



Physics Assessment

Eligible Texas Essential Knowledge and Skills

STAAR Physics Assessment

Reporting Category 1: Force and Motion

The student will demonstrate an understanding of the relationship of force and motion in one and two dimensions.

- (P.4) **Science concepts.** The student knows and applies the laws governing motion in a variety of situations. The student is expected to
- (A) generate and interpret graphs and charts describing different types of motion, including the use of real-time technology such as motion detectors or photogates;
Readiness Standard
 - (B) describe and analyze motion in one dimension using equations with the concepts of distance, displacement, speed, average velocity, instantaneous velocity, and acceleration;
Readiness Standard
 - (C) analyze and describe accelerated motion in two dimensions using equations, including projectile and circular examples;
Supporting Standard
 - (D) calculate the effect of forces on objects, including the law of inertia, the relationship between force and acceleration, and the nature of force pairs between objects;
Readiness Standard
 - (E) develop and interpret free-body force diagrams; and
Supporting Standard
 - (F) identify and describe motion relative to different frames of reference. **Supporting Standard**

Reporting Category 2: Gravitational, Electrical, Magnetic, and Nuclear Forces

The student will demonstrate an understanding of gravitational, electrical, magnetic, and nuclear forces.

- (P.5) **Science concepts.** The student knows the nature of forces in the physical world. The student is expected to
- (A) research and describe the historical development of the concepts of gravitational, electromagnetic, weak nuclear, and strong nuclear forces; ***Supporting Standard***
 - (B) describe and calculate how the magnitude of the gravitational force between two objects depends on their masses and the distance between their centers; ***Readiness Standard***
 - (C) describe and calculate how the magnitude of the electrical force between two objects depends on their charges and the distance between them; ***Supporting Standard***
 - (D) identify examples of electric and magnetic forces in everyday life; ***Supporting Standard***
 - (E) characterize materials as conductors or insulators based on their electrical properties; ***Supporting Standard***
 - (F) design, construct, and calculate in terms of current through, potential difference across, resistance of, and power used by electric circuit elements connected in both series and parallel combinations; ***Readiness Standard***
 - (G) investigate and describe the relationship between electric and magnetic fields in applications such as generators, motors, and transformers; and ***Supporting Standard***
 - (H) describe evidence for and effects of the strong and weak nuclear forces in nature. ***Supporting Standard***

Reporting Category 3: Momentum and Energy

The student will demonstrate an understanding of momentum and energy.

- (P.6) **Science concepts.** 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
- (A) investigate and calculate quantities using the work-energy theorem in various situations; *Readiness Standard*
 - (B) investigate examples of kinetic and potential energy and their transformations; *Readiness Standard*
 - (C) calculate the mechanical energy of, power generated within, impulse applied to, and momentum of a physical system; *Readiness Standard*
 - (D) demonstrate and apply the laws of conservation of energy and conservation of momentum in one dimension; *Readiness Standard*
 - (E) describe how the macroscopic properties of a thermodynamic system such as temperature, specific heat, and pressure are related to the molecular level of matter, including kinetic or potential energy of atoms; *Supporting Standard*
 - (F) contrast and give examples of different processes of thermal energy transfer, including conduction, convection, and radiation; and *Supporting Standard*
 - (G) analyze and explain everyday examples that illustrate the laws of thermodynamics, including the law of conservation of energy and the law of entropy. *Supporting Standard*

Reporting Category 4: Waves and Quantum Phenomena

The student will demonstrate an understanding of waves and quantum phenomena.

- (P.7) **Science concepts.** The student knows the characteristics and behavior of waves. The student is expected to
- (A) examine and describe oscillatory motion and wave propagation in various types of media;
Supporting Standard
 - (B) investigate and analyze characteristics of waves, including velocity, frequency, amplitude, and wavelength, and calculate using the relationship between wavespeed, frequency, and wavelength; *Readiness Standard*
 - (C) compare characteristics and behaviors of transverse waves, including electromagnetic waves and the electromagnetic spectrum, and characteristics and behaviors of longitudinal waves, including sound waves; *Supporting Standard*
 - (D) investigate behaviors of waves, including reflection, refraction, diffraction, interference, resonance, and the Doppler effect;
Readiness Standard
 - (E) describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens; and *Supporting Standard*
 - (F) describe the role of wave characteristics and behaviors in medical and industrial applications. *Supporting Standard*
- (P.8) **Science concepts.** The student knows simple examples of atomic, nuclear, and quantum phenomena. The student is expected to
- (A) describe the photoelectric effect and the dual nature of light;
Readiness Standard
 - (B) compare and explain the emission spectra produced by various atoms; *Supporting Standard*

- (C) describe the significance of mass-energy equivalence and apply it in explanations of phenomena such as nuclear stability, fission, and fusion; and ***Supporting Standard***
- (D) give examples of applications of atomic and nuclear phenomena such as radiation therapy, diagnostic imaging, and nuclear power and examples of applications of quantum phenomena such as digital cameras. ***Supporting Standard***

Scientific Process Skills

These skills will not be listed under a separate reporting category. Instead, they will be incorporated into at least 40% of the test questions from reporting categories 1–4 and will be identified along with content standards.

- (P.1) **Scientific processes.** The student conducts investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to
- (A) demonstrate safe practices during laboratory and field investigations; and
 - (B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.
- (P.2) **Scientific processes.** The student uses a systematic approach to answer scientific laboratory and field investigative questions. The student is expected to
- (A) know the definition of science and understand that it has limitations, as specified in chapter 112.39, subsection (b)(2) of 19 TAC;
 - (B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;
 - (C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;
 - (D) distinguish between scientific hypotheses and scientific theories;

- (E) design and implement investigative procedures, including making observations, asking well-defined questions, formulating testable hypotheses, identifying variables, selecting appropriate equipment and technology, and evaluating numerical answers for reasonableness;
- (F) demonstrate the use of course apparatus, equipment, techniques, and procedures, including multimeters (current, voltage, resistance), triple beam balances, batteries, clamps, dynamics demonstration equipment, collision apparatus, data acquisition probes, discharge tubes with power supply (H, He, Ne, Ar), hand-held visual spectrosopes, hot plates, slotted and hooked lab masses, bar magnets, horseshoe magnets, plane mirrors, convex lenses, pendulum support, power supply, ring clamps, ring stands, stopwatches, trajectory apparatus, tuning forks, carbon paper, graph paper, magnetic compasses, polarized film, prisms, protractors, resistors, friction blocks, mini lamps (bulbs) and sockets, electrostatics kits, 90-degree rod clamps, metric rulers, spring scales, knife blade switches, Celsius thermometers, meter sticks, scientific calculators, graphing technology, computers, cathode ray tubes with horseshoe magnets, ballistic carts or equivalent, resonance tubes, spools of nylon thread or string, containers of iron filings, rolls of white craft paper, copper wire, Periodic Table, electromagnetic spectrum charts, slinky springs, wave motion ropes, and laser pointers;
- (G) use a wide variety of additional course apparatus, equipment, techniques, materials, and procedures as appropriate such as ripple tank with wave generator, wave motion rope, micrometer, caliper, radiation monitor, computer, ballistic pendulum, electroscope, inclined plane, optics bench, optics kit, pulley with table clamp, resonance tube, ring stand screen, four-inch ring, stroboscope, graduated cylinders, and ticker timer;
- (H) make measurements with accuracy and precision and record data using scientific notation and International System (SI) units;
- (I) identify and quantify causes and effects of uncertainties in measured data;
- (J) organize and evaluate data and make inferences from data, including the use of tables, charts, and graphs;

- (K) communicate valid conclusions supported by the data through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports; and
 - (L) express and manipulate relationships among physical variables quantitatively, including the use of graphs, charts, and equations.
- (P.3) **Scientific processes.** The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to
- (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;
 - (B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;
 - (C) draw inferences based on data related to promotional materials for products and services;
 - (D) explain the impacts of the scientific contributions of a variety of historical and contemporary scientists on scientific thought and society;
 - (E) research and describe the connections between physics and future careers; and
 - (F) express and interpret relationships symbolically in accordance with accepted theories to make predictions and solve problems mathematically, including problems requiring proportional reasoning and graphical vector addition.