Coordinated Science for the 21st Century to the Michigan Curriculum Framework Science Benchmarks

"X" = Coverage Secondary concept of the activity or problem. Students gain a basic understanding or introduction of the concept. "XX" = In-depth Coverage	CH. 1	CH.2	CH. 3	CH. 4	CH. 5	CH. 6	CH. 7	CH. 8	CH. 9	CH. 10	CH.11	CH. 12	CH. 13	CH. 14	CH. 15
	PHYICS IN ACTION	SAFETY	LET US ENTERTAIN YOU	TOYS FOR UNDERSTANDING	PATTERNS AND PREDICTIONS	MOVIE SPECIAL EFFECTS	THE PERIODIC TABLE	COOL CHEMISTRY SHOW	A VOTE FOR ECOLOGY	A HIGHWAY THROUGH THE PAST	ASTRONOMY AND YOUR COMMUNITY	CLIMATE CHANGE AND YOUR COMMUNITY	ENERGY RESOURCES AND YOUR COMMUNITY	VOLCANOES NAD YOUR COMMUNITY	PLATE TECTONICS AND YOUR COMMUNITY
STRAND I: CONSTRUCTING NEW SCIENTIFIC KNOWLEDGE															
Standard I.1: Constructing New Scientific Knowledge															
All students will ask questions that help them learn about the world; design and conduct investigations using appropriate methodology and technology; learn from books and other sources of information; communicate their findings using appropriate technology; and reconstruct previously learned knowledge.															
1. Ask questions that can be investigated empirically. (Key concepts: Questions often build on existing knowledge. Real-world contexts: Any in the sections on Using Scientific Knowledge.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX
2. Design and conduct scientific investigations. (Key concepts: Types of scientific knowledge— hypothesis, theory, observation, conclusion, law, data, generalization. Aspects of field research— hypothesis, design, observations, samples, analysis, conclusion. Aspects of experimental research— hypothesis, design, variable, experimental group, control group, prediction, analysis, conclusion. Investigations are based on questions about the world (see C-I.1 h.1). Real-world contexts: Any suggested in Using Scientific Knowledge benchmarks for which students would design and/or conduct investigations.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX
3. Recognize and explain the limitations of measuring devices. (Key concepts: Uncertainty, error, range, tolerances, accuracy, precision. Tools: Balance, thermometer, measuring tape, ruler, graduated cylinder, electronic measuring devices. Real-world contexts: Experiments that use quantitative data; manufacturing systems where measurements are critical.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX
4. Gather and synthesize information from books and other sources of information. (Key concepts: Scientific journals, text- and computer based reference materials. Real-world contexts: Libraries, technical reference books, Internet, computer software.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX
5. Discuss topics in groups by making clear presentations, restating or summarizing what others have said, asking for clarification or elaboration, taking alternative perspectives, and defending a position. (Key concepts: Logical argument, summary, clarification, elaboration, alternative perspectives. Real-world contexts: Newspaper or magazine articles discussing a topic of social concern.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX

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STRAND II: REFELCTING ON SCIENTIFIC KNOWLEDGE **Standard II.1: Reflecting on Scientific Knowledge** **All students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge; how science is related to other ways of knowing; how science and technology affect our society; and how people of diverse cultures have contributed to and influenced developments in science.**															
1. Justify plans or explanations on a theoretical or empirical basis. (Key concepts: Aspects of logical argument, including evidence, fact, opinion, assumptions, claims, conclusions, observations. Real-world contexts: Any in the sections on Using Scientific Knowledge.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX
2. Describe some general limitations of scientific knowledge. (Key concepts: Understanding of the general limits of science and scientific knowledge as constantly developing human enterprises; recognizing that arguments can have emotive, economic, and political dimensions as well as scientific. Real-world contexts: Any in the sections on Using Scientific Knowledge.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX
3. Show how common themes of science, mathematics, and technology apply in real-world contexts. (Thematic ideas: Systems-subsystems, feedback models, mathematical constancy, scale, conservation, structure, function, adaptation. Real-world contexts: Any in the sections on Using Scientific Knowledge.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX
4. Discuss the historical development of key scientific concepts and principles. (Key concepts: Historical, political, social, and economic factors influencing the development of science. See Benchmarks for science Literacy, AAAS, Chapter 10. Real-world contexts: Historical development of key scientific theories.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX
5. Explain the social and economic advantages and risks of new technology. (Key concepts: Cost-benefit analysis; See LO h.5 (health technology), PME-IV.1 h.1 (household and agricultural materials, EG-V.1 h.4 (resource use), LEC-III.5 h.6 (effects of urban development and agriculture on ecosystems), EAW-V.3 h.4 (air pollution), EH-V.2 h.2 (water pollution.) Real-world contexts: Issues related to new technologies, including ones in health-care, transportation, communications, manufacturing, information and media.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX
6. Develop an awareness of and sensitivity to the natural world. (Key concepts: Appreciation of the balance of nature and the effects organisms have on each other, including the effects humans have on the natural world. Real-world contexts: Any in the sections on Using Scientific Knowledge appropriate to high school.)	XX	XX	XX	XX		XX	XX	XX	XX	XX				XX	XX

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7. Describe the historical, political, and social factors affecting developments in science. (Key concepts: Historical, political, social, and economic factors influencing the development of science. Real-world contexts: The development of the sun-centered model of the solar system and political pressures on Galileo; the development of Darwin's theory of evolution by natural selection.)	XX	XX	XX	XX	xx	XX	XX	XX	XX	XX	xx	xx	xx	XX	XX
STRAND III: USING SCIENTIFIC KNOWLEDGE IN															
Standard III.1: Cells															
All students will apply an understanding of cells to the functioning of multicellular organisms; and explain how cells grow, develop and reproduce.															
1. Explain how multi-cellular organisms grow, based on how cells grow and reproduce. (Key concepts: Specialized functions of cells— respiration (see LO h.3), protein synthesis, mitosis, meiosis (see LH-III.3 h.2). Basic molecules for cell growth—simple sugars, amino acids, fatty acids. Basic chemicals, molecules and atoms—water, minerals, carbohydrates, proteins, fats and lipids, nucleic acids; carbon, hydrogen, oxygen, nitrogen. Cells come only from other cells. See LO m.4 (digestion). Real-world contexts: The growth of plants and animals.)									X	X					
2. Compare and contrast ways in which selected cells are specialized to carry out particular life functions. (Key concepts: Classifications of organisms by cell type—plant, animal, bacteria; selected specialized plant and animal cells—red blood cells, white blood cells, muscle cells, nerve cells, root cells, leaf cells, stem cells; cell parts used for classification — organelle, nucleus, cell wall, cell membrane; specialized functions — reproduction (see LC-III.1 h.1, LH-III.3 h.2), photosynthesis (see LO m.3), transport; cell shape. Tools: microscopes. Real-world contexts: Reproduction, growth, response, movement, etc. of animals and plants. Functions of bacteria.)									X	X					
Standard III.2: Organization of Living Things															
All students will use classification systems to describe groups of living things; compare and contrast differences in the life cycles of living things; investigate and explain how living things obtain and use energy; and analyze how parts of living things are adapted to carry out specific functions.															
1. Classify major groups of organisms to the kingdom level. (Key concepts: Kingdom categories—protist, fungi, moneran, animal, plant. Characteristics for classification—cell wall, cell membrane, organelle, single-celled, multicellular. Real-world contexts: Common local representatives of each of the five major kingdoms—Paramecium, yeast, mushroom, bacteria, frog, geranium.)										X					
2. Describe the life cycle of an organism associated with human disease. (Key concepts: Infection process—disease, parasite, carrier, host, infection. Tools: Microscope, hand lens. Real-world contexts: Life cycle of organism(s) associated with human disease(s), such as Lyme disease—tick, malaria—mosquito, parasites.)															

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3. Explain the process of food storage and food use in organisms. (Key concepts: Cellular respiration, photosynthesis (see LO m.3), oxygen, sunlight, carbon dioxide, carbohydrate, fat, protein, minerals, water. See LC-III.1 h.1 (how organisms grow), LO-III.2 m.3 (how plants store food) LO-III.2 m.4 (how food and oxygen are distributed to cells), LEC-III.5 m.2 (the sun as the ultimate source of energy for organisms) and PCM-IV.2 m.3 (energy transformations). Real-world contexts: Food storage, such as maple tree—maple sap, potato—starch, honey bee—honey, cow—beef, milk. Weight gain and weight loss. Change in respiration rates with exercise.)									XX					
4. Explain how living things maintain a stable internal environment. (Key concepts: Related systems/cells/ chemicals— excretory system, endocrine system, circulatory system, hormones, immune response, white blood cell, bacteria, virus. Factors/ mechanisms under control—temperature, disease/infection, homeostasis. Real-world contexts: Mechanisms for maintaining internal stability, such as body temperature, disease control.)															
5. Describe technology used in the prevention, diagnosis, and treatment of diseases and explain its function in terms of human body processes. (Key concepts: Available technologies—sanitation, adequate food and water supplies, inoculation, antibodies, biochemistry, medicines, organ transplants. (See PWV-IV.4 h.4, ultrasound/x-ray.) Real-world contexts: Common contexts for these technologies—health maintenance and disease prevention activities, such as exercise and controlled diets; health monitoring activities, such as cholesterol and blood pressure checks and various tests for cancer.)															
Standard III.3: Heredity **All students will investigate and explain how characteristics of living things are passed on through generations; explain why organisms within a species are different from one another; and explain how new traits can be established by changing or manipulating genes.**															
1. Explain how characteristics of living things are passed on from generation to generation. (Key concepts: Traits—dominant, recessive. Genetic material—gene pair, gene combination, gene sorting. Real-world contexts: Common contexts—inheritance of a human genetic disease/disorder, such as sickle cell anemia; a family tree focused on certain traits; examining animal or plant pedigrees.)										XX					
2. Describe how genetic material is passed from parent to young during sexual and asexual reproduction. (Key concepts: Types of cell division—mitosis, meiosis. DNA replication, chromosome. Types of reproduction—sexual, asexual. Genetic variation. Tools: A-V media, diagrams showing DNA replication during cell division. Real-world contexts: Fruit flies, yeast, reproduction by spores, cloning.)										X					

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3. Explain how new traits may arise in individuals through changes in genetic material (DNA). (Key concepts: Genetic changes—variation, new gene combinations, mutation. Natural and human produced sources of mutation—radiation, chemicals. See LE-III.4 m.2 (how new traits become established in populations.) Real-world contexts: Products of genetic engineering, such as medical advances—insulin, cancer drugs; agricultural related products, such as navel oranges, new flower colors, higher-yield grains; effects of natural and man-made contamination; examples of variations due to new gene combinations, such as hybrid organisms or new plant varieties resulting from multiple sets of genes.)										X					
Standard III.4: Evolution **All students will explain how scientists construct and scientifically test theories concerning the origin of life and evolution of species; compare ways that living organisms are adapted (suited) to survive and reproduce in their environments; and analyze how species change through time.**															
1. Describe what biologists consider to be evidence for human evolutionary relationships to selected animal groups. (Key concepts: Common types of evidence used—hominid fossils, vestigial structures, DNA, protein structure. Real-world contexts: Skeletal comparisons, such as modern human to hominid fossils; anatomical and biochemical similarities of humans and other higher primates, such as blood proteins; similarity of early human embryo stages to those of other vertebrates; vestigial structures, such as appendix, tail bone.)										X					
2. Explain how a new species or variety may originate through the evolutionary process of natural selection. (Key concepts: Concept of species; how new species or varieties are established—natural selection, inheritable, non-inheritable characteristics, species variation. Real-world contexts: Contemporary examples of natural selection, such as bacteria resistance to antibiotics, insect resistance to pesticides; examples of artificial selection, such as agricultural selection to increase production, selecting desired traits for pets; historical examples of naïve explanations of evolution, such as the Lamarkian explanation of the evolution of the giraffe's long neck.)										XX					
Standard III.5: Ecosystems **All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; and analyze how humans and the environment interact.**															
1. Describe common ecological relationships between and among species and their environments. (Key concepts: Competition, territory, carrying capacity, natural balance, population, dependence, survival; biotic, abiotic factors. Real-world contexts: Animals that live in packs or herds and plant colonies, such as—wolves, bison, lilies and other bulb plants, various forms of algae.)									XX						
2. Explain how energy flows through familiar ecosystems. (Key concepts: Participants and relationships—food chain, food web, energy pyramid, energy flow, producers, consumers, decomposers. See LO-III.2 m.3 (producers), PCM-IV.2 h.4 (conservation of energy). Real-world contexts: Energy pyramids for food webs in various ecosystems.)									XX						

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3. Describe general factors regulating population size in ecosystems. (Key concepts: Carrying capacity, competition, parasitism, predation, loss of habitat. Real-world contexts: Common factors that influence relationships, such as weather, disease, predation, migration.)									XX						
4. Describe responses of an ecosystem to events that cause it to change. (Key concepts: Succession, pioneer, climate/physical conditions, introduction of new/different species, elimination of existing species, biodiversity; cataclysmic changes. Real-world contexts: Climax forests comprised of maple, beech, or conifers; effects of urban sprawl or clear cutting forests; effects of cataclysmic changes such as the eruption of Mt. St. Helens.)									XX						
5. Describe how carbon and soil nutrients cycle through selected ecosystems. (Key concepts: Common nutrients/elements — nitrogen, sulfur, carbon, phosphorous. Inorganic compounds containing nutrients—soil minerals, carbon dioxide. Organic compounds in living communities—proteins, fats, carbohydrates. See LOIII. 2 h.3 (cell respiration) and LO-III.2 m.3 (photosynthesis). Real-world contexts: Movement of food materials through various food webs, including decomposition.)									XX						
6. Explain the effects of agriculture and urban development on selected ecosystems. (Key concepts: Common factors that influence ecosystems, such as pollution of ecosystems from fertilizer, insecticide, and other chemicals. Land management, biodiversity, sustainability. Loss of habitat. See PME-IV.1 h.1 (risk/benefit analysis), EH-V.2 h.2 (water pollution). Real-world contexts: Common factors that influence ecosystems, such as pollution of ecosystems from fertilizer, insecticide, and other chemicals.)								X	X						
STRAND IV: USING SCIENTIFIC KNOWLEDGE IN **Standard IV.1: Matter and Energy** **All students will measure and describe the things around us; explain what the world around us is made of; identify and describe forms of energy; and explain how electricity and magnetism interact with matter.**															
1. Analyze properties of common household and agricultural materials in terms of risk/benefit balance. (Key concepts: Risk/benefit analysis. Real-world contexts: Herbicides, refrigerants, fertilizers, detergents.)								X							
2. Identify properties of common families of elements. (Key concepts: Properties—state, reactivity, metal/non-metal, conductivity. Tools: Various element samples. Real-world contexts: Highly reactive metals (such as potassium, sodium), less-reactive metals (such as calcium), highly reactive nonmetals (such as chlorine, fluorine, and oxygen), almost completely non-reactive gases (such as helium and neon); relationships on the Periodic Table of Elements.)						X	XX	XX							

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3. Explain how elements differ, in terms of the structural parts and electrical charges of atoms. (Key concepts: Parts of atoms—nucleus, electron cloud. Subatomic particles—proton, neutron, electron. Electrical charges—positive, negative, neutral. Each element has a unique number of protons. See PMO-IV.3 m.3 (electric force). Real-world contexts: All elements.)						X	XX	XX							
4. Explain how current is controlled in simple series and parallel circuits. (Key concepts: Single path, multiple paths, switches, fuses, circuit breakers, power supply, batteries, household current, motors, bulbs, circuit diagrams. Real-world contexts: Basic household wiring, automobile wiring, flashlights, tree lights, power lines; electrical conductivity testing.)		X		X											
5. Describe how electric currents can be produced by interacting wires and magnets, and explain applications of this principle. (Key concepts: Current flow and direction, magnetic fields. See PMO-IV.3 m.4 (magnetism from electricity). Real-world contexts: Generators, alternating current, direct current.)				XX	x		X								
Standard IV.2: Changes in Matter **All students will investigate, describe and analyze ways in which matter changes; describe how living things and human technology change matter and transform energy; explain how visible changes in matter are related to atoms and molecules; and how changes in matter are related to changes in energy.**															
1. Explain chemical changes in terms of the breaking of bonds and the rearrangement of atoms to form new substances. (Key concepts: atom, molecule, ion, bond, reactant, product; conservation of mass; rate of reaction— temperature, surface area, concentration; specific chemical reactions—burning paper or wood, rusting iron, formation of sugars during photosynthesis. See PME-IV.1 h.3 (structure of the atom). Real-world contexts: Examples of chemical changes—See PCM-IV.2 m.2.)						X	XX	XX			x				
2. Explain why mass is conserved in physical and chemical changes. (Key concepts: atom, molecule, mass. Real-world contexts: Common physical and chemical changes, including matter cycles in ecosystems.)						X	XX	XX			x				
3. Contrast nuclear fission, nuclear fusion, and natural radioactivity. (Key concepts: Nucleus, nuclear change, force that hold nucleus together, nuclear energy. Stable and unstable isotopes. Properties—mass, element, radioactivity. See PME-IV.1 h.3 (structure of the atom). Real-world contexts: Nuclear power plants, nuclear energy from sun, natural radioactive decay, use of radiation and radioactive isotopes in medicine.)							X				XX				

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4. Describe energy transformations involved in physical, chemical and nuclear changes, and contrast their relative magnitudes. (Key concepts: Potential energy, kinetic energy, heat, light, electrical energy, chemical energy, sound; temperature changes. Original sources of energy: sun, radioactivity. Conservation of energy, conservation of mass/energy; E=mc2. See PCM-IV.2 m.4 (common energy transformations), PCM-IV.2 h.3 (nuclear changes). Real-world contexts: Common physical, chemical and nuclear changes, including changes of state, burning, electrical decomposition of water, photosynthesis, cellular respiration, fireworks and dynamite, nuclear power, stars.)		X		XX		XX	XX	XX			x		x		
5. Explain changes in matter and energy involving heat transfer. (Key concepts: Mechanisms of heat transfer — convection, conduction, radiation. Conservation of energy, efficiency. Changes in matter related to heat transfer—changes in temperature, volume, pressure. See PCM-IV.2 m.1 (thermal expansion), EAW-V.3 h.3 (convection). Real-world contexts: Convection currents, lake turnover, wind, hot frying pans, heating and cooling buildings, heat lamps, sunlight heating the earth, greenhouse effect, fires for warming.)				X		X	X	X			xx		x	XX	XX
Standard IV.3: Motion of Objects **All students will describe how things around us move and explain why things move as they do; demonstrate and explain how we control the motions of objects; and relate motion to energy and energy conversions.**															
1. Analyze patterns of force and motion in the operation of complex machines. (Key concepts: Electrical and/or mechanical components of complex machines. Real-world contexts: Machines, such as bicycles, automobiles, pumps, electrical motors.)		X		XX											
2. Explain energy conversions in moving objects and machines. (Key concepts: Types of energy—electrical energy, kinetic energy, gravitational potential energy, potential energy in springs, chemical potential energy, heat energy, radiation. Energy transformations—see PCM-IV.2 m.4. Efficiency. See PME-IV.1 h.4 (conservation of energy) and PCMIV. 2 h.4 (energy in physical and chemical changes). Real-world contexts: Simple and complex machines, roller coasters, swings, pendulums, elevators, automobiles, fans, motors.)	X	X		XX				X							
Standard IV.4: Waves and Vibrations **All students will describe sounds and sound waves; explain shadows, color, and other light phenomena; measure and describe vibrations and waves; and explain how waves and vibrations transfer energy.**															
1. Relate characteristics of sounds that we hear to properties of sound waves. (Key concepts: Properties of sounds—pitch, volume. Characteristics of sound waves—frequency, amplitude, velocity. Real-world contexts: Common sounds that vary in pitch and volume—see PWV-IV.4 e.1.)			XX		x									X	

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2. Explain how we see colors of objects. (Key concepts: Characteristics of light—brightness, amplitude, colors of spectrum (red, orange, yellow, green, blue, indigo, violet) wavelength, frequency (see PWV-IV.4 h.3). Ways that objects interact with light—emission, reflection, absorption, transmission, scattering (see PWV-IV.4 m.4). Real-world contexts: Colored light-reflecting objects, such as books, clothes, color photographs; colored light-transmitting objects, such as stained glass, cellophane; colored light-emitting objects, such as television, neon lights. Scattering of light by the atmosphere.)			XX			X	X	X			x				
3. Describe waves in terms of their properties. (Key concepts: Mechanical waves, electromagnetic waves—see PWV-IV.4 h.4. Colors of light. Properties of waves—frequency, amplitude, wavelength, wave velocity, energy. Units of measurement—hertz or cycles per second, micrometers, meters, meters per second. Tools for making spectra: Prism, diffraction grating. Real-world contexts: Examples of mechanical and electromagnetic waves—see PWV-IV.4 h.4. Colors of light, frequencies of radio and TV transmission.)			XX	X	XX	X	X				XX			X	X
4. Describe different types of waves and their technological applications. (Key concepts: Types of waves—mechanical: sound, ultrasound, water waves, shock wave; electromagnetic: radio waves, microwaves, radiant heat, infrared radiation, visible light, ultraviolet radiation, x-rays. Properties of waves—see PWVIV. 4 h.3. See PCM-IV.2 m.4 (energy transformations). Real-world contexts: Examples of mechanical waves—sound, ultrasound, ocean waves, wave tanks, earthquakes, seismic waves; examples of electromagnetic waves, such as light—see above, radio and television signals, heat lamps, microwave transmitters, radar, ultraviolet radiation in sunlight, X-ray machines, CAT-scans, gamma rays from radioactive decay.)			XX	X	x	X	X				x			X	X
STRAND V: USING SCIENTIFIC KNOWLEDGE IN EARTH SCIENCE **Standrad V.1: Geosphere** **All students will describe the earth's surface; describe and explain how the earth's features change over time; and analyze effects of technology on the earth's surface and resources.**															
1. Explain the surface features of the Great Lakes region using Ice Age theory. (Key concepts: Glacial processes—climate change, snow changing to ice, pressure, moving (advance, retreat), melting; deposits; features—hills, lakes, Great Lakes. See EAW-V.3 h.1 (long-term climate change.) Tools: Relief map, topographic map, elevation map. Real-world contexts: Examples in Michigan of glacial formations, such as moraines, kettles, drumlins.)															

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2. Use the plate tectonics theory to explain features of the earth's surface and geological phenomena and describe evidence for the plate tectonics theory. (Key concepts: Earth composition—crust, mantle: upper part is able to flow very slowly; core: interior at high temperature and pressure (see ES-V.4 h.3.) Forces—tension, compression shearing. Plates— continental crust, oceanic crust. Features—faults, trenches, mid-ocean ridges, folded mountains, hot spots, volcanoes. Related actions—earthquakes (see PWV-IV.4 m.6), volcanic activity, seafloor spreading, mountain building, convection in mantle. Evidence of "continental drift"—physical fit of continents, fossil evidence, measurements of movement, rock layer sequences, glacial evidence. See Reflecting on Scientific Knowledge benchmarks related to evidence and theory. Real-world contexts: Recent patterns of earthquake and volcanic activities; maps showing the direction of movement of major plates and associated earthquake and volcanic activity; compressional boundaries: folded mountains, thrust faults, trenches, lines of volcanoes (e.g. Pacific "ring of fire"); tensional boundaries: mid-ocean ridges, rift valleys; shearing boundaries: lateral movement producing faults (e.g. San Andreas Fault).											**X**		**XX**	**XX**
3. Explain how common objects are made from earth materials and why earth materials are conserved and recycled. (Key concepts: Valuable materials—minerals, metallic ores, iron, copper, aluminum, fuels. Types of resources—renewable, nonrenewable. Conservation, limits, recycling, costs for developing more remote supplies. Manufacturing, refining, mining. Recycling processes—melting, shredding, dissolving. Real-world contexts: Manufacturing processes— steel mills, auto assembly lines, paper making; local recycling center for materials, such as glass, plastic, aluminum, steel cans, motor oil; examples of technical and social means for slowing the depletion of earth's resources, such as developing more fuel efficient cars and mandating their use; disposal in landfills and incinerators.)												**XX**		
4. Evaluate alternative long range plans for resource use and by-product disposal in terms of environmental and economic impact. (Key concepts: Understanding of limitations of knowledge and technology (see R-II.1 h.2), side effects of resource use (see PME-IV.1 h.1, risk/benefit analysis). Also see R-II.1 h.5 (new technologies), EAW-V.3 .4 (air pollution). Real-world contexts: Industries for mining, energy production, manufacturing, transportation, housing. Resources including fossil fuels, metals, wood, water. Pollution prevention and events, such as catalytic converters, Love Canal, Superfund waste sites.)												**XX**		
Standard V.2: Hydrosphere **All students will demonstrate where water is found on earth; describe the characteristics of water and how water moves; and analyze the interaction of human activities with the hydrosphere.**															
1. Identify and describe regional watersheds. (Key concepts: drainage basins, divides, reservoirs, tributaries, run-off. Tools: maps. Real-world contexts: Local and regional watersheds, Great Lakes Basin, Continental Divide; planning water management, evaluating potential disposal sites, analyzing pollution events which concern both surface and ground water.)															

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2. Describe how human activities affect the quality of water in the hydrosphere. (Key concepts: Human activities—agriculture, fishing, manufacturing, energy production. Quantity of water—rate of use, urbanization. Oceans—oil spills, garbage, global warming, marine life. Fresh water pollution—industrial waste disposal, agricultural runoff, herbicides, pesticides, sewage, acid rain, nutrient levels. Ground water—landfills, leaching, disposal of toxic wastes. Purification technology—filtering, chlorination. Limits to natural resources. Real-world contexts: Examples of local and regional human activities that have measurable effects on water, including farming, industry, sewage disposal, toxic waste disposal.)														
Standard V.3: Atmosphere and Weather															
All students will investigate and describe what makes up weather and how it changes from day to day, from season to season and over long periods of time; explain what causes different kinds of weather; and nalyze the relationships between human activities and the atmosphere.															
1. Explain how interactions of the atmosphere, hydrosphere and geosphere create climates and how climates change over time. (Key concepts: Average yearly temperatures; ice ages, volcanic dust in atmosphere, greenhouse effect, global air circulation, effects of latitude, effects of landforms, ocean currents. Real-world contexts: Causes of short-term climate changes, such as catastrophic volcanic eruptions and impact of solar system objects; evidence of long-term climate changes, such as ice ages, global warming. El Nino, La Nina.)												**XX**		**X**	
2. Describe patterns of air movement in the atmosphere and how they affect weather conditions. (Key concepts: Air movement—air masses, fronts, pressure systems, prevailing winds, jet stream. Real-world contexts: Reports of local weather patterns influenced by the jet stream and prevailing winds.)												**x**		**X**	
3. Explain and predict general weather patterns and storms. (Key concepts: Weather patterns—cold front, warm front, stationary front, air mass, high and low pressure systems. Storms—thunderstorms, lightning and thunder, tornadoes, hurricanes, winds, blizzards. Buoyancy, thermal expansion, convection. See PCM-IV.2 m.1 (thermal expansion) and PME-IV.1 m.1 (density). Tools: Weather maps, thermometer, hygrometer, barometer, anemometer, wind vane, rain gauge, satellite and radar monitoring (see PWV-IV.4 h.4). Real-world contexts: Observable daily weather patterns; examples of weather reports from TV, radio, newspapers, including representations on weather maps. Reports of local weather patterns influenced by the jet stream and prevailing winds.)														**X**	

	CH. 1	CH.2	CH. 3	CH. 4	CH. 5	CH. 6	CH. 7	CH. 8	CH. 9	CH. 10	CH.11	CH. 12	CH. 13	CH. 14	CH. 15
4. Explain the impact of human activities on the atmosphere and explain ways that individuals and society can reduce pollution. (Key concepts: Air pollution—car exhaust, industrial emissions, smog. Related effects—breathing problems, acid rain, global warming, deforestation, ozone depletion. See EG-V.1 h.4 (resource use). Real-world contexts: Examples of human activities that affect the atmosphere, including use of aerosol spray cans, discharge from smoke stacks, car exhaust, burning leaves and wood in stoves and fireplaces, climate change, global warming; actions, including turning off lights, turning down heat, tuning-up cars, filling tires, driving at a consistent speed, mandating higher fuel efficiencies, energy savings from recycling.)												X		
Standard V.4: Solar System, Galaxy and Universe **All students will compare and contrast our planet and sun to other planets and star systems; describe and explain how objects in the solar system move; explain scientific theories as to the origin of the solar system; and explain how we learn about the universe.**															
1. Compare our sun to other stars. (Key concepts: Temperatures, colors, sizes, apparent and absolute brightness; double stars. Real-world contexts: Observing color and brightness of stars, observing double stars.)											XX	X			
2. Describe the position and motion of our solar system in our galaxy and the overall scale, structure and age of the universe. (Key concepts: Stars, galaxies, Milky Way, spiral structure, speed of light, light year, travel times, big bang, red shift. Tools: Telescopes, binoculars, spectroscopes. Real-world contexts: Observations of other stars, star clusters, nebulas, and galaxies, observations of other potential planetary systems, accounts of possible travel to other star systems.)					X						XX	X			
3. Explain how stars and planetary systems form and how stars produce energy. (Key concepts: Processes of formation—coalescence from clouds of dust and gases by gravity; explosions of stars producing heavy elements; hydrogen, helium. Production of energy—fusion, radiation. Planetary systems may form during this process—heavy and light elements, hot interiors of earth-like planets. Age of the solar system. Real-world contexts: Nebulas considered to be star forming regions, supernovas, nuclear fusion research.											XX	X			
4. Explain how technology and scientific inquiry have helped us learn about the universe. (Key concepts: Information—radiant energy, radio waves, light, spectra, color of stars, moon and meteor samples. Devices—radio, optical and other types of telescopes, space probes, satellites, computer imaging/modeling (see PWV-IV.4 h.4.) Problems for investigation—geology and weather of planets and moons, origins, extraterrestrial life. Real-world contexts: Histories of discoveries, stories of exploration, visits to observatories and planetariums; videos showing space exploration; samples of space materials, including moon rocks and meteorites; remote sensing data; SETI—Search for Extraterrestrial Life.)					X						XX	X			