br>Organisms are organized on a cellular basis and have a finite life span. | ● identify major cell structures<br>● identify cell division as a cell activity | ● distinguish cell organelles and their functions<br>● describe outcome of cell division | ● demonstrate cellular organization and processes to maintain homeostasis<br>● demonstrate that mitosis is a cellular process for growth and maintaining interconnected systems | ● predict how changes in external factors affect cellular activities<br>● demonstrate how disruptions in the cell-division process interfere with growth and maintaining interconnected systems |
| L2<br>Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. | ● identify stable ecosystems<br>● identify sources of energy for ecosystems<br>● differentiate photosynthesis from cellular respiration | ● describe human activities that can impact an ecosystem<br>● distinguish energy sources available to different species in an ecosystem<br>● identify inputs and outputs of photosynthesis and cellular respiration | ● demonstrate how humans impact biodiversity of an ecosystem<br>● understand how energy transfer involving different species occurs in an ecosystem<br>● show the flow of energy and matter between photosynthesis and cellular respiration | ● predict or evaluate results of human activity on the biodiversity of an ecosystem<br>● predict effects of changes in available energy to different species in an ecosystem<br>● evaluate/contrast the conditions, inputs, and outputs for photosynthesis and cellular respiration |
| L3<br>Genetic information is passed down from one generation of organisms to another. | ● identify DNA's role in sexual reproduction<br>●identify a DNA mutation<br>● identify genetic technology | ● describe how sex cells form<br>● describe causes of DNA mutations<br>● describe effects of gene technology | ● demonstrate how genetic variation is achieved by sexual reproduction<br>● demonstrate causes and implications of DNA mutations<br>● describe ethical, social, economic, and/or political implications of the application of gene technology | ● predict the outcome of situations involving sexual reproduction<br>● predict the effect of DNA mutations on the expression of traits<br>● evaluate the implications of employing gene technology |
| L4<br>The unity and diversity of organisms, living and extinct, is the result of evolution. | ● identify genetic traits<br>● identify evidence of evolution | ● describe trait variation frequencies in a population<br>● describe the process of natural selection | ● demonstrate how biodiversity is affected by the frequency of inherited traits in a population<br>● demonstrate multiple mechanisms of evolution | ● predict how variation of traits in a population can lead to biological diversity over multiple generations<br>● evaluate evidence that explains the mechanisms of evolution |

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| **Science and Engineering Practices** | | | | |
| Ask questions and define problems | ● ask questions that identify observations<br>● ask questions that can be investigated in lab settings<br>● ask questions that identify design problems | ● ask questions that determine relationships between variables<br>● ask questions that are testable<br>● ask questions that arise from observation of phenomena or unexpected results<br>● ask questions to distinguish variables | ● ask questions that clarify or provide additional information about phenomena, models, or theories<br>● ask questions to determine relationships, including quantitative relationships, between variables<br>● determine if a question is testable and relevant | ● ask questions that evaluate the relevance and feasibility of a proposed investigation<br>● ask questions that revise or clarify a model, an explanation, or an engineering design<br>● ask questions that challenge the premise(s) of an argument, the interpretation of data, or the suitability of a design |
| Develop and use models | ● identify reliable models<br>● identify models that illustrate a relationship between systems | ● distinguish models that address the same process or system<br>● develop or modify a model based on evidence | ● design a test of the model to ascertain reliability and identify limitations<br>● develop and use models to describe merits or limitations of two models of the same process<br>● develop and use models to show relationships between systems or components of a system<br>● develop and use models to generate data that supports explanations of phenomena or provides a solution to a problem<br>● develop and use models to describe unobservable mechanisms | ● evaluate or revise a model for a proposed process, tool, or system<br>● develop, revise, and use models to manipulate or test a proposed system<br>● revise and use models to describe unobservable mechanisms<br>● develop, revise, and use models to generate data useful in predicting phenomena |
| Plan and carry out investigations | ● identify data that can be used as evidence<br>● identify hypotheses that properly state the independent and dependent variables | ● identify and carry out investigations that generate data that can be used as evidence to support explanations<br>● identify and carry out investigations that produce data of sufficient quantity and accuracy to form or support | ● test a design by producing relevant data<br>● have directional hypotheses that will determine what happens to the responding variable when another variable is manipulated<br>● provide data of a proposed | ● ensure proper variables are used, measured, and controlled<br>● improve performance relative to criteria for success or other variables |

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| | | explanations<br>● identify and carry out investigations that include safe and ethical procedures<br>● identify appropriate tools to collect, record, analyze, and evaluate data | process to identify failure points or to improve performance<br>● use appropriate tools to collect, record, analyze, and evaluate data | |
| Analyze and interpret data | ● identify tools, technology, and/or models used in analyzing data | ● identify, distinguish, or describe data to compare data sets to determine consistency of observations<br>● identify, distinguish, or describe data to provide an analysis of a proposed process or system | ● analyze and interpret data to make a valid and reliable scientific claim<br>● analyze and interpret data to determine an optimal design solution<br>● analyze and interpret data to establish limitations of data analysis<br>● analyze and interpret data to identify design features or characteristics to optimize a process or system, given success criteria | ● analyze, interpret, and evaluate data to generate statistical analysis including correlation coefficient for linear data, slope, and intercept using digital tools<br>● analyze, interpret, and evaluate data to determine measurement error<br>● analyze, interpret, and evaluate data to propose explanations of the impact of new data on a process or system |
| Use mathematics and computational thinking | ●identify what type of data (qualitative or quantitative) is best to determine whether a proposed object or tool meets criteria for success<br>●identify units that accompany measurement computations | ●use mathematical and computational thinking to verify a solution<br>●use mathematical and computational thinking to distinguish between solutions<br>●use mathematical and computational thinking to apply correct units to solutions | ●use mathematical and computational thinking to construct a model or simulation of a process, phenomenon, or system<br>●use mathematical and computational thinking to select and apply correct techniques to derive a solution<br>●use mathematical and computational thinking to apply ratios, rates, percentages, and unit conversions in measurements | ●use mathematical and computational thinking to evaluate a proposed solution<br>●use mathematical and computational thinking to revise a solution to include supplemental data<br>●use mathematical and computational thinking to convert units of complex measurements involving derived units |
| Construct explanations and design solutions | ● identify explanations supported by evidence<br>● identify manipulated and responding variables | ● distinguish explanations and solutions that are supported by valid and reliable evidence<br>● distinguish explanations and solutions that contain | ● make a quantitative and/or a qualitative claim regarding the relationship between manipulated and responding variables<br>● construct explanations and | ●construct and evaluate explanations and solutions that predict outcomes when certain conditions exist<br>●construct and evaluate explanations and solutions |

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| | | qualitative or quantitative information regarding the relationship between variables | design solutions based on reliable and valid evidence obtained from a variety of sources<br>● apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems taking into account possible unanticipated effects<br>● apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion | that describe methods ensuring validity and reliability of results<br>●construct and evaluate explanations and solutions that prioritize criteria and include tradeoff considerations |
| Engage in argument from evidence | ●identify claims or evidence that support an argument | ● engage in arguments from evidence to describe merits of an argument<br>● engage in arguments from evidence to distinguish data that supports a claim or argument | ●evaluate an argument or solutions in light of new evidence or trade-offs<br>● evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument<br>● engage in arguments from evidence to defend a claim or argument based on evidence based on scientific knowledge<br>● engage in arguments from evidence to construct a claim, an argument, or counterargument based on data and evidence<br>● engage in arguments from evidence to compare competing design solutions based on scientific principles | ● engage in arguments from evidence to evaluate competing arguments or solutions in light of new evidence or trade-offs<br>● engage in arguments from evidence to evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument |
| Obtain, evaluate, and communicate information | ● identify useful scientific information | ● obtain, evaluate, and communicate information to determine the central idea or conclusion of presented | ● obtain, evaluate, and communicate information to | ● obtain, evaluate, and communicate information to defend or critique the validity or reliability of claims |

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| | ● identify ways to communicate scientific information | information<br>● obtain, evaluate, and communicate information to distinguish sources of information that can be used to address a scientific question or problem | summarize complex evidence, concepts, or processes<br>● obtain, evaluate, and communicate information to integrate credible sources that address scientific questions or solve problems<br>● obtain, evaluate, and communicate information to present technical information or ideas that address a phenomenon or that address the process of the development and design of a proposed solution | ● obtain, evaluate, and communicate information to defend or critique the validity or reliability of sources of information |

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| **Cross-cutting Concepts** | | | | |
| Patterns | ●recognize different scales among patterns<br>●identify mathematical representations within patterns<br>●identify patterns that can be used as evidence of relationships | ●describe mathematical representations to identify patterns<br>●demonstrate how patterns can be used as evidence for relationships | ●cite patterns as empirical evidence for causality in support of phenomena<br>●recognize that classifications or explanations used at one scale may not be useful or need revision using a different scale<br>●use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system | ●use patterns to explain empirical evidence for causality in support of phenomena<br>●recommend revisions to classifications/explanations of patterns using a more useful scale<br>●recommend revisions to reengineer and improve a designed system |
| Cause and effect | ●identify claims about specific causes and effects<br>●identify causal or correlational relationships and identify when correlation does not equal causation | ●identify empirical evidence to differentiate between cause and correlation<br>●describe claims about specific causes and effects | ●understand that empirical evidence is required to differentiate between cause and correlation<br>●use empirical evidence to make claims about specific causes and effects<br>●suggest cause-and-effect relationships to explain complex systems and make predictions<br>●propose causal relationships by examining what is known about smaller-scale mechanisms within the system<br>●recognize that changes in systems may have various causes that may not have equal effects | ●evaluate cause-and-effect relationships to explain and predict behaviors in complex systems<br>●evaluate empirical evidence used to differentiate between cause and correlation<br>●demonstrate causal relationships by examining what is known about smaller scale mechanisms within the system<br>●describe equal and unequal effects in relationships |
| Structure and function | ● identify that the properties and structures of components are different depending on their interactions and function | ● describe how the properties and structures of components are different depending on their interactions and function | ● describe properties and structures of different components to explain their interactions and system function and/or solve a | ● demonstrate the functions and properties of objects and systems from their overall structure, the way their components are shaped and |

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| | | | problem<br>● infer the functions and properties of objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials | used, and the molecular substructures of their various materials |
| Systems and systems models | ● identify models to simulate the flow of energy, matter, and interactions within and between systems<br>● identify systems boundaries, initial conditions, inputs, and outputs<br>● identify models that predict the behavior of a system | ● describe models to simulate the flow of energy, matter, and interactions within and between systems at different scales<br>● describe systems boundaries, initial conditions, inputs, and outputs<br>● describe models that predict the behavior of a system | ● analyze a system by defining its boundaries and initial conditions, inputs, and outputs<br>● use models to simulate the flow of energy, matter, and interactions within and between systems at different scales<br>● use models to predict the behavior of a system and recognize that these predictions have limited precision and reliability due to the assumptions and approximations<br>● design systems to do specific tasks | ● develop models to simulate the flow of energy, matter, and interactions within and between systems at different scales<br>● develop and use models to predict the behavior of a system and identify the limited precision and reliability due to the assumptions and approximations |
| Stability and change | ● identify systems that have greater or lesser stability<br>● identify changes in systems over very short or very long periods of time<br>● identify changes to a system as irreversible or reversible | ● describe systems that have greater or lesser stability<br>● describe changes in systems over very short or very long periods of time<br>● describe the effects of negative and positive feedback within a system | ● construct explanations of how things change and how they remain stable<br>● quantify and model changes in systems over very short or very long periods of time<br>● recognize systems can be designed for greater or lesser stability and that some changes are irreversible<br>● demonstrate how feedback (negative or positive) can stabilize or destabilize a system | ● demonstrate how a system can be designed for greater or lesser stability<br>● evaluate explanations of how things change and how they remain stable |

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| Scale, proportion, and quantity | ● identify scales, proportions, and/or quantities in phenomena<br>● identify patterns that are or are not observable at specific scales | ● describe patterns that are or are not observable at specific scales<br>● use algebraic thinking to examine scientific data and describe changes in a system<br>● describe scales, proportions, and/or quantities in phenomena | ● demonstrate how the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs<br>● recognize that patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly<br>● use orders of magnitude to understand how a model at one scale relates to a model at another scale<br>● use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth) | ● predict how the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs<br>● demonstrate that patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly<br>● evaluate orders of magnitude to understand how a model at one scale relates to a model at another scale |
| Energy and matter | ● identify changes of energy in a system in terms of energy and matter flows<br>● identify that energy cannot be created or destroyed | ● identify changes of energy in a system in terms of energy and matter flows into, out of, and within that system<br>● identify that the total amount of energy and matter in closed systems is conserved | ● describe that the total amount of energy and matter in closed systems is conserved<br>● demonstrate changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system<br>● demonstrate that energy only moves between one place and another place, between objects and/or fields, or between systems; it cannot be created or destroyed<br>● demonstrate that energy drives the cycling of matter within and between systems | ● analyze a system to show that energy only moves between one place and another place, between objects and/or fields, or between systems; it cannot be created or destroyed |