2020 CAS for Science Content - Disciplinary Core Ideas (Updated April 25, 2019)

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Kindergarten - Resource Link	1st Grade - Resource Link	2nd Grade - Resource Link
Physical Science • Pushes and pulls can have different strengths and directions, and can change the speed or direction of an object's motion or start or stop it. • Sunlight affects the Earth's surface. • ~~Objects can be sorted by physical properties, which can be observed and measured~~ **Life Science** • To live and grow, animals obtain food they need from plants or other animals, and plants need water and light. • ~~Organisms can be described and sorted by their physical characteristics~~ **Earth and Space Science** • Patterns are observed when measuring the local weather, including how humans and other organisms impact their environment. • Plants and animals meet their needs in their habitats and impact one another; people can prepare for severe weather.	**Physical Science** • Sound can make matter vibrate and vibrating matter can make sound. • ~~Solids and liquids have unique properties that distinguish them~~ **Life Science** • All organisms have external parts that they use to perform daily functions. • Young organisms are very much, but not exactly, like their parents, and also resemble other organisms of the same kinds. **Earth and Space Science** • Patterns of movement of the sun, moon and stars as seen from Earth can be observed, described and predicted. • ~~Earth's materials can be compared and classified based on their properties~~	**Physical Science** • Matter exists as different substances that have observable different properties. • ~~Changes in speed or direction of motion are caused by forces such as pushes and pulls.~~ **Life Science** • Plants depend on water and light to grow and on animals for pollination or to move their seeds around. • A range of different organisms live in different places. **Earth and Space Science** • Some events on Earth occur quickly; others can occur very slowly. • Wind and water can change the shape of the land; models can show the shape and these changes to the land. • ~~Weather and the changing seasons impact the environment and organisms such as humans, plants, and other animals~~

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3rd Grade - Resource Link

Physical Science

- Patterns of motion can be used to predict future motion.
- Objects in contact exert forces on each other; electric and magnetic forces between a pair of objects do not require contact.
- ~~Matter exists in different states such as solids, liquids, and gases and can change from one state to another by heating and cooling~~

Life Science

- Organisms have unique and diverse life cycles.
- Being part of a group helps animals obtain food, defend themselves and cope with changes.
- Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.
- Some living organisms resemble organisms that once lived on Earth.
- Sometimes differences in characteristics between individuals of the same species provide advantages in survival and reproduction.

Earth and Space Science

- Climate describes patterns of typical weather conditions over different scales and variations; historical weather patterns can be analyzed.
- A variety of weather hazards result from natural process; humans cannot eliminate weather-related hazards but can reduce their impacts.
- ~~Earth's materials can be broken down and/or combined into different materials such as rocks, minerals, rock cycle, formation of soil, and sand – some of which are usable resources for human activity~~

4th Grade - Resource Link

Physical Science

- The faster an object moves the more energy it has.
- Energy can be moved from place to place.
- When objects collide contact forces transfer so as to change objects' motion.
- Energy can be produced, used or released by converting stored energy.
- Waves are regular patterns of motion.
- An object can be seen when light reflected from its surface enters the eyes.
- Patterns can encode, send, receive and decode information.

Life Science

- Organisms have both internal and external structures that serve various functions.
- ~~Comparing fossils to each other or to living organisms reveals features of prehistoric environments and provides information about organisms today~~
- ~~There is interaction and interdependence between and among living and nonliving components of systems~~

Earth and Space Science

- Earth has changed over time.
- Four major earth systems interact.
- Earth's physical features occur in patterns.
- Energy and fuels that humans use are derived from natural sources and their use affects the environment in multiple ways.
- A variety of hazards results from natural process; humans cannot eliminate natural hazards but can reduce their impacts' effect.
- ~~Earth is part of the solar system, which includes the Sun, Moon, and other bodies that orbit the Sun in predictable patterns that lead to observable paths of objects in the sky as seen from Earth~~

5th Grade - Resource Link

Physical Science

- Matter exists as particles that are too small to be seen; measurements of a variety of observable properties can be used to identify particular materials.
- Chemical Reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same.
- The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.
- The energy released from food was once energy from the sun.

Life Science

- Plants acquire their material from growth chiefly from air and water.
- Matter cycles between air and soil and among plants, animals and microbes as these organisms live and die.
- ~~All organisms have structures and systems with separate functions~~
- ~~Human body systems have basic structures, functions, and needs~~

Earth and Space Science

- Stars range greatly in size and distance from Earth, and this can explain their relative brightness.
- Earth's orbit and rotation and the orbit of the moon around Earth cause observable patterns.
- Earth's major systems interact in multiple ways to affect Earth's surface materials and processes.
- Most of Earth's water is in the ocean and much of Earth's freshwater in glaciers or underground.
- Societal activities have had major effects on land, ocean atmosphere and even outer space.
- ~~Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation~~
- ~~Earth and sun provide a diversity of renewable and nonrenewable resources~~

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Middle School

The 2020 CAS for Science are banded for grades 6-8. The eighth grade CMAS Science assessment in 2021 will reflect the banded nature of the middle school science standards, assessing the GLEs and Evidence Outcomes found within the middle school band of the 2020 CAS for Science.

Physical Science

- The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter and phases of changes.
- Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.
- Motion is described relative to a reference frame that must be shared with others and is determined by the sum of the forces acting on it. The greater the mass of the object, the greater the force needed to achieve the same change in motion.
- Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object.
- Kinetic energy can be distinguished from the various forms of potential energy.
- Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states and amounts of matter.
- When two objects interact, each one exerts a force on the other than can cause energy to be transferred to and from the object.
- A simple wave model has a repeating pattern with specific wavelength, frequency, and amplitude and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena which include light and sound.
- A wave model of light is useful to explain how light interacts with objects through a variety of properties.
- Designed technologies can transmit digital information as wave pulses.

Life Science

- All living things are made up of cells, which is the smallest unit that can be said to be alive.
- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.
- Sustaining life requires substantial energy and matter inputs.
- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain.
- Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving.
- Ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system.
- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem

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Life Science continued

- Heredity explains why offspring resemble, but are not identical to, their parents and is a unifying biological principle. Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes.
- Fossils are mineral replacements, preserved remains, or traces of organisms that lived in the past.
- Genetic variations among individuals in a population give some individuals an advantage in surviving and reproducing in their environment.
- Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions.
- Biodiversity is the wide range of existing life forms that have adapted to the variety of conditions on Earth, from terrestrial to marine ecosystems.

Earth and Space Science

- Motion is predictable in both solar systems and galaxies.
- The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
- Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history.
- Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.
- Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history.
- Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of seawater drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.
- Complex interactions determine local weather patterns and influence climate, including the role of the ocean.
- Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.
- Mapping the history of natural hazards in a region and understanding related geological forces.
- Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things.
- Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.

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The table below is a **working framework** for breaking up the middle school science standards within grades 6, 7, and 8. Middle schools and their feeder elementary schools will want to consider how to support vertical conversations and vertical alignment for the middle school banded 2020 CAS for Science. For more information, click the link. **GLEs that would be similar between the 2009/10 and 2020 CAS for Science for a grade level in the proposal are denoted in blue. GLEs that would be new to a grade level in the proposal for the 2020 CAS for Science are denoted in red.**

6th Grade - Resource Link	***7th Grade*** - Resource Link	***8th Grade*** - Resource Link
Physical Science • The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter and phases of changes. • Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy. • ~~Distinguish among, explain, and apply the relationships among mass, weight, volume, and density~~ **Life Science** • Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving. • Ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system. • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological	**Physical Science** • Motion is described relative to a reference frame that must be shared with others and is determined by the sum of the forces acting on it. The greater the mass of the object, the greater the force needed to achieve the same change in motion. • Forces that act a distance (gravitational, electric, and magnetic) can be explained by force fields that extend through space and can be mapped by their effect on a test object. • ~~Mixtures of substances can be separated based on their properties such as solubility, boiling points, magnetic properties, and densities~~ **Life Science** • All living things are made up of cells, which is the smallest unit that can be said to be alive. • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. • Sustaining life requires substantial energy and matter inputs. • Each sense receptor responds to different inputs (electromagnetic,	**Physical Science** • Kinetic energy can be distinguished from the various forms of potential energy. • Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states and amounts of matter. • When two objects interact, each one exerts a force on the other than can cause energy to be transferred to and from the object. • A simple wave model has a repeating pattern with specific wavelength, frequency, and amplitude and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena which include light and sound. • A wave model of light is useful to explain how light interacts with objects through a variety of properties. • Designed technologies can transmit digital information as wave pulses. **Life Science** • Heredity explains why offspring resemble, but are not identical to, their

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component of an ecosystem can lead to shifts in all of its populations. • Biodiversity is the wide range of existing life forms that have adapted to the variety of conditions on Earth, from terrestrial to marine ecosystems. **Earth and Space Science** • Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of seawater drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features. • Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes. • ~~Complex interrelationships exist between Earth's structure and natural processes that over time are both constructive and destructive~~	mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. • Fossils are mineral replacements, preserved remains, or traces of organisms that lived in the past. • ~~The human body is composed of atoms, molecules, cells, tissues, organs, and organ systems that have specific functions and interactions~~ **Earth and Space Science** • Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history. • Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes. • Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. • Mapping the history of natural hazards in a region and understanding related geological forces.	parents and is a unifying biological principle. Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes. • Genetic variations among individuals in a population give some individuals an advantage in surviving and reproducing in their environment. • Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. **Earth and Space Science** • Motion is predictable in both solar systems and galaxies. • The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons. • Complex interactions determine local weather patterns and influence climate, including the role of the ocean. • Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. • Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.

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High School

Physical Science Resource Link

- The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter.
- Chemical processes, their rates, their outcomes, and whether or not energy is stored or released can be understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.
- The strong nuclear interaction provides the primary force that holds nuclei together. Nuclear processes including fusion, fission, and radioactive decays of unstable nuclei involve changes in nuclear binding energies.
- Newton's second law and the conservation of momentum can be used to predict changes in the motion of macroscopic objects.
- Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them.
- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system.
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
- Force fields (gravitational, electric, and magnetic) contain energy and can transmit energy across space from one object to another.
- Although energy cannot be destroyed, it can be converted to less useful forms as it is captured, stored, and transferred.
- Waves have characteristic properties and behaviors.
- Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation.
- Multiple technologies that are part of everyday experiences are based on waves and their interactions with matter.

Life Science Resource Link

- DNA codes for the complex hierarchical organization of systems that enable life's functions.
- Growth and division of cells in complex organisms occurs by mitosis, which differentiates specific cell types.
- Organisms use matter and energy to live and grow.
- Organisms interact with the living and nonliving components of the environment to obtain matter and energy.
- Matter and energy necessary for life are conserved as they move through ecosystems.
- A complex set of interactions determine how ecosystems respond to disturbances.
- Organisms interact in groups to benefit the species.

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- The characteristics of one generation are dependent upon the genetic information inherited from previous generations.
- Variation between individuals results from genetic and environmental factors.
- Evidence of common ancestry and diversity between species can be determined by examining variations including genetic, anatomical and physiological differences.
- Genetic variation among organisms affects survival and reproduction.
- The environment influences survival and reproduction of organisms over multiple generations.
- Humans have complex interactions with ecosystems and have the ability to influence biodiversity on the planet.

Earth and Space Science Resource Link

- All stars, including the sun, undergo stellar evolution, and the study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.
- Explanations of and predictions about the motions of orbiting objects are described by the laws of physics.
- The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations.
- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes, and these effects occur on different time scales, from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.
- Plate tectonics can be viewed as the surface expression of mantle convection, which is driven by heat from radioactive decay within Earth's crust and mantle.
- The planet's dynamics are greatly influenced by water's unique chemical and physical properties.
- The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors.
- The biosphere and Earth's other systems have many interconnections that cause a continual co-evolution of Earth's surface and life on it.
- Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.
- Natural hazards and other geological events have shaped the course of human history at local regional, and global scales.
- Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.
- Global climate models used to predict future climate change continue to improve our understanding of the impact of human activities on the global climate system.