Active Physical Science Correlation 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 Primary concept that is the focus of the activity or problem. Students gain thorough understanding of the concept.	CH. 1 PHYSICS IN ACTION	CH. 2 SAFETY	CH. 3 THE TRACK AND FIELD CHAMPIONSHIP	CH. 4 THRILLS AND CHILLS	CH. 5 LET US ENTERTAIN YOU	CH. 6 DESIGNING THE UNIVERSAL DWELLING	CH. 7 ELECTRICITY FOR EVERYONE	CH. 8 TOYS FOR UNDERSTANDING	CH. 9 ATOMS ON DISPLAY	CH. 10 MOVIE SPECIAL EFFECTS	CH. 11 THE PERIODIC TABLE	CH. 12 COOL CHEMISTRY SHOW
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
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

	CH. 1	CH. 2	CH. 3	CH. 4	CH. 5	CH. 6	CH. 7	CH. 8	CH. 9	CH. 10	CH. 11	CH. 12
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
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
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
STRAND II: REFLECTING 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

	CH. 1	CH. 2	CH. 3	CH. 4	CH. 5	CH. 6	CH. 7	CH. 8	CH. 9	CH. 10	CH. 11	CH. 12
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
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
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
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

	CH. 1	CH. 2	CH. 3	CH. 4	CH. 5	CH. 6	CH. 7	CH. 8	CH. 9	CH. 10	CH. 11	CH. 12
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	XX
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
STRAND IV: USING SCIENTIFIC KNOWLEDGE IN PHYSICAL SCIENCE												
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	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

	CH. 1	CH. 2	CH. 3	CH. 4	CH. 5	CH. 6	CH. 7	CH. 8	CH. 9	CH. 10	CH. 11	CH. 12
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.)									XX	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					XX	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.)							X	XX				
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	X	XX	XX

	CH. 1	CH. 2	CH. 3	CH. 4	CH. 5	CH. 6	CH. 7	CH. 8	CH. 9	CH. 10	CH. 11	CH. 12
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**	**X**	**XX**	**XX**
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.)									**XX**		**X**	
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**	**X**	**X**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
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**	**XX**	**X**	**X**	**X**	**X**	**X**	**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
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		X			XX	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	X	XX	XX		XX	XX	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							

	CH. 1	CH. 2	CH. 3	CH. 4	CH. 5	CH. 6	CH. 7	CH. 8	CH. 9	CH. 10	CH. 11	CH. 12
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				XX	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	X	XX	X	XX	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	XX	X	X	X