

# Arizona Science Standards - 8th Grade

## Three Dimensions of Science

Sensemaking in science occurs with the integration of three essential dimensions.

### Science and Engineering Practices

- ask questions and define problems
- develop and use models
- plan and carry out investigations
- analyze and interpret data
- use mathematics and computational thinking
- construct explanations and design solutions
- engage in argument from evidence
- obtain, evaluate, and communicate information

### Crosscutting Concepts

- patterns
- cause and effect
- structure and function
- systems and system models
- stability and change
- scale, proportion, and quantity
- energy and matter

### Core Ideas

#### Core Ideas for Knowing Science

##### Physical Science

P1: All matter in the Universe is made of very small particles.

P2: Objects can affect other objects at a distance.

P3: Changing the movement of an object requires a net force to be acting on it.

P4: 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.

##### Earth and Space Science

E1: 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.

E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe.

##### Life Science

L1: Organisms are organized on a cellular basis and have a finite life span.

L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.

L3: Genetic information is passed down from one generation of organisms to another.

L4: The unity and diversity of organisms, living and extinct, is the result of evolution.

#### Core Ideas for Using Science

U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised.

U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products.

U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.

## Physical Science Standards

Students apply stability and change to explore chemical properties of matter and chemical reactions to further understand energy and matter.

8.P1U1.1	Develop and use a model to demonstrate that atoms and molecules can be combined or rearranged in chemical reactions to form new compounds with the total number of each type of atom conserved.
8.P1U1.2	Obtain and evaluate information regarding how scientists identify substances based on unique physical and chemical properties.
8.P4U1.3	Construct an explanation on how energy can be transferred from one energy store to another.
8.P4U1.4	Develop and use mathematical models to explain wave characteristics and interactions.
8.P4U2.5	Develop a solution to increase efficiency when transferring energy from one source to another.

## Earth and Space Science Standards

Students explore natural and human-induced cause-and-effect changes in Earth systems over time.

8.E1U1.6	Analyze and interpret data about the Earth's geological column to communicate relative ages of rock layers and fossils.
8.E1U3.7	Obtain, evaluate, and communicate information about data and historical patterns to predict natural hazards and other geological events.
8.E1U3.8	Construct and support an argument about how human consumption of limited resources impacts the biosphere.

## Life Science Standards

Students develop an understanding of patterns and how genetic information is passed from generation to generation. They also develop the understanding of how traits within populations change over time.

8.L3U1.9	Construct an explanation of how genetic variations occur in offspring through the inheritance of traits or through mutations.
8.L3U3.10	Communicate how advancements in technology have furthered the field of genetic research and use evidence to support an argument about the positive and negative effects of genetic research on human lives.
8.L4U1.11	Develop and use a model to explain how natural selection may lead to increases and decreases of specific traits in populations over time.
8.L4U1.12	Gather and communicate evidence on how the process of natural selection provides an explanation of how new species can evolve.

**Key Crosscutting Concepts in 8<sup>th</sup> Grade**  
*Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Structure and Function; Stability and Change*

**Phenomena** are observable events that can be explained or explored. Science aims to explain the causes of these events, or phenomena, using scientific ideas, concepts, and practices (3-dimensions).

\*Optimized for 11x17 printing

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# Arizona Science Standards - 8th Grade

## Core Ideas for Knowing Science: Elements for Physical, Earth & Space, and Life Science Standards

### Elements of Physical Science Standards

**8.P1U1.1** Develop and use a model to demonstrate that atoms and molecules can be combined or rearranged in chemical reactions to form new compounds with the total number of each type of atom conserved.

- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- The total number of each type of atom is conserved, and thus the mass does not change.

**8.P1U1.2** Obtain and evaluate information regarding how scientists identify substances based on unique physical and chemical properties.

- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

**8.P4U1.3** Construct an explanation on how energy can be transferred from one energy store to another.

- Energy is transferred out of hotter regions or objects and into colder ones by the processes of conduction, convection, and radiation.

**8.P4U1.4** Develop and use mathematical models to explain wave characteristics and interactions.

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
- A sound wave needs a medium through which it is transmitted.
- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of light.
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials where the light bends.
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.
- Since light can travel through space, it cannot be a matter wave, like sound or water waves.

*Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking. Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.*

**8.P4U2.5** Develop a solution to increase efficiency when transferring energy from one source to another.

- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

### Elements of Earth and Space Science Standards

**8.E1U1.6** Analyze and interpret data about the Earth's geological column to communicate relative ages of rock layers and fossils.

- The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analysis of rock strata and the fossil record provide only relative dates, not an absolute scale.

**8.E1U3.7** Obtain, evaluate, and communicate information about data and historical patterns to predict natural hazards and other geological events.

- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces, can help forecast the locations and likelihoods of future events.

**8.E1U3.8** Construct and support an argument about how human consumption of limited resources impacts the biosphere.

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing extinction of many other species. But changes to Earth's environment can have different impacts (negative and positive) for different living things.
- Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

### Elements of Life Science Standards

**8.L3U1.9** Construct an explanation of how genetic variations occur in offspring through the inheritance of traits or through mutations.

- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of a specific protein, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.
- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.
- In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (8.L3U3.10)

### Elements of Life Science Standards con't

**8.L3U3.10** Communicate how advancements in technology have furthered the field of genetic research and use evidence to support an argument about the positive and negative effects of genetic research on human lives.

- In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (8.L3U1.9)
- In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring.

**8.L4U1.11** Develop and use a model to explain how natural selection may lead to increases and decreases of specific traits in populations over time.

- Natural selection leads to the predominance of certain traits in a population and the suppression of others.
- Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (8.L4U1.12)

**8.L4U1.12** Gather and communicate evidence on how the process of natural selection provides an explanation of how new species can evolve.

- The natural selection of organisms with certain features that enable them to survive in particular environmental conditions has been going since the first form of life appeared on Earth.
- Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (8.L4U1.11)
- In separated populations with different conditions, the changes can be large enough that the populations, provided they remain separated (a process called reproductive isolation), evolve to become separate species.

**The elements are not to be used as a check-off list, but rather a useful tool to help educators identify the specific pieces of knowledge and skill that make up the practice, crosscutting concept, or core idea at that grade-band.**