Texas Science

Physics

Adopted 2020

The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to: PHYS.1

- **A.** ask questions and define problems based on observations or information from text, phenomena, models, or investigations; PHYS.1.A
- **B.** apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations, and use engineering practices to design solutions to problems; PHYS.1.B
- **C.** use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards; PHYS.1.C
- **D.** use appropriate tools such as balances, ballistic carts or equivalent, batteries, computers, constant velocity cars, convex lenses, copper wire, discharge tubes with power supply (H, He, Ne, Ar), data acquisition probes and software, dynamics and force demonstration equipment, electrostatic generators, electrostatic kits, friction blocks, graph paper, graphing technology, hand-held visual spectroscopes, inclined planes, iron filings, lab masses, laser pointers, magnets, magnetic compasses, metric rulers, motion detectors, multimeters (current, voltage, resistance), optics bench, optics kit, photogates, plane mirrors, prisms, protractors, pulleys, resistors, rope or string, scientific calculators, stopwatches, springs, spring scales, switches, tuning forks, wave generators, or other equipment and materials that will produce the same results; PHYS.1.D
- **E.** collect quantitative data using the International System of Units (SI) and qualitative data as evidence; PHYS.1.E
- **F.** organize quantitative and qualitative data using bar charts, line graphs, scatter plots, data tables, labeled diagrams, and conceptual mathematical relationships; PHYS.1.F
- **G.** develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and PHYS.1.G
- **H.** distinguish among scientific hypotheses, theories, and laws. PHYS.1.H

The student analyzes and interprets data to derive meaning, identify features and patterns, and discover

- **A.** identify advantages and limitations of models such as their size, scale, properties, and materials; PHYS.2.A

relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to: PHYS.2	**B.** **analyze data by identifying significant statistical features, patterns, sources of error, and limitations;** PHYS.2.B
	C. **use mathematical calculations to assess quantitative relationships in data; and** PHYS.2.C
	D. **evaluate experimental and engineering designs.** PHYS.2.D
The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to: PHYS.3	**A.** **develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;** PHYS.3.A
	B. **communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and** PHYS.3.B
	C. **engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.** PHYS.3.C
The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to: PHYS.4	**A.** **analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;** PHYS.4.A
	B. **relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and** PHYS.4.B
	C. **research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.** PHYS.4.C
The student knows and applies the laws governing motion in a variety of situations. The student is expected to: PHYS.5	**A.** **analyze different types of motion by generating and interpreting position versus time, velocity versus time, and acceleration versus time using hand graphing and real-time technology such as motion detectors, photogates, or digital applications;** PHYS.5.A
	B. **define scalar and vector quantities related to one- and two-dimensional motion and combine vectors using both graphical vector addition and the Pythagorean theorem;** PHYS.5.B
	C. **describe and analyze motion in one dimension using equations with the concepts of distance, displacement, speed, velocity, frames of reference, and acceleration;** PHYS.5.C
	D. **describe and analyze acceleration in uniform circular and horizontal projectile motion in two dimensions using equations; (E) explain and apply the concepts of equilibrium and inertia as represented by Newton's first law of motion using relevant real-world examples such as rockets, satellites, and automobile safety devices;** PHYS.5.D

	F. **calculate the effect of forces on objects, including tension, friction, normal, gravity, centripetal, and applied forces, using free body diagrams and the relationship between force and acceleration as represented by Newton's second law of motion;** PHYS.5.F **G.** **illustrate and analyze the simultaneous forces between two objects as represented in Newton's third law of motion using free body diagrams and in an experimental design scenario; and** PHYS.5.G **H.** **describe and calculate, using scientific notation, how the magnitude of force between two objects depends on their masses and the distance between their centers, and predict the effects on objects in linear and orbiting systems using Newton's law of universal gravitation.** PHYS.5.H
The student knows the nature of forces in the physical world. The student is expected to: PHYS.6	**A.** **use scientific notation and predict how the magnitude of the electric force between two objects depends on their charges and the distance between their centers using Coulomb's law;** PHYS.6.A **B.** **identify and describe examples of electric and magnetic forces and fields in everyday life such as generators, motors, and transformers;** PHYS.6.B **C.** **investigate and describe conservation of charge during the processes of induction, conduction, and polarization using different materials such as electroscopes, balloons, rods, fur, silk, and Van de Graaf generators;** PHYS.6.C **D.** **analyze, design, and construct series and parallel circuits using schematics and materials such as switches, wires, resistors, lightbulbs, batteries, voltmeters, and ammeters; and** PHYS.6.D **E.** **calculate current through, potential difference across, resistance of, and power used by electric circuit elements connected in both series and parallel circuits using Ohm's law.** PHYS.6.E
The student knows that changes occur within a physical system and applies the laws of conservation of energy and momentum. The student is expected to: PHYS.7	**A.** **calculate and explain work and power in one dimension and identify when work is and is not being done by or on a system;** PHYS.7.A **B.** **investigate and calculate mechanical, kinetic, and potential energy of a system;** PHYS.7.B **C.** **apply the concept of conservation of energy using the work-energy theorem, energy diagrams, and energy transformation equations, including transformations between kinetic, potential, and thermal energy;** PHYS.7.C **D.** **calculate and describe the impulse and momentum of objects in physical systems such as automobile safety features, athletics, and rockets; and** PHYS.7.D **E.** **analyze the conservation of momentum qualitatively in inelastic and elastic collisions in one dimension using models, diagrams, and simulations.** PHYS.7.E

The student knows the characteristics and behavior of waves. The student is expected to: PHYS.8

- **A.** **examine and describe simple harmonic motion such as masses on springs and pendulums and wave energy propagation in various types of media such as surface waves on a body of water and pulses in ropes;** PHYS.8.A
- **B.** **compare the characteristics of transverse and longitudinal waves, including electromagnetic and sound waves;** PHYS.8.B
- **C.** **investigate and analyze characteristics of waves, including velocity, frequency, amplitude, and wavelength, and calculate using the relationships between wave speed, frequency, and wavelength;** PHYS.8.C
- **D.** **investigate behaviors of waves, including reflection, refraction, diffraction, interference, standing wave, the Doppler effect and polarization and superposition; and** PHYS.8.D
- **E.** **compare the different applications of the electromagnetic spectrum, including radio telescopes, microwaves, and x-rays;** PHYS.8.E
- **F.** **investigate the emission spectra produced by various atoms and explain the relationship to the electromagnetic spectrum; and** PHYS.8.F
- **G.** **describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens.** PHYS.8.G

The student knows examples of quantum phenomena and their applications. The student is expected to: PHYS.9

- **A.** **describe the photoelectric effect and emission spectra produced by various atoms and how both are explained by the photon model for light;** PHYS.9.A
- **B.** **investigate Malus's Law and describe examples of applications of wave polarization, including 3-D movie glasses and LCD computer screens;** PHYS.9.B
- **C.** **compare and explain how superposition of quantum states is related to the wave-particle duality nature of light; and** PHYS.9.C
- **D.** **give examples of applications of quantum phenomena, including the Heisenberg uncertainty principle, quantum computing, and cybersecurity.** PHYS.9.D