Active Physical Science Correlation to the Ohio Academic Content Standards for Physical Sciences, Grades 9-10*

Physical Sciences
Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with the physical sciences.

Benchmark	**Indicator**	**Location/Page where Standard is found**
<u>Benchmark A</u>: Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.		
Nature of Matter(Grade 9)	1. Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes.	**450-454, 669-670, 702-711, 713-719, 721-730, 740-747, 826-829**

	2. Illustrate that atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral.	**548-555, 556-560, 567-575, 576-586, 587-594, 713-720**
	4. Show that when elements are listed in order according to the number of protons (called the atomic number), the repeating patterns of physical and chemical properties identify families of elements. Recognize that the periodic table was formed as a result of the repeating pattern of electron configurations.	**666-672, 702-712, 713-720, 731-739, 755-766, 785-791**
	5. Describe how ions are formed when an atom or a group of atoms acquire an unbalanced charge by gaining or losing one or more electrons.	**556-560, 567-575, 678-682, 713-720, 721-730, 826-831**
<u>Benchmark B</u>: Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.		
Nature of Matter(Grade 9)	6. Explain that the electric force between the nucleus and the electrons hold an atom together. Relate that on a larger scale, electric forces hold solid and liquid materials together (e.g., salt crystals and water).	**713-720, 755-759, 760-768**
	7. Show how atoms may be bonded together by losing, gaining or sharing electrons and that in a chemical reaction, the number, type of atoms and total mass must be the same before and after the reaction (e.g., writing correct chemical formulas and writing balanced chemical equations).	**673-677, 687-688, 702-711, 713-720, 721-730, 731-739, 740-747, 755-766, 772-778, 779-784, 785-791, 792-801**
	8. Demonstrate that the pH scale (0-14) is used to measure acidity and classify substances or solutions as acidic, basic, or neutral.	**779-784, 816-825**

<u>Benchmark C</u>: Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.		
Nature of Matter(Grade 9)	9. Investigate the properties of pure substances and mixtures (e.g., density, conductivity, hardness, properties of alloys, superconductors and semiconductors).	**626-633, 634-643, 644-649, 650-655, 656-665, 666-671, 683-687, 772-778, 779-784, 785-791, 792-801, 816-825, 826-831**
	10. Compare the conductivity of different materials and explain the role of electrons in the ability to conduct electricity.	**416-420, 421-424, 425-428, 433-440, 486-497, 650-655, 666-672**
<u>Benchmark D</u>: Explain the movement of objects by applying Newton's three laws of motion.		
Forces and Motion(Grade 9)	21. Demonstrate that motion is a measurable quantity that depends on the observer's frame of reference and describe the object's motion in terms of position, velocity, acceleration and time.	**4-14, 15-25, 31-44, 45-49, 56-60, 81-85, 142-146, 151-155, 156-160, 161-166, 167-170, 176-183, 208-217**
	22. Demonstrate that any object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced (net) force acts on it.	**15-25, 31-44, 45-49, 69-74, 99-104, 105-110, 117-121, 123-134, 161-166, 167-170, 176-183, 208-217, 253-265**
	23. Explain the change in motion (acceleration) of an object. Demonstrate that the acceleration is proportional to the net force acting on the object and inversely proportional to the mass of the object. (F_{net}=ma. Note that weight is the gravitational force on a mass.)	**4-14, 15-25, 45-49, 56-60, 69-74, 81-85, 86-93, 99-104, 117-121, 122-128, 142-146, 147-150, 151-155, 156-160, 161-166, 194-202, 214-217, 218-230, 231-238, 239-255, 253-265**
	24. Demonstrate that whenever one object exerts a force on another, an equal amount of force is exerted back on the first object.	**45-49, 50-55, 69-74, 122-128, 194-202, 253-265**

	25. Demonstrate the ways in which frictional forces constrain the motion of objects (e.g., a car traveling around a curve, a block on an inclined plane, a person running, an airplane in flight).	**50-55, 69-74, 218-230, 239-252**
<u>Benchmark E:</u> Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored).		
Nature of Energy(Grade 9)	12. Explain how an object's kinetic energy depends on its mass and its speed ($KE=\frac{1}{2}mv^2$).	**31-44, 45-49, 99-104, 105-110, 123-134, 176-183, 218-230, 231-238**
	13. Demonstrate that near Earth's surface an object's gravitational potential energy depends upon its weight (mg where m is the object's mass and g is the acceleration due to gravity) and height (h) above a reference surface ($PE=mgh$).	**31-44, 45-49, 176-183, 184-193, 194-202, 218-230, 231-238, 239-252**
<u>Benchmark F:</u> Explain how energy may change form or be redistributed but the total quantity of energy is conserved.		
Nature of Matter(Grade 9)	3. Describe radioactive substances as unstable nuclei that undergo random spontaneous nuclear decay emitting particles and/or high energy wavelike radiation.	**587-594, 595-604, 605-611, 612-619, 755-766**
Nature of Energy(Grade 9)	11. Explain how thermal energy exists in the random motion and vibrations of atoms and molecules. Recognize that the higher the temperature, the greater the average atomic or molecular motion, and during changes of state the temperature remains constant.	**416-420, 433-440, 486-497, 634-643, 809-815**
	14. Summarize how nuclear reactions convert a small amount of matter into a large amount of energy. (Fission involves the splitting of a large nucleus into smaller nuclei; fusion is the joining of two small nuclei into a larger nucleus at extremely high energies.)	**595-604, 605-611, 612-619, 755-766**
	15. Trace the transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy.	**56-60, 61-68, 487-497, 634-643, 683-688, 713-720, 721-730, 809-815**

	16. Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels).	**486-497, 634-643, 683-688, 802-808, 809-815**
	17. Demonstrate that thermal energy can be transferred by conduction, convection or radiation (e.g., through materials by the collision of particles, moving air masses or across empty space by forms of electromagnetic radiation).	**99-104, 411-415, 416-420, 421-428, 433-440, 634-643**
<u>Benchmark G:</u> Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.		
Nature of Energy(Grade 9)	18. Demonstrate that electromagnetic radiation is a form of energy. Recognize that light acts as a wave. Show that visible light is a part of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays).	**354-361, 362-370, 371-376, 377-385, 386-390, 576-586, 721-730**
	19. Show how the properties of a wave depend on the properties of the medium through which it travels. Recognize that electromagnetic waves can be propagated without a medium.	**326-329, 340-345, 346-353, 576-586, 721-730**
	20. Describe how waves can superimpose on one another when propagated in the same medium. Analyze conditions in which waves can bend around corners, reflect off surfaces, are absorbed by materials they enter, and change direction and speed when entering a different material.	**326-339, 340-345, 346-353, 354-361**
<u>Benchmark H:</u> Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences.		
Historical Perspectivesand Scientific Revolutions(Grade 9)	26. Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., atomic theory, quantum theory and Newtonian mechanics).	**567-572, 572-574, 713-720**
	27. Describe advances and issues in physical science that have important, long-lasting effects on science and society (e.g., atomic	**94-98, 396-399, 400-404, 405-410, 411-416, 463-471,**

	theory, quantum theory, Newtonian mechanics, nuclear energy, nanotechnology, plastics, ceramics and communication technology).	**576-578, 612-619, 673-677, 721-730**

Science and Technology

Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Benchmark	**Indicator**	**Location/Page where Standard is found**
<u>Benchmark A</u>: Explain the ways in which the processes of technological design respond to the needs of society.		
Abilities To DoTechnological Design (Grade 9)	2. Identify a problem or need, propose designs and choose among alternative solutions for the problem.	**94-98, 123-134, 171-175, 600-601, 716-725, 726-730, 740-747**
	3. Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined.	**94-98, 123-134**
<u>Benchmark B</u>: Explain that science and technology are interdependent; each drives the other.		
UnderstandingTechnology (Grade 9)	1. Describe means of comparing the benefits with the risks of technology and how science can inform public policy.	**105-110, 147-150, 673-677**

Scientific Inquiry
Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Benchmark	**Indicator**	**Location/Page where Standard is found**
<u>Benchmark A:</u> Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.		
Doing Scientific Inquiry (Grade 9)	1. Distinguish between observations and inferences given a scientific situation.	**142-146, 147-150, 533-537**
	2. Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, Material Safety Data Sheets [MSDS], eyewash, goggles and ventilation).	**142-146, 147-150, 533-537**
	3. Construct, interpret and apply physical and conceptual models that represent or explain systems, objects, events or concepts.	**81-85, 86-93, 147-150, 151-155, 171-175, 208-213, 239-255, 309-319, 324-325**
	4. Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs.	**141-146, 147-150, 151-155, 167-170, 239-255, 656-665**
	5. Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology.	**86-91, 142-146, 147-150, 156-160, 214-217, 340-345**

	6. Draw logical conclusions based on scientific knowledge and evidence from investigations.	**94-98, 135, 171-175, 184-188, 600-601**

Scientific Ways of Knowing
Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Benchmark	**Indicator**	**Location/Page where Standard is found**
<u>Benchmark A:</u> Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world.		
Nature of Science(Grade 9)	1. Comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose - to better understand a portion of our universe.	**75, 135, 203, 391, 441, 507, 542**
	3. Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions.	**117-121, 572-574**
<u>Benchmark B:</u> Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.		
Scientific Theories(Grade 9)	5. Justify that scientific theories are explanations of large bodies of information and/or observations that withstand repeated testing.	**94-98, 135, 184-185**

	6. Explain that inquiry fuels observation and experimentation that produce data that are the foundation of scientific disciplines. Theories are explanations of these data.	**94-98, 572-574, 600-605**
	7. Recognize that scientific knowledge and explanations have changed over time, almost always building on earlier knowledge.	**111-116, 117-121, 129-134, 208-217, 567-572, 572-574**
Benchmark C: Describe the ethical practices and guidelines in which science operates.		
*Nature of Science**(Grade 9)***	2. Illustrate that the methods and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigations.	**86-91, 214-217, 340-345**
*Ethical Practices **(Grade 9)***	4. Explain how support of ethical practices in science (e.g., individual observations and confirmations, accurate reporting, peer review and publication) are required to reduce bias.	**171-175, 600-601**
Benchmark D: Recognize that scientific literacy is part of being a knowledgeable citizen.		
Science and Society (Grade 9)	8. Illustrate that much can be learned about the internal workings of science and the nature of science from the study of scientists, their daily work and their efforts to advance scientific knowledge in their area of study.	**75, 135, 203, 391, 441, 507, 542**
	9. Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue.	**75, 135, 203, 391, 441, 507, 542**

***** There are no 10th Grade Benchmarks/Indicators present for Physical Science.