(B)

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(E)

are expected to gain sufficient knowledge of the scientific and engineering practices across the disciplines of science to make informed decisions using critical thinking and scientific problem solving.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not currently scientifically testable.

(3) Scientific hypotheses and theories. Students are expected to know that:

(A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and

(B) 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 they may be subject to change as new areas of science and new technologies are developed.

(4) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations includes descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.

(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models. .6.3 (e)-5.2933 (edJ)5TjEMC P MCID 10 BDC -(t)5.6 (o(h3 (e)--8- 86.1 (749(ed[(9.5d3(m7)9TD[.

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

(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.

(5) Science concepts. The student understands the development of the Periodic Table and applies its predictive power. The student is expected to:

(A) explain the development of the Periodic Table over time using evidence such as chemical and physical properties;

(B) predict the properties of elements in chemical families, including alkali metals, alkaline

(A) interpret, write, and balance chemical equations, including synthesis, decomposition, single replacement, double replacement, and combustion reactions using the law of conservation of mass;

(B) differentiate among acid-base reactions, precipitation reactions, and oxidation-reduction reactions;

(C) perform stoichiometric calculations, including determination of mass relationships, gas volume relationships, and percent yield; and

(D) describe the concept of limiting reactants in a balanced chemical equation.

(10) Science concepts. The student understands the principles of the kinetic molecular theory and ideal gas behavior. The student is expected to:

(A) describe the postulates of the kinetic molecular theory;

(B) describe and calculate the relationships among volume, pressure, number of moles, and temperature for an ideal gas; and

(C) define and apply Dalton's law of partial pressure.

(11) Science concepts. The student understands and can apply the factors that influence the behavior of solutions. The student is expected to:

(A) describe the unique role of water in solutions in terms of polarity;

(B) distinguish among types of solutions, including electrolytes and nonelectrolytes and unsaturated, saturated, and supersaturated solutions;

(C) investigate how solid and gas solubilities are influenced by temperature using solubility curves and how rates of dissolution are influenced by temperature, agitation, and surface area;

(D) investigate the general rules regarding solubility and predict the solubility of the products of a double replacement reaction;

(E) calculate the concentration of solutions in units of molarity; and

(F) calculate the dilutions of solutions using molarity.

(12) Science concepts. The student understands and applies various rules regarding acids and bases. The student is expected to:

(A) name and write the chemical formulas for acids and bases using IUPAC nomenclature rules;

(B) define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions;

(C) differentiate between strong and weak acids and bases;

(D) predict products in acid-base reactions that form water; and

(E) define pH and calculate the pH of a solution using the hydrogen ion concentration.

(13) Science concepts. The student understands the energy changes that occur in chemical reactions. The student is expected to:

(A) explain everyday examples that illustrate the four laws of thermodynamics;

(B) investigate the process of heat transfer using calorimetry;

(C) classify processes as exothermic or endothermic and represent energy changes that occur in chemical reactions using thermochemical equations or graphical analysis; and

(D) perform calculations involving heat, mass, temperature change, and specific heat.

(14) Science concepts. The student understands the basic processes of nuclear chemistry. The student is expected to:

(A) describe the characteristics of alpha, beta, and gamma radioactive decay processes in terms of balanced nuclear equations;

(B) compare fission and fusion reactions; and

(C)

(3) Scientific and engineering practices. The student develops evidence-based explanations and

(D)

(1) Physics. In Physics, students conduct laboratory and field investigations, use scientific practices during investigations, and make informed decisions using critical thinking and scientific problem solving. Students study a variety of topics that include: laws of motion, changes within physical systems and conservation of energy and momentum, forces, characteristics and behavior of waves, and electricity and magnetism. Students will apply conceptual knowledge and collaborative skills to experimental design, implementation, and interpretation. By the end of Grade 12, students are expected to gain sufficient knowledge of the scientific and engineering practices across the disciplines of science to make informed decisions using critical thinking and scientific problem solving.

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(4) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:

(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;

(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 (h)3.5 (07o (h)0.D4.8ds (e)i)0.5 (1 T2o)2 ee bre488

(C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors e6ms5 ( )TJ-8.509 -1c(o)6 (r(xpl)11.)1.5 ( )6.5 nd aaecrr

(D)

established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.

(4) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.

(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

(B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.

(5) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).

(B)

(D) describe human uses of fresh water and how human freshwater use competes with that of other organisms.

(11) The student knows that geological phenomena and fluid dynamics affect aquatic systems. The student is expected to:

(A) examine basic principles of fluid dynamics, including hydrostatic pressure, density as a result of salinity, and buoyancy;

(B) identify interrelationships between ocean currents, climates, and geologic features such as continental margins, active and passive margins, abyssal plains, island atolls, peninsulas, barrier islands, and hydrothermal vents;

(C) explain how fluid dynamics causes upwelling and lake turnover; and

(D) describe how erosion and deposition in river systems lead to formation of geologic features.

(12) The student understands the types of aquatic ecosystems. The student is expected to:

(A) differentiate among freshwater, brackish, and marine ecosystems; and

(B) identify th.9 (t)1 (12)-6 ())]TJrcg(s)-1.3 (t)1. (i)1.5 (( )0.5 (t)0.6 (a)0.6 (d)cc ( )6.5 (f)0.7 S1t8 (of)0. ())]TJ)0. (
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(C) research and explore resources such as museums, planetariums, observatories, 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.

(5) Science concepts. The student understands how astronomy influenced and advanced civilizations. The student is expected to:

(A) evaluate and communicate how ancient civilizations developed models of the universe using astronomical structures, instruments, and tools such as the astrolabe, gnomons, and charts and how those models influenced society, time keeping, and navigation;

(B) research and evaluate the contributions of scientists, including Ptolemy, Copernicus, Tycho Brahe, Kepler, Galileo, and Newton, as astronomy progressed from a geocentric model to a heliocentric model; and

(C) describe and explain the historical origins of the perceived patterns of constellations and the role of constellations in ancient and modern navigation.

(6) Science concepts. The student conducts and explains astronomical observations f l 6.1 (s)2.7 (9 ( )6.5 (s)2 0.5 (i)utc

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(D) explain the significance of Earth's solstices and equinoxes.

(10) Science concepts. The student knows how astronomical tools collect and record information about celestial objects. The student is expected to:

(A) investigate the use of black body radiation curves and emission, absorption, and continuous spectra in the identification and classification of celestial objects;

(B) calculate the relative light-gather.5 (u)1I(th)-bhelr.5 (u)1I(th)4(o)-5 (b)-f(th)-bh.002 T.2 (l)01-cuellclul (th)-2

(G) illustrate how astronomers use geometric parallax to determine stellar distances and intrinsic luminosities; and

(H) describe how stellar distances are determined by comparing apparent brightness and intrinsic luminosity when using spectroscopic parallax and the Leavitt relation for variable stars.

(14) Science concepts. The student knows the structure of the universe and our relative place in it. The student is expected to:

(A) illustrate the structure and components of our Milky Way galaxy and model the size, location, and movement of our solar system within it;

(B) compare spiral, elliptical, irregular, dwarf, and actiwc.-4.6 (a)-1.1 (r)1.7 (f)-4.311(u)2 (r)-3.3 (e)6.1-3.3 (e)

(1) Earth Systems Science. The Earth Systems Science course is designed to build on students' prior scientific and academic knowledge and skills to develop their understanding of Earth's systems. These systems (the atmosphere, hydrosphere, geosphere, and biosphere) interact through time to produce the Earth's landscapes, climate, and resources. Students explore the geologic history of individual dynamic systems through the flow of energy and matter, their current states, and how these systems affect and are affected by human use.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not currently scientifically testable.

(3) Scientific hypotheses and theories. Students are expected to know that:

(A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durat bvi6 (e)3.9 ( )6.5h9S8.5 (d5) (e)3.9 (s)2.8 (

(1) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to explain phenomena or design solutions using appropriate tools and models. The student is expec

(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

(C) research and explore resources such as museums, planetariums, observatories, libraries, professional organizations, private companies, online platforms, and mentors employed

(A) evaluate heat transfer through Earth's systems by convection and conduction and include its role in plate tectonics and volcanism;

(B) develop a model of the physical, mechanical, and chemical composition of Earth's layers using evidence from Earth's magnetic field, the composition of meteorites, and seismic waves;

(C) investigate how new conceptual interpretations of data and innovative geophysical technologies led to the current theory of plate tectonics;

(D) describe how heat and rock composition affect density within Earth's interior and how density influences the development and motion of Earth's tectonic plates;

(E) explain how plate tectonics accounts for geologic processes, including sea floor spreading and subduction, and features, including ocean ridges, rift valleys, earthquakes, volcanoes, mountain ranges, hot spots, and hydrothermal vents;

(F) calculate the motion history of tectonic plates using equations relating rate, time, and distance to predict future motions, locations, and resulting geologic features;

(G) distinguish the location, type, and relative motion of convergent, divergent, and transform plate boundaries using evidence from the distribution of earthquakes and volcanoes; and

(H) evaluate the role of plate tectonics with respect to long-term global changes in Earth's subsystems such as continental buildup, glaciation, sea level fluctuations, mass extinctions, and climate change.

(9) Science concepts. The student knows that the lithosphere continuously changes as a result of dynamic and complex interactions among Earth's systems. The student is expected to:

(A)

(C)

(A)

(A) evaluate the negative effects of human activities on the environment, including overhunting, overfishing, ecotourism, all-terrain vehicles, and personal watercraft;

(B) evaluate the positive effects of human activities on the environment, including habitat restoration projects, species preservation efforts, nature conservancy groups, game and wildlife management, and ecotourism; and

(C) research the advantages and disadvantages of "going green" such as organic gardening and farming, natural methods of pest control, hydroponics, xeriscaping, energy-efficient homes and appliances, and 6 (d)-5 (lin22z8f942.6 (s)3.8 (o-1448f942.6 (s)c)5.5 (s)9 (r)0..8 (c)322d[()-6 (s(

science, citizen science, science investigations, science careers, specialized disciplines of science, designing innovations, the ethics of science, or history of science.

(B) By the end of Grade 12, students are expected to gain sufficient knowledge of the scientific and engineering practices across the disciplines of science to make informed decisions using critical thinking and scientific problem solving.

(2) Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

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

(A) ask questions and define problems related to specialized topics of study based on observations or information from text, phenomena, models, or investigations;

(B) apply science practices related to specialized topics of study to plan and conduct investigations or use engineering practices to design solutions to problems;

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

(D) use tools appropriate to the specialized topic of study;

(E) collect quantitative data using the International System of Units (SI) or qualitative data as evidence as appropriate to the specialized topic of study;

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ea.5 (at)1.1.5 (ab (i)1l.1.5 (e)6e)n23oitosle31.2 ( )0.5 (ap)1.9 cyasdoy,sme20.gTJ-0 (t)74. (ab)2 (o)-4 (r)n-5 (

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence as appropriate to the specialized topic of study.

(4)