Grade Level 9

Science Content Focus:

Properties of Matter; Physical, Chemical, and Nuclear Change

Motion, Force

Universe, Earth, and Environment

Grade Level 9, Science Content: Properties of Matter; Physical, Chemical, and Nuclear Change

Science Domains: Inquiry; Physical Science

Science Content: Properties of Matter, Physical Change, Chemical Change, Nuclear Change

Overarching Enduring Knowledge:

- All living things and non-living things are composed of matter having characteristic properties that distinguish one substance from another.
- A transfer of energy can result in the physical change of state of a substance.
- When matter undergoes a chemical change it turns into a new and different substance whose properties are different from the original. No matter how substances interact with one another, the total mass of a system remains the same.
- The nucleus of some atoms is unstable and may spontaneously decay.

Concepts to Emphasize:
atomic bonding principles, atomic identity, chemical properties, nuclear stability

Grade Level 9, Science Content: Properties of Matter; Physical, Chemical, and Nuclear Change

Science Domains: Inquiry; Physical Science
Science Content: Properties of Matter, Physical Change, Chemical Change, Nuclear Change

CCSU Power Standards

Power Standard #1 – Scientific Inquiry: Students demonstrate the ability to apply inquiry skills to explore and understand the world around them. (Aligns with Vermont Standard 7.1)

Power Standard #2 - Physical Science: Students describe the relationship between energy and matter. (Aligns with Vermont Standard 7.12)

Aligns with Vermont Standards	Vermont Grade Cluster Expectations Competency Focus	Essential Questions and Science Concepts	CCSU Power Indicators Proficiency Focus
	S9-12:9 – *Properties of Matter* Students demonstrate their understanding of Properties of Matter by… • Distinguishing one substance from another through examination of physical properties (such as density, melting point, conductivity), chemical properties (such as reactivity with O2 or acid or water), and nuclear properties (such as changes in atomic mass, isotopes and half-life).	• **What is matter?** • **In what ways do physical, chemical, and nuclear properties define all matter or distinguish one substance from another?** • **To what extent is there a relationship among pressure, volume, temperature, and amount of gas?** a) Substances (elements, compounds) differ from one another based on their physical, chemical and nuclear properties.	
	S9-12:9 Extension • Explaining the states of a substance in terms of the particulate nature of matter and the forces of interaction between particles.		

	S9-12:10 – *Properties of Matter* Students demonstrate their understanding of Properties of Matter by… • Comparing the characteristics of three major components of all atoms (protons, electrons, neutrons) their location within an atom, their relative size and their charge. **AND** • Writing formulae for compounds and developing models using electron structure (e.g., Lewis dot).	b) Atoms have a dense nucleus containing positively charged protons and neutral neutrons. The number of protons in the nucleus determines the identity of an element. c) The nucleus of an atom is surrounded by much lighter negatively charged electrons in mostly empty space. d) In neutral atoms the number of protons and electrons is equal. e) d. The arrangement of electrons of an atom determines what kinds of bonds are formed to produce molecules (compounds).	Identify subatomic particles and their locations in the atom (2a) Distinguish subatomic particles on the basis of charge, mass, and relative size (2c)
	S9-12:11 – *Properties of Matter* Students demonstrate their understanding of the Properties of Matter by… • Identifying and explaining the basis for the arrangement of elements within the Periodic Table (e.g., trends, valence, reactivity, electro negativity, ionization). **AND** • Determining valence electrons of selected elements. **AND** • Predicting the relative physical and chemical properties of an element based on its location within the Periodic Table.	f) Elements (substances composed of a single type of atom) are arranged in repeating. g) The arrangement of electrons of an atom determines placement in the Periodic Table.	Demonstrate an understanding of the basic information in the periodic table (2b) Identify elements as metals, nonmetals, or metalloids based on location in the periodic table (2e) Predict whether an element forms ionic or covalent bonds with another element (2f)

	S9-12:12 Extension Students demonstrate their understanding of the States of Matter by… • Investigating the interactions between atoms or molecules within a system (e.g., hydrogen bonding, van der Waals forces, fluorescent light, stars).	h) Solids, liquids and gases differ in distance and angles between atoms or molecules and the energy that binds them. i) Plasma is another state of matter composed of electrons and positive ions that have been separated by collisions at very high temperatures.	
	S9-12:13 – *Properties of Matter* Students demonstrate their understanding of the Properties of a Gas by... • Determining the pressure of a given volume of gas when the temperature changes incrementally (doubles, triples, etc.).	j) There are specific proportional relationships that exist among volume, pressure, temperature and amount of gas (mass) in a system.	
	S9-12:13 Extension Students demonstrate their understanding of the Properties of a Gas by… • Quantitatively determining how volume, pressure, temperature and amount of gas affect each other (PV=nRT) in a system**.**	k) There are specific relationships that exist between volume, pressure, temperature and amount of gas (moles).	
	S9-12:14 – *Physical Change* Students demonstrate their understanding of Physical Change by… • Investigating and graphing the effect of heat energy on the phase changes of water from a solid state to a liquid state to a gaseous state and comparing that data to other substances.	• **In what ways does the composition of matter affect the amount of energy needed for a change to occur?** a) Different compounds require different amounts of energy for phase change due to their unique molecular structure.	Identify the subatomic particles involved in chemical and nuclear changes (2d) Distinguish among physical, chemical, and nuclear changes (2g)

	S9-12:15 – *Chemical Change* Students demonstrate their understanding of Chemical Change by… • Writing simple balanced chemical equations to represent chemical reactions and illustrate the conservation of atoms. **AND** • Qualitatively predicting reactants and products in a prescribed investigation (e.g. oxidation, reduction, acid/base reactions).	• **How does chemical change affect the mass of a system?** • **To what extent is there a relationship between energy and chemical change?** a) The mass of reactants of any chemical reaction is the same as the mass of the products of that chemical reaction (The total mass of reactants is also the same as the total mass of products in a chemical reaction.).	
	S9-12: 15 Extension Students demonstrate their understanding of Chemical Change by… • Using chemical equations and information about molar masses to predict quantitatively the masses of reactants and products in chemical reactions.	b) The numbers of atoms of the reactants of any chemical reaction are the same as the numbers of atoms of the products of that chemical reaction	
	S9-12:16 – *Chemical Change* Students demonstrate their understanding of Chemical Change by… • Investigating, and explaining the increase or decrease in temperature of the substances in a chemical reaction caused by a transfer of heat energy from that reaction. (e.g., exothermic and endothermic reactions).	c) During a chemical change, energy is absorbed or released (e.g., AMP, ADP, ATP or burning wood).	

	S9-12:17 – *Nuclear Change* Students demonstrate their understanding of Nuclear Change by… • Explaining how alpha and beta emissions create changes in the nucleus of an atom, resulting in a completely different element. **AND** • Distinguishing between the reactants and products of a chemical reaction and those of a nuclear decay reaction. **AND** • Comparing the relative energies produced by each. **AND** • Explaining the organization of an atomic nucleus and identifying the universal forces from strongest to weakest.	• **What is the relationship between nuclear composition and stability?** • **What is the relationship between half-life of a nucleus and its stability?** • **How can the relationship between half-life of a nucleus and its stability determine the age of materials?** a) The number of neutrons in the nucleus can vary and gives rise to different isotopes of an element. b) Certain nuclear configurations lead to radioactive decay, producing alpha and beta particles, and ultimately a different element. c) Nuclear forces, which exist only within the nucleus of an atom, are the forces that hold the nucleus of an atom together and are much stronger than either gravitational or electrical forces.	
	S9-12:17 Extension Students demonstrate their understanding of Nuclear Change by… • <u>Comparing the transmission and penetration effects</u> of alpha, beta and gamma radiation.	d) Gamma radiation may also be produced. Physical Science	
	S9-12:18 – *Nuclear Change* Students demonstrate their understanding of Nuclear Change by… • Explaining the concept of half-life and using the half-life principle to predict the approximate age of a material.	e) Radioactive decay occurs at a predictable rate (half-life) which allows radioactivity to be used for estimating the age of materials that contain radioactive substances.	Apply the concept of half-life to radiometric dating (2h) Differentiate between various parent / daughter isotope pairs based on their usefulness for dating a particular rock sample (i.e. K-Ar dating vs. C-dating) (2i)

Grade Level 9, Science Content: Motion, Force

Science Domains: Inquiry; Physical Science

Science Content: Motion, Force

Overarching Enduring Understandings:

Everything constantly moving; motion is relative, but the motion of an object can be described and predicted by tracing and measuring its position over time.

Force is an influence that can change the motion of an object.

Concepts to Emphasize:
motion as position over time, velocity, constant velocity, acceleration (positive and negative), free fall, acceleration due to gravity, speed, inertia, force, gravity, mass compared to weight, f=ma

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Science Domains: Inquiry; Physical Science
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CCSU Power Standards

Power Standard #1 – Scientific Inquiry: Students demonstrate the ability to apply inquiry skills to explore and understand the world around them. (Aligns with Vermont Standard 7.1)

Power Standard #3 - Physical Science: Students describe motion and demonstrate how forces affect motion. (Aligns with Vermont Standard 7.12)

Aligns with Vermont Standards	Vermont Grade Cluster Expectations Competency Focus	Essential Questions and Science Concepts	CCSU Power Indicators Proficiency Focus
	S9-12:19 – *Motion* Students demonstrate their understanding of Motion by... • Predicting the path of an object in different reference planes and explaining how and why this occurs. **AND** • Using modeling, illustrating and explaining of how distance and velocity change over time for a free falling object. **AND** • Modeling, illustrating and explaining the path of an object which has horizontal and free fall motion (i.e., football, bullet).	• **What is the relationship among velocity, momentum, and acceleration?** • **How does the motion of an object predict its position over time?** • **How can we tell if something is moving?** • **Why are things in constant motion?** a) Motion is relative. The motion of an object is observed and measured relative to a given frame of reference (point of view) (e.g. trees flashing by when sitting in a moving vehicle). b) Acceleration occurs when an object undergoes a change in velocity over time (speed up, slow down, change direction).	Distinguish between velocity and acceleration (3a) Calculate average speed, speed, and acceleration (3b) Predict free fall motion (3c)

		c) Motion is predictable; a falling object increases speed in a predictable pattern as it falls. d) Motion is predictable; projectile motion combines a uniform horizontal motion and free-fall motion simultaneously.	
	S9-12:19 Extension Students demonstrate their understanding of the predictability of Motion by… • Using a quantitative representation of how distance and velocity change over time for a free falling object. **AND** • Using a quantitative representation of the path of an object which has horizontal and free fall motion (i.e., football, bullet).	e) Motion is predictable; a falling object increases speed in a predictable pattern as it falls. f) Motion is predictable; projectile motion combines a uniform horizontal motion and free-fall motion simultaneously.	Determine + and – slope on a graph (3d)
	S9-12:20 – *Motion* Students demonstrate their understanding of Motion by… • Qualitatively analyzing how inertia affects the outcome in each of a series of situations (i.e., kicking a sand-filled football, moving a bowl of soup quickly across the table).	g) An object at rest or moving uniformly (in a straight line) will remain so unless acted upon by an external unbalanced (net) force. (Newton's Third Law The Law of Inertia) (e.g.,We wear seatbelts, because our body has a tendency to keep moving when the vehicle stops.).	Describe how forces influence the motion of objects (3f) Distinguish between mass and weight (3h) Describe the relationship between force, mass, and acceleration given f = m X a (3g)

	S9-12:21 – *Force* Students demonstrate their understanding of Force by… • Investigating (model, illustrate, explain) whether the acceleration is greater or less as either the mass of the system or the force accelerating the mass is changed (e.g., cart with variable weights on horizontal table attached to a string with weights). **AND** • Investigating whether acceleration is greater or less as either the mass of the system or the force accelerating the mass is changed (e.g., cart with variable weights on horizontal table attached to a string with weights). **AND** • Demonstrating action force/reaction force in one of three different ways; describing in words, demonstrating physically, and modeling the occurrence of opposing actions.	• **What is force?** • **What is gravitational force?** • **How can forces influence the motion of objects?** • **To what extent do forces influence the motion of an object?** • **What are the forces that influence the motion of objects in your daily life?** a) If an unbalanced force acts on an object it will accelerate; the acceleration is proportional to the net force and inversely proportional to the mass of the object. (Newton's Law F=ma) (e.g. A vehicle accelerates more slowly when it's full of passengers.) b) Whenever one object exerts a force on a second object, a force equal in magnitude but opposite in direction is exerted on the first object. (Forces always arise in pairs) (e.g., When you lean against a wall, the wall pushes back at you.) (Newton's Law of Action/ Reaction).	
	S9-12:21 Extension Students demonstrate their understanding of Force by… • Investigating quantitatively the acceleration as either the mass of the system or the force accelerating the mass is changed (e.g., cart with variable weights on horizontal table attached to a string with weights).	c) If an unbalanced force acts on an object it will accelerate; the acceleration is proportional to the net force and inversely proportional to the mass of the object. (Newton's Law F=ma) (e.g., A vehicle accelerates more slowly when it's full of passengers.)	Determine direct versus indirect (inverse) relationships (3e)

	S9-12:22 – *Force* Students demonstrate their understanding of Gravitational Force by… • Predicting in a variety of situations how gravitational force changes when mass changes; or when distance changes.	d) The force of gravity is a universal force of attraction between ANY two objects and is proportional to the masses of those two objects and weakens rapidly with the distance between the objects (e.g., More mass produces more force; less distance produces more force) (e.g., small objects on earth, bodies in the solar system).	Describe how the force of gravity is affected by masses of two objects and the distance between them (3i) Describe the ways that objects in our solar system move (3j)
	S9-12:22 Extension Students demonstrate their understanding of Gravitational Force by… • Determining quantitatively how gravitational force changes when mass changes; or when distance changes.	e) The force of gravity is a universal force of attraction between two objects and is proportional to the product of the masses of those two objects and inversely proportional to the square of the distance between objects. (i.e. F = Gm1m2/d2).	

Grade Level 9, Science Content: Universe, Earth, and Environment

Science Domains: Inquiry; Universe, Earth, and Environment

Science Content: Solar System; Scale, Distance, Star Formation, Theories, Instrumentation; Earth Materials and the Rock Cycle; Forces and Changes on the Earth's Surface; Atmosphere, Water Cycle, Weather, Seasons; Natural Resources

Overarching Enduring Understandings:

The universe, earth and all earth systems have undergone change in the past, continue to change in the present and predicted to continue changing in the future.

Concepts to Emphasize:
revolution (orbit), rotation (spin), elliptical orbits, planet formation and composition, life cycle of stars, Big Bang Theory, red shift (as evidence for expansion of the universe), Copernican revolution, greenhouse effect, unequal heating, extreme weather patterns, weather prediction, Earth's external and internal energy sources, geologic dating, plate tectonics, geologic time, radioactive decay, carbon cycle, rock cycle, human modification of ecosystems and natural resources

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CCSU Power Standards

Power Standard #1 – Scientific Inquiry: Students demonstrate the ability to apply inquiry skills to explore and understand the world around them. (Aligns with Vermont Standard 7.1)

Power Standard #5 - Universe, Earth, and Environment: Students observe, describe, explain, and predict continual changes in the universe and in Earth's features and atmosphere and consider their impact on managing natural resources and agricultural systems. (Aligns with Vermont Standards 7.15, 7.16)

Aligns with Vermont Standards	Vermont Grade Cluster Expectations Competency Focus	Essential Questions and Science Concepts	CCSU Power Indicators Proficiency Focus
	S9-12:44 – *Solar System* Students demonstrate their understanding of Characteristics of the Solar System by… • Comparing the nature and composition of the atmosphere of inner and outer planets. **AND** • Explaining the effect of distance from the sun on the nature of the planets (e.g., inner vs. outer planets).	• **How can we describe the characteristics of our solar system?** a) Our solar system developed from a giant cloud of gas and debris of exploding stars 4.6 billion years ago, and everything on earth, including organisms, is made of this material. b) As the earth and other planets formed, the heavier elements fell to their centers. On planets close to the sun (Mercury, Venus, Earth and Mars) the lightest elements were mostly blown or boiled away by radiation from the newly formed sun; on the outer planets (Jupiter, Saturn, Uranus, Neptune, and Pluto) the lighter elements still surround them as deep atmospheres f gas or as frozen solid layers.	Distinguish between the inner and outer planets (5a)

	S9-12:45 – *Scale, Distance, Star Formation, Theories, Instrumentation* Students demonstrate their understanding of Processes and Change over Time within Systems of the Universe by… • Describing the process of star formation (i.e. our sun) in relation to its size, including the interaction of the force of gravity, fusion and energy release. **AND** • Explaining the process of the Big Bang Theory and its effect on the Universe today, citing evidence to support its occurrence (Doppler effect/red shift). **AND** • Explaining how technology through time has influenced our understanding of the vastness (i.e., light years) and the nature of the universe (e.g., Ptolemy, Copernicus, Kepler, Einstein).	• **In what ways do objects in our sky change or appear to change?** • **To what extent does distance from earth affect the apparent size of an object?** • **In what ways do objects in our solar system move?** • **How have our ideas about the solar system & universe changed?** a) Stars formed by gravitational clumping of hydrogen and helium out of clouds of molecules of these lightest elements until nuclear fusion of these light elements into heavier ones began to occur, releasing great amounts of energy over millions of years. The process of star formation continues today, as some stars explode, creating new clouds from which other stars from and eventually dissipate with changes in matter and energy. Stars differ in size, temperature and age, but appear to be made of the same elements found on earth and behave according to the same physical principles. b) The Universe expanded explosively into being perhaps between 10 and 20 billion years ago from a hot, dense, chaotic mass. c) The nature of electromagnetic waves (radio waves—the longest, to gamma rays, the shortest) has provided a useful tool to determine the movement of objects in the Universe. Because light from almost all distant galaxies has longer wavelengths that comparable light here on earth, astronomers believe the whole Universe is continuing to expand. Mathematical models and computer simulations are used to study evidence from many sources to explain	Identify the stages of the life cycle of stars (5b) Describe the Big Bang Theory and cite evidence that supports it (5c) Describe how technology has changed our understanding of the universe (5d)

		events in the Universe. A variety of increasingly sophisticated technology is used to learn about the Universe (e.g., visual telescopes, radio telescopes, X-ray telescopes, computers, space probes, atomic accelerators. d) Scientific theories on the nature of the Universe have evolved significantly through the past 2000+ years (Ptolemy, Copernicus, Kepler, Galileo), and new views are emerging.	
	S9-12:46 – *Earth Materials and the Rock Cycle* Students demonstrate their understanding of Processes and Change over Time within Earth Systems by… • Investigating and explaining evidence illustrating that despite changes in form, conservation in the amount of earth materials occurs during the Rock Cycle. **AND** • Explaining how the heat (energy) produced by radioactive decay and pressure affects the Rock Cycle. **AND** • Explaining the processes by which elements (e.g., carbon, nitrogen, oxygen atoms) move through the earth's reservoirs (soil, atmosphere, bodies of water, organisms).	• **What are the basic earth materials?** • **How can we describe the characteristics of soils & rocks?** • **How are rocks formed?** • **What causes and sustains the rock cycle?** a) The formation, weathering, sedimentation and reformation of rock constitutes a continuing "rock cycle" in which the total amount of material remains the same, while its form changes. b) The earth's systems have internal sources of energy (heat), such as radioactive decay and pressure which create heat. c) The earth is a system containing essentially a fixed amount of each stable chemical atom or element. Movement of this matter between reservoirs, driven by the earth's internal and external sources of energy, is often accomplished by a change in the physical and chemical properties of the matter in the solid earth atmosphere and organisms.	Model the process of change during the rock cycle and forces that affect it (5g)

	S9-12:47 – *Forces and Changes on the Earth's Surface* Students demonstrate their understanding of Processes and Change over Time within Earth Systems by… • Creating a model, diagram or computer simulation to demonstrate how convection circulation of the mantle initiates the movement of crustal plates which then causes earthquake and volcanic activity (e.g. Mid-Atlantic Ridge, North American and European plate collisions producing the Green Mountains). **AND** • Analyzing samples of rock sequences to determine the relative age of the rock structure. **AND** • Comparing the usefulness of various methods of determining the age of different rock structures (e.g. relative dating vs. C-dating vs. K-Ar dating. If rock structure is less than 500,000 years old, K-Ar dating cannot be used and Cdating can only be used for tens of thousands of years).	• **In what ways do features of earth's surface change?** • **What causes the changes of earth's features?** • **How long does it take earth's features to change?** a) The convection circulation of the earth's mantle slowly moves the solid crustal sections of the earth's continents and ocean basins over the denser, hot layers beneath—separating in some areas and pressing against one another in other areas resulting in plate collisions—mountain building—volcanic activity—islands. b) Interactions among solid earth, atmosphere, oceans and organisms have resulted in ongoing change of earth's systems (e.g., effects of earthquakes, volcanic eruptions, and glacial activity). c) The age and changes of the earth and its inhabitants can be extrapolated from rock sequences and fossils in the earth's sediments and land forms and also through the decay rates of radioactive isotopes, indicating a long history (Lyell's Principles of Geology, fossil records, Charles Darwin).	Use a model, diagram, or computer simulation to demonstrate how convection currents move plates and cause geologic activity (5e) Analyze samples of rock sequences to determine relative age of rock structures (5f)
	S9-12:48 – *Atmosphere, Water Cycle, Weather, Seasons* Students demonstrate their understanding of Processes and Change over Time within Earth Systems by… • Explaining the uniqueness of the earth's characteristics (e.g., solar intensity, gravity related to size of earth, makeup of atmosphere).	• **How can we describe weather?** • **How can weather be measured?** • **What causes the daily & seasonal weather changes?** • **To what extent is weather related to the water cycle?** • **In what ways is the earth's climate influenced by our oceans?** • **To what extent does the composition of the**	Explain how water's ability to retain heat results in differences in Earth's weather patterns (5h) Diagram and explain local and large scale wind systems (5i)

	AND • Explaining how water as a molecule is also unique in its ability to retain heat, compared to land and air on earth. **AND** • Diagramming and explaining local and large scale wind systems (e.g., land and sea breezes and global wind patterns, Coriolis effect). **AND** • Predicting weather for a particular location, using weather map data (barometric pressure, frontal systems, isobars, isotherms, mountain effects, lake/ocean effects, ocean currents, temperature/humidity) and examining world weather maps and identifying the most likely locations where extreme weather might occur (e.g., blizzards thunderstorms, hurricanes, tornadoes).	**atmosphere affect earth's weather and climate?** • **To what extent can we predict the weather?** a) Of all the diverse planets and moons in the solar system, earth's unique physical/chemical characteristics, its position, its atmosphere and its intensity of solar radiation that allows for the existence of liquid water. Water is a unique molecule generating unique properties that influence the earth's weather (ability to retain heat, melting, boiling, and freezing points). The intensity of radiation from the sun allows water to cycle between liquid and vapor, which supports life as we know it on earth. b) The earth's climatic patterns and weather are governed by the transfer of heat energy between atmosphere and land and oceans. Heat transfer at boundaries of atmosphere and oceans causes the circulation of wind and ocean currents, which influence the composition (temperature and moisture content) and the movement of large air masses). c) The meeting of air masses with different characteristics causes our most.	Predict weather for a particular location using weather map data (5j) Examine world weather maps and identify the most likely locations for extreme weather (5k)
	S9-12:49 – *Natural Resources* **Students demonstrate their understanding of Processes and Change within Natural Resources by …** • Comparing the availability of natural resources and the impact of different management plans (e.g., management of forests depends upon use, lumber production,	• **What are natural resources?** • **To what extent is food a natural resource?** • **What characteristics make some earth materials useful as a natural resource?** • **How do we manage our natural resources?** • **To what extent does overpopulation affect our management of natural resources?** • **To what extent can an ecosystem be restored**	

	sugarbush, deer habitat, mining, recreation) within the management area (forest, farmland, rivers, streams). **AND** • Choosing a Vermont ecosystem and tracing its succession before and after a damaging event, showing how the ecosystem has been restored through the maintenance of atmosphere quality, generation of soils, control of the water cycle, disposal of wastes and recycling of nutrients (e.g., flooding, former mining sites, glacial impact, deforestation, recovery of rivers from sewage/chemical dumping, burning of fossil fuels). **AND** • Explaining a natural chemical cycle that has been disrupted by human activity and predict what the long term effect will be on organisms (e.g., acid precipitation, global warming. ozone depletion, pollution of water by phosphates, mercury, PCBs, etc.). **AND** • Tracing the processes that are necessary to produce a common, everyday object from the original raw materials to its final destination after human use, considering alternate routes—including extraction of raw material, production and transportation, energy use and waste disposal throughout, packaging and recycling and/or disposal (e.g., aluminum can, steel).	**through natural resource management?** • **What is the long-term effect of disruption of a natural chemical cycle by human activity?** • **What are the processes necessary to produce a common everyday object from raw materials to its final destination?** a) Human activities can enhance potential for accelerating rates of natural change. b) Natural ecosystems provide many basic processes that affect humans—maintenance of atmospheric quality, generation of soils, control of the water cycle, disposal of wastes and recycling of nutrients, etc. c) Materials and habits from human societies affect both physical and chemical cycles on earth, and human alteration of these cycles can be detrimental to all organisms. d) Natural ecosystems provide the raw materials for the development of many products for human use (e.g. steel, glass, fertilizers).	