PHYSICAL SCIENCE: COURSE OVERVIEW

These academic standards establish the core content for Physical Science courses taught in Tennessee high schools.

The major disciplinary core ideas utilized for Physical Science include:

Physical Science (PSCI)
Physical Sciences (PS)
Matter and Its Interactions • Structure and properties of matter • Chemical reactions • Nuclear process
Motion and Stability: Forces and Interactions • Forces and motion • Types of interactions • Stability and instability in physical systems
Energy • Definitions of energy • Conservation of energy and energy transfer • Relationship between energy and forces • Energy in chemical processes and everyday life
Waves and Their Applications in Technologies for Information Transfer • Wave properties • Electromagnetic radiation

Science and engineering practices are embedded in the content standards. These practices are established to meet the specific academic standards. Skills, such as pattern recognition, cause and effect, experimental design, scale and proportion, systems, structure and function, and stability, should be stressed through hands-on learning within the classroom.

Inquiry is the central action within science and engineering. The process of observation, hypothesis testing, and refinement/application of ideas should be continually incorporated within the content of this course and not taught in isolation. Inquiry activities should be appropriate for the students' abilities.

By using these academic standards, curriculum relating to this course should be developed by teachers, schools, and districts. Emphasis should be placed on critical thinking, problem solving and applications, and communication (written and verbal) of student learning. It is recommended that a minimum of 25%

of this course be devoted to hands-on learning. Equipment and materials for completion of these investigations should be available for implementation by small student groups.

Although science is a body of content knowledge consisting of theories that explain data, science is also a set of practices that use analysis and argumentation to establish, extend, and refine knowledge. The science and engineering practices are used as a means to learn science by doing science, thus combining content knowledge with skill. These practices are not intended to be a sequence of steps nor are they intended to be taught as a separate, introductory unit for the course. By combining content knowledge with skill, students discover how scientific knowledge is acquired and applied to solve problems or advance scientific knowledge further. In addition, there are seven crosscutting concepts that are fundamental to the nature of science and thus stretch across all science disciplines. The Physical Science standards have been constructed by explicitly integrating practices and crosscutting concepts, iteratively and in combination, within each core idea to provide students with a well-rounded education in science.

These academic standards should be used for the development of classroom and course-level assessments.

PHYSICAL SCIENCE: ACADEMIC STANDARDS

PSCI.PS1: Matter and Its Interactions

1) Using the kinetic molecular theory and heat flow considerations, explain the changes of state for solids, liquids, gases, and plasma.

2) Graphically represent and discuss the results of an investigation involving pressure, volume, and temperature of a gas.

3) Construct a graphical organizer for the major classifications of matter using composition and separation techniques.

4) Apply scientific principles and evidence to provide explanations about physical and chemical changes.

5) Trace the development of the modern atomic theory to describe atomic particle properties and position.

6) Characterize the difference between atoms of different isotopes of an element.

7) Use the periodic table as a model to predict the relative properties of elements.

8) Using the patterns of electrons in the outermost energy level, predict how elements may combine.

9) Use the periodic table as a model to predict the formulas of binary ionic compounds. Explain and use the naming conventions for binary ionic and molecular compounds.

10) Develop a model to illustrate the claim that atoms and mass are conserved during a chemical reaction (i.e., balancing chemical equations).

11) Use models to identify chemical reactions as synthesis, decomposition, single-replacement, and double-replacement. Given the reactants, use these models to predict the products of those chemical reactions.

12) Classify a substance as acidic, basic, or neutral by using pH tools and appropriate indicators.

13) Research and communicate explanations on how acid rain is created and its impact on the ecosystem.

14) Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

15) Communicate scientific and technical information about nuclear energy and radioactive isotopes with respect to their impact on society.

PSCI.PS2: Motion and Stability: Forces and Interactions

1) Use mathematical representations to show how various factors (e.g., position, time, direction of force) affect one-dimensional kinematics parameters (distance, displacement, speed, velocity, acceleration). Determine graphically the relationships among those one-dimensional kinematics parameters.

2) Algebraically solve problems involving constant velocity and constant acceleration in one-dimension.
3) Use free-body diagrams to illustrate the contact and non-contact forces acting on an object.

4) Plan and conduct an investigation to gather evidence and provide a mathematical explanation about the relationship between force, mass, and acceleration. Solve related problems using F=ma.

5) Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

6) Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on an object during a collision.

7) Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field.

PSCI.PS3: Energy

1) Identify and give examples of the various forms of energy (kinetic, gravitational potential, elastic potential) and solve mathematical problems regarding the work-energy theorem and power.

2) Plan and conduct an investigation to provide evidence that thermal energy will move as heat between objects of two different temperatures, resulting in a more uniform energy distribution (temperature) among the objects.

3) Design, build, and refine a device within design constraints that has a series of simple machines to transfer energy and/or do mechanical work.

4) Collect data and present your findings regarding the law of conservation of energy and the efficiency, mechanical advantage, and power of the refined device.

5) Investigate the relationships among kinetic, potential, and total energy within a closed system (the law of conservation of energy).

6) Determine the mathematical relationships among heat, mass, specific heat capacity, and temperature change using the equation $Q = mC_p\Delta T$.

7) Demonstrate Ohm's Law through the design and construction of simple series and parallel circuits.

8) Plan and conduct an experiment using a controlled chemical reaction to transfer thermal energy and/or do mechanical work.

9) Demonstrate the impact of the starting amounts of reacting substances upon the energy released.

PSCI.PS4: Waves and Their Applications in Technologies for Information Transfer

1) Use scientific reasoning to compare and contrast the properties of transverse and longitudinal waves and give examples of each type.

2) Design/conduct an investigation and interpret gathered data to explain how mechanical waves transmit energy through a medium.

3) Develop and use mathematical models to represent the properties of waves including frequency, amplitude, wavelength, and speed.

4) Describe and communicate the similarities and differences across the electromagnetic spectrum. Research methods and devices used to measure these characteristics.

5) Research and communicate scientific explanations about how electromagnetic waves are used in modern technology to produce, transmit, receive, and store information. Examples include: medical imaging, cell phones, and wireless networks.