# Science Standard Articulated by Grade Level
## Strand 6: Earth and Space Science

| **Concept 1: Properties of Earth Materials**<br>Identify the basic properties of Earth materials. | | | | |
|---|---|---|---|---|
| **Kindergarten** | **Grade 1** | **Grade 2** | **Grade 3** | **Grade 4** |
| PO 1. Identify rocks, soil, and water as basic Earth materials. | PO 1. Describe the following basic Earth materials:<br>• rocks<br>• soil<br>• water | | PO 1. Identify the layers of the Earth:<br>• crust<br>• mantle<br>• core (inner and outer) | |
| PO 2. Compare physical properties (e.g., color, texture, capacity to retain water) of basic Earth materials. | PO 2. Compare the following physical properties of basic Earth materials:<br>• color<br>• texture<br>• capacity to retain water | | PO 2. Describe the different types of rocks and how they are formed:<br>• metamorphic<br>• igneous<br>• sedimentary | |
| PO 3. Classify a variety of objects as being natural or man-made. | PO 3. Identify common uses (e.g., construction, decoration) of basic Earth materials (i.e., rocks, water, soil). | | PO 3. Classify rocks based on the following physical properties:<br>• color<br>• texture | |
| PO 4. Identify ways some natural or man-made materials can be reused or recycled (e.g., efficient use of paper, recycle aluminum cans). | PO 4. Identify the following as being natural resources:<br>• air<br>• water<br>• soil<br>• trees<br>• wildlife | | PO 4. Describe fossils as a record of past life forms. | |
| | PO 5. Identify ways to conserve natural resources (e.g., reduce, reuse, recycle, find alternatives). | | PO 5. Describe how fossils are formed. | |

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## Strand 6: Earth and Space Science

| **Concept 1: Properties of Earth Materials**<br>Identify the basic properties of Earth materials. | | | | |
|---|---|---|---|---|
| **Kindergarten** | **Grade 1** | **Grade 2** | **Grade 3** | **Grade 4** |
| | | | PO 6. Describe ways humans use Earth materials (e.g., fuel, building materials, growing food). | |

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# Science Standard Articulated by Grade Level
# Strand 6: Earth and Space Science

| **Concept 1: Structure of the Earth**<br>Describe the composition and interactions between the structure of the Earth and its atmosphere. | | | |
|---|---|---|---|
| **Grade 5** | **Grade 6** | **Grade 7** | **Grade 8** |
| | PO 1. Describe the properties and the composition of the layers of the atmosphere. | PO 1. Classify rocks and minerals by the following observable properties:<br>• grain<br>• color<br>• texture<br>• hardness | |
| | PO 2. Explain the composition, properties, and structure of the Earth's lakes and rivers. | PO 2. Describe the properties and the composition of the following major layers of the Earth:<br>• crust<br>• mantle<br>• core | |
| | PO 3. Explain the composition, properties, and structures of the oceans' zones and layers. | PO 3. Explain the following processes involved in the formation of the Earth's structure:<br>• erosion<br>• deposition<br>• plate tectonics<br>• volcanism | |
| | PO 4. Analyze the interactions between the Earth's atmosphere and the Earth's bodies of water (water cycle). | PO 4. Describe how the rock and fossil record show that environmental conditions have changed over geologic and recent time. | |
| | PO 5. Describe ways scientists explore the Earth's atmosphere and bodies of water.<br>(See Strand 2 Concept 1) | | |

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**Concept 1: Geochemical Cycles**

Analyze the interactions between the Earth's structures, atmosphere, and geochemical cycles.

**High School**

PO 1. Identify ways materials are cycled within the Earth system (i.e., carbon cycle, water cycle, rock cycle).

PO 2. Demonstrate how dynamic processes such as weathering, erosion, sedimentation, metamorphism, and orogenesis relate to redistribution of materials within the Earth system.

PO 3. Explain how the rock cycle is related to plate tectonics.

PO 4. Demonstrate how the hydrosphere links the biosphere, lithosphere, cryosphere, and atmosphere.

PO 5. Describe factors that impact current and future water quantity and quality including surface, ground, and local water issues.

PO 6. Analyze methods of reclamation and conservation of water.

PO 7. Explain how the geochemical processes are responsible for the concentration of economically valuable minerals and ores in Arizona and worldwide.

| **Concept 2: Objects in the Sky**<br>Identify objects in the sky. | | | |
|---|---|---|---|
| **Kindergarten** | **Grade 1** | **Grade 2** | **Grade 3** |
| | PO 1. Identify evidence that the Sun is the natural source of heat and light on the Earth (e.g., warm surfaces, shadows, shade). | | |
| | PO 2. Compare celestial objects (e.g., Sun, Moon, stars) and transient objects in the sky (e.g., clouds, birds, airplanes, contrails). | | |
| | PO 3. Describe observable changes that occur in the sky, (e.g., clouds forming and moving, the position of the Moon). | | |

# Science Standard Articulated by Grade Level
# Strand 6: Earth and Space Science

| **Concept 2: Earth's Processes and Systems**<br>Understand the processes acting on the Earth and their interaction with the Earth systems. | | | | |
|---|---|---|---|---|
| **Grade 4** | **Grade 5** | **Grade 6** | **Grade 7** | **Grade 8** |
| PO 1. Identify the Earth processes that cause erosion. | PO 1. Describe how the Moon's appearance changes during a four-week lunar cycle. | PO 1. Explain how water is cycled in nature. | PO 1. Explain the rock cycle. | |
| PO 2. Describe how currents and wind cause erosion and land changes. | PO 2. Describe how Earth's rotation results in day and night at any particular location. | PO 2. Identify the distribution of water within or among the following:<br>• atmosphere<br>• lithosphere<br>• hydrosphere | PO 2. Distinguish the components and characteristics of the rock cycle for the following types of rocks:<br>• igneous<br>• metamorphic<br>• sedimentary | |
| PO 3. Describe the role that water plays in the following processes that alter the Earth's surface features:<br>• erosion<br>• deposition<br>• weathering | PO 3. Distinguish between revolution and rotation. | PO 3. Analyze the effects that bodies of water have on the climate of a region. | PO 3. Analyze the evidence that lithospheric plate movements occur. | |
| PO 4. Compare rapid and slow processes that change the Earth's surface, including:<br>• rapid – earthquakes, volcanoes, floods<br>• slow – wind, weathering | PO 4. Describe the role of gravity as an attractive force between celestial objects. | PO 4. Analyze the following factors that affect climate:<br>• ocean currents<br>• elevation<br>• location | PO 4. Explain lithospheric plate movement as a result of convection. | |

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# Science Standard Articulated by Grade Level
## Strand 6: Earth and Space Science

**Concept 2: Earth's Processes and Systems**

Understand the processes acting on the Earth and their interaction with the Earth systems.

| Grade 4 | Grade 5 | Grade 6 | Grade 7 | Grade 8 |
|---|---|---|---|---|
| PO 5. Identify the Earth events that cause changes in atmospheric conditions (e.g., volcanic eruptions, forest fires). | | PO 5. Analyze the impact of large-scale weather systems on the local weather. | PO 5. Relate plate boundary movements to their resulting landforms, including:<br>• mountains<br>• faults<br>• rift valleys<br>• trenches<br>• volcanoes | |
| PO 6. Analyze evidence that indicates life and environmental conditions have changed (e.g., tree rings, fish fossils in desert regions, ice cores). | | PO 6. Create a weather system model that includes:<br>• the Sun<br>• the atmosphere<br>• bodies of water | PO 6. Describe how earthquakes are measured. | |

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**Concept 2: Energy in the Earth System (Both Internal and External)**
Understand the relationships between the Earth's land masses, oceans, and atmosphere.

**High School**

PO 1. Describe the flow of energy to and from the Earth.

PO 2. Explain the mechanisms of heat transfer (convection, conduction, radiation) among the atmosphere, land masses, and oceans.

PO 3. Distinguish between weather and climate.

**Internal Energy:**

PO 4. Demonstrate the relationship between the Earth's internal convective heat flow and plate tectonics.

PO 5. Demonstrate the relationships among earthquakes, volcanoes, mountain ranges, mid-oceanic ridges, deep sea trenches, and tectonic plates.

PO 6. Distinguish among seismic S, P, and surface waves.

PO 7. Analyze the seismic evidence (S and P waves) used to determine the structure of the Earth.

PO 8. Describe how radioactive decay maintains the Earth's internal temperature.

**External Energy:**

PO 9. Explain the effect of heat transfer on climate and weather.

PO 10. Demonstrate the effect of the Earth's rotation (i.e., Coriolis effect) on the movement of water and air.

PO 11. Describe the origin, life cycle, and behavior of weather systems (i.e., air mass, front, high and low systems, pressure gradients).

PO 12. Describe the conditions that cause severe weather (e.g., hurricanes, tornadoes, thunderstorms).

PO 13. Propose appropriate safety measures that can be taken in preparation for severe weather.

PO 14. Analyze how weather is influenced by both natural and artificial Earth features (e.g., mountain ranges, bodies of water, cities, air pollution).

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| **Concept 2: Energy in the Earth System (Both Internal and External)**<br>Understand the relationships between the Earth's land masses, oceans, and atmosphere. |
|---|
| **High School** |
| PO 15. List the factors that determine climate (e.g., altitude, latitude, water bodies, precipitation, prevailing winds, topography).<br><br>PO 16. Explain the causes and/or effects of climate changes over long periods of time (e.g., glaciation, desertification, solar activity, greenhouse effect).<br><br>PO 17. Investigate the effects of acid rain, smoke, volcanic dust, urban development, and greenhouse gases, on climate change over various periods of time. |

| **Concept 3: Changes in the Earth and Sky**<br>Understand characteristics of weather conditions and climate. | | | | |
|---|---|---|---|---|
| **Kindergarten** | **Grade 1** | **Grade 2** | **Grade 3** | **Grade 4** |
| PO 1. Identify the following aspects of weather:<br>• temperature<br>• wind<br>• precipitation<br>• storms | PO 1. Identify the following characteristics of seasonal weather patterns:<br>• temperature<br>• type of precipitation<br>• wind | PO 1. Measure weather conditions (e.g., temperature, precipitation). (See M02-S4C4-04 and M02-S4C4-05) | | PO 1. Identify the sources of water within an environment (e.g., ground water, surface water, atmospheric water, glaciers). |
| PO 2. Describe observable changes in weather. | PO 2. Analyze how the weather affects daily activities. | PO 2. Record weather conditions (e.g., temperature, precipitation). | | PO 2. Describe the distribution of water on the Earth's surface. |
| PO 3. Give examples of how the weather affects people's daily activities. | | PO 3. Identify the following types of clouds:<br>• cumulus<br>• stratus<br>• cirrus | | PO 3. Differentiate between weather and climate as they relate to the southwestern United States. |
| | | PO 4. Analyze the relationship between clouds, temperature, and weather patterns. | | PO 4. Measure changes in weather (e.g., precipitation, wind speed, barometric pressure). |
| | | | | PO 5. Interpret the symbols on a weather map or chart to identify the following:<br>• temperatures<br>• fronts<br>• precipitation |

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| **Concept 3: Changes in the Earth and Sky**<br>Understand characteristics of weather conditions and climate. | | | | |
|---|---|---|---|---|
| **Kindergarten** | **Grade 1** | **Grade 2** | **Grade 3** | **Grade 4** |
| | | | | PO 6. Compare weather conditions in various locations (e.g., regions of Arizona, various U.S. cities, coastal vs. interior geographical regions). |

| **Concept 3: Earth in the Solar System**<br>Understand the relationships of the Earth and other objects in the solar system. | | | |
|---|---|---|---|
| **Grade 5** | **Grade 6** | **Grade 7** | **Grade 8** |
| PO 1. Identify the known planets of the solar system. | | PO 1. Explain the phases of the Moon in terms of the relative positions of the Earth, Sun, and Moon. | |
| PO 2. Describe the distinguishing characteristics of the known planets in the solar system. | | PO 2. Construct a model for the relative positions of the Earth, Sun, and Moon as they relate to corresponding eclipses. | |
| PO 3. Describe various objects in the sky (e.g., asteroids, comets, stars, meteors/shooting stars). | | PO 3. Explain the interrelationship between the Earth's tides and the Moon. | |
| PO 4. Describe the change in position and motion of the following objects in the sky over time:<br>• real motion – Moon, planets<br>• apparent motion (due to the motion of the Earth) – Sun, Moon, stars | | PO 4. Explain the seasons in the Northern and Southern Hemispheres in terms of the tilt of the Earth's axis relative to the Earth's revolution around the Sun. | |
| PO 5. Explain the apparent motion of the Sun and stars. | | PO 5. Identify the following major constellations visible (seasonally) from the Northern Hemisphere:<br>• Orion<br>• Ursa Major (Great Bear)<br>• Cygnus<br>• Scorpius<br>• Cassiopeia | |

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| **Concept 3: Earth in the Solar System**<br>Understand the relationships of the Earth and other objects in the solar system. | | | |
|---|---|---|---|
| **Grade 5** | **Grade 6** | **Grade 7** | **Grade 8** |
| PO 6. Describe efforts to explore space (e.g., Apollo missions, space shuttles, Hubble space telescope, space probes).<br>(See Strand 2) | | PO 6. Explain the relationship among common objects in the solar system, galaxy, and the universe. | |

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**Concept 3: Origin and Evolution of the Earth System**

Analyze the factors used to explain the history and evolution of the Earth.

**High School**

**Earth Origin/System:**

PO 1. Describe the scientific theory of the origin of the solar system (solar nebular hypothesis).

PO 2. Describe the characteristics, location, and motions of the various kinds of objects in our solar system, including the Sun, planets, satellites, comets, meteors, and asteroids.

PO 3. Explain the phases of the Moon, eclipses (lunar and solar), and the interaction of the Sun, Moon, and Earth (tidal effect).

**Earth History/Evolution:**

PO 4. Interpret a geologic time scale.

PO 5. Distinguish between relative and absolute geologic dating techniques.

PO 6. Investigate scientific theories of how life originated on Earth (high temperature, low oxygen, clay catalyst model).

PO 7. Describe how life on Earth has influenced the evolution of the Earth's systems.

PO 8. Sequence major events in the Earth's evolution (e.g., mass extinctions, glacial episodes) using relative and absolute dating data.

PO 9. Analyze patterns in the fossil record related to the theory of organic evolution.

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| **Concept 4: Origin and Evolution of the Universe**<br>Analyze the factors used to explain the origin and evolution of the universe. |
|---|
| **High School** |
| PO 1. Describe the Big Bang Theory as an explanation for the origin of the universe.<br><br>PO 2. Describe the fusion process that takes place in stars.<br><br>PO 3. Analyze the evolution of various types of stars using the Hertzsprung-Russell (HR) diagram.<br><br>PO 4. Compare the evolution (life cycles) of stars of different masses (low and high mass).<br><br>PO 5. Explain the formation of the light elements in stars and the heavier elements (what astronomers call “metals”) in supernova explosions.<br><br>PO 6. Explain the evolution and life cycles of galaxies. |