Aquatic Science Texas Essential Knowledge and Skills

Side-by-Side Comparison 2021 to 2010

2021 Introduction

(1) Aquatic Science. In Aquatic Science, students study the interactions of biotic and abiotic components in aquatic environments, including natural and human impacts on aquatic systems. Investigations and field work in this course may emphasize fresh water or marine aspects of aquatic science depending primarily upon the natural resources available for study near the school. Students who successfully complete Aquatic Science acquire knowledge about how the properties of water and fluid dynamics affect aquatic ecosystems and acquire knowledge about a variety of aquatic systems. Students who successfully complete Aquatic Science conduct investigations and observations of aquatic environments, work collaboratively with peers, and develop critical thinking and problem-solving skills.

(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.

2010 Introduction

(1) *Aquatic Science. In Aquatic Science, students study the interactions of biotic and abiotic components in aquatic environments, including impacts on aquatic systems. Investigations and field work in this course may emphasize fresh water or marine aspects of aquatic science depending primarily upon the natural resources available for study near the school. Students who successfully complete Aquatic Science will acquire knowledge about a variety of aquatic systems, conduct investigations and observations of aquatic environments, work collaboratively with peers, and develop critical-thinking and problem-solving skills.*

(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 inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific practices of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.*

(4) *Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.*

(5) *Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.*

2021 Introduction (continued)	2010 Introduction (continued)
Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without 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). **(6)** Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested, while models allow for boundary specification and provide a tool for understanding the ideas presented. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment. **(7)** Statements containing the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.	

2021	2010
Scientific and Engineering Practices	**Scientific Processes**
(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 answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	***(1) Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:***
(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;	*NEW*
(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;	*(2)(E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting, handling, and maintaining appropriate equipment and technology;*
(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency approved safety standards;	*(1)(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms; and*
(D) use appropriate tools such as Global Positioning System (GPS), Geographic Information System (GIS), weather balloons, buoys, water testing kits, meter sticks, metric rulers, pipettes, graduated cylinders, standard laboratory glassware, balances, timing devices, pH meters or probes, various data collecting probes, thermometers, calculators, computers, internet access, turbidity testing devices, hand magnifiers, work and disposable gloves, compasses, first aid kits, field guides, water quality test kits or probes, 30-meter tape measures, tarps, ripple tanks, trowels, screens, buckets, sediment samples equipment, cameras, flow meters, cast nets, kick nets, seines, computer models, spectrophotometers, stereomicroscopes, compound microscopes, clinometers, and field journals, various prepared slides, hand lenses, hot plates, Petri dishes, sampling nets, waders, leveling grade rods (Jason sticks), protractors, inclination and height distance calculators, samples of biological specimens or structures, core sampling equipment, fish tanks and associated supplies, and hydrometers;	*(2)(G) demonstrate the use of course apparatuses, equipment, techniques, and procedures;*
(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;	*(2)(F) collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range;*
(C) organize quantitative and qualitative data using probeware, spreadsheets, lab notebooks or journals, models, diagrams, graphs paper, computers, or cellphone applications;	*(2)(H) organize, analyze, evaluate, build models, make inferences, and predict trends from data;*

2021	2010
(F) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and	*NEW*
(G) distinguish among scientific hypotheses, theories, and laws	*(2)(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;* *(2)(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;* *(2)(D) distinguish between scientific hypotheses and scientific theories;*
	REMOVED *(1)(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.* *(2)(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;*
(2) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:	***(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:***
(A) identify advantages and limitations of models such as their size, scale, properties, and materials;	*NEW*
(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;	*NEW*
(C) use mathematical calculations to assess quantitative relationships in data; and	*(2)(I) perform calculations using dimensional analysis, significant digits, and scientific notation; and*
(D) evaluate experimental and engineering designs.	*NEW*
(3) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	***(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:***

2021	2010
(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;	*(2)(J) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.*
(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	*NEW*
(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.	*NEW*
(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:	***NEW***
(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;	*(3)(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) 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	*(3)(D) evaluate the impact of research on scientific thought, society, and the environment;* *(3)(F) research and describe the history of environmental science and contributions of scientists*
(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.	*(3)(E) describe the connection between environmental science and future careers; and*
	REMOVED *(3)(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;* *(3)(C) draw inferences based on data related to promotional materials for products and services;*
Science Concepts	**Science Concepts**
(5) Science concepts. The student understands how the properties of water build the foundation of aquatic ecosystems. The student is expected to:	**NEW**

2021	2010
(A) describe how the shape and polarity of the water molecule make it a "universal solvent" in aquatic systems;	*NEW*
(B) identify how aquatic ecosystems are affected by water's properties of adhesion, cohesion, surface tension, heat capacity, and thermal conductivity; and	*NEW*
(C) explain how the density of water is critical for organisms in cold environments.	*NEW*
(6) Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:	***(4) Science concepts. Students know that aquatic environments are the product of Earth systems interactions. The student is expected to:***
(A) identify key features and characteristics of atmospheric, geological, hydrological, and biological systems as they relate to aquatic environments;	*(4)(A) identify key features and characteristics of atmospheric, geological, hydrological, and biological systems as they relate to aquatic environments;*
(B) describe the interrelatedness of atmospheric, geological, hydrological, and biological systems in aquatic ecosystems, including positive and negative feedback loops; and	*NEW*
(C) evaluate environmental data using technology such as maps, visualizations, satellite data, Global Positioning System (GPS), Geographic Information System (GIS), weather balloons, and buoys to model the interactions that affect aquatic ecosystems.	*(4)(C) collect and evaluate global environmental data using technology such as maps, visualizations, satellite data, Global Positioning System (GPS), Geographic Information System (GIS), weather balloons, buoys, etc.*
	REMOVED *(4)(B) apply systems thinking to the examination of aquatic environments, including positive and negative feedback cycles; and*
(7) Science Concept: The student knows about the interdependence and interactions that occur in aquatic environments. The student is expected to:	***(11) Science concepts. The student knows about the interdependence and interactions that occur in aquatic environments. The student is expected to:***
(A) identify how energy flows and matter cycles through both freshwater and marine aquatic systems, including food webs, chains, and pyramids;	*(11)(A) identify how energy flows and matter cycles through both fresh water and salt water aquatic systems, including food webs, chains, and pyramids; and;*
(B) identify biological, chemical, geological, and physical components of an aquatic life zone as they relate to the organisms in it;	*(9)(C) identify biological, chemical, geological, and physical components of an aquatic life zone as they relate to the organisms in it.*

(C) identify variables that affect the solubility of carbon dioxide and oxygen in water;	*NEW*
(D) evaluate factors affecting aquatic population cycles such as lunar cycles, temperature variations, hours of daylight, and predator-prey relationships; and	*(11)(B) evaluate the factors affecting aquatic population cycles.*
(E) identify the interdependence of organisms in an aquatic environment such as in a pond, a river, a lake, an ocean, or an aquifer and the biosphere.	*(5)(D) identify the interdependence of organisms in an aquatic environment such as in a pond, river, lake, ocean, or aquifer and the biosphere.*
(8) Science concepts. The student conducts short-term and long-term studies on local aquatic environments. Local natural environments are to be preferred over artificial or virtual environments. The student is expected to:	***(5) Science concepts. The student conducts long-term studies on local aquatic environments. Local natural environments are to be preferred over artificial or virtual environments. The student is expected to:***
(A) evaluate data over a period of time from an established aquatic environment documenting seasonal changes and the behavior of organisms;	*(5)(A) evaluate data over a period of time from an established aquatic environment documenting seasonal changes and the behavior of organisms;*
(B) collect and analyze pH, salinity, temperature, mineral content, nitrogen compounds, dissolved oxygen, and turbidity data periodically, starting with baseline measurements; and	*(5)(B) collect baseline quantitative data, including pH, salinity, temperature, mineral content, nitrogen compounds, and turbidity from an aquatic environment;*
(C) use data from short-term or long-term studies to analyze interrelationships between producers, consumers, and decomposers in aquatic ecosystems.	*(5)(C) analyze interrelationships among producers, consumers, and decomposers in a local aquatic ecosystem; and*
(9) Science concepts. The student knows the role of cycles in an aquatic environment. The student is expected to:	***(6) Science concepts. The student knows the role of cycles in an aquatic environment. The student is expected to:***
(A) identify the role of carbon, nitrogen, water, and nutrient cycles in an aquatic environment, including upwellings and turnovers;	*(6)(A) identify the role of carbon, nitrogen, water, and nutrient cycles in an aquatic environment, including upwellings and turnovers; and*
(B) examine the interrelationships between aquatic systems and climate and weather, including El Niño and La Niña, currents, and hurricanes; and	*(6)(B) examine the interrelationships between aquatic systems and climate and weather, including El Niño and La Niña, currents, and hurricanes.*
(C) explain how tidal cycles influence intertidal ecology	*NEW*
(10) Science concepts. The student knows the origin and potential uses of fresh water. The student is expected to:	***(7) The student knows the origin and use of water in a watershed. The student is expected to:***
(A) identify sources of water in a watershed, including rainfall, groundwater, and surface water;	*(7)(A) identify sources and determine the amounts of water in a watershed, including rainfall, groundwater, and surface water;*

2021	2010
(B) identify factors that contribute to how water flows through a watershed;	*(7)(B) identify factors that contribute to how water flows through a watershed; and*
(C) analyze water quantity and quality in a local watershed or aquifer; and	*(7)(C) identify water quantity and quality in a local watershed.*
(D) describe human uses of fresh water and how human freshwater use competes with that of other organisms.	*NEW*
(11) Science concepts. The student knows that geological phenomena and fluid dynamics affect aquatic systems. The student is expected to:	***(8) Science concepts. The student knows the origin and use of water in a watershed. The student is expected to:***
(A) examine basic principles of fluid dynamics, including hydrostatic pressure, density as a result of salinity, and buoyancy;	*(8)(A) demonstrate basic principles of fluid dynamics, including hydrostatic pressure, density, 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;	*(8)(B) identify interrelationships between ocean currents, climates, and geologic features; and*
(C) explain how fluid dynamics causes upwelling and lake turnover; and	*(8)(C) describe and explain fluid dynamics in an upwelling and lake turnover.*
(D) describe how erosion and deposition in river systems lead to formation of geologic features.	*NEW*
(12) Science concepts. The student understands the types of aquatic ecosystems. The student is expected to:	***(9) Science concepts. The student knows the types and components of aquatic ecosystems. The student is expected to:***
(A) differentiate among freshwater, brackish, and marine ecosystems; and	*(9)(A) differentiate among freshwater, brackish, and saltwater ecosystems;*
(B) identify the major properties and components of different marine and freshwater life zones.	*(9)(B) identify the major properties and components of different marine and freshwater life zones; and*
(13) Science concepts. The student knows environmental adaptations of aquatic organisms. The student is expected to:	***(10) Science concepts. The student knows environmental adaptations of aquatic organisms. The student is expected to:***
(A) compare different traits in aquatic organisms using tools such as dichotomous keys;	*(10)(A) classify different aquatic organisms using tools such as dichotomous keys;*
(B) describe how adaptations allow an organism to exist within an aquatic environment; and	*(10)(B) compare and describe how adaptations allow an organism to exist within an aquatic environment; and*
(C) compare adaptations of freshwater and marine organisms.	*(10)(C) compare differences in adaptations of aquatic organisms to fresh water and marine environments*

2021	2010
(14) Science concepts. The student understands how human activities impact aquatic environments. The student is expected to:	***(12) Science concepts. The student understands how human activities impact aquatic environments. The student is expected to:***
(A) analyze the cumulative impact of human population growth on an aquatic ecosystem;	*(12)(B) analyze the cumulative impact of human population growth on an aquatic system;*
(B) predict effects of chemical, organic, physical, and thermal changes due to humans on the living and nonliving components of an aquatic ecosystem;	*(12)(A) predict effects of chemical, organic, physical, and thermal changes from humans on the living and nonliving components of an aquatic ecosystem;*
(C) investigate the role of humans in unbalanced systems involving phenomena such as invasive species, fish farming, cultural eutrophication, or red tides;	*(12)(C) investigate the role of humans in unbalanced systems such as invasive species, fish farming, cultural eutrophication, or red tides;*
(D) analyze and discuss how human activities such as fishing, transportation, dams, and recreation influence aquatic environments;	*(12)(D) analyze and discuss how human activities such as fishing, transportation, dams, and recreation influence aquatic environments; and*
(E) describe the impact such as costs and benefits of various laws and policies such as The Endangered Species Act, right of capture laws, or Clean Water Act on aquatic systems; and	*(12)(E) understand the impact of various laws and policies such as The Endangered Species Act, right of capture laws, or Clean Water Act on aquatic systems.*
(F) analyze the purpose and effectiveness of human efforts to restore aquatic ecosystems affected by human activities.	*NEW*