<table>
<thead>
<tr>
<th>Aquatic Science Side-by-Side</th>
<th>2021 Knowledge and Skill Statement/Student Expectation</th>
<th>2017 Knowledge and Skill Statement/Student Expectation</th>
<th>Notes from TEA Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AQUA.1</strong></td>
<td>Scientific and engineering practices: The student, for at least 40% of instructional time, asks questions, defines 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:</td>
<td>AQUA.1</td>
<td></td>
</tr>
<tr>
<td><strong>AQUA.1.A</strong></td>
<td>Use appropriate tools such as Global Positioning System (GPS), Geographic Information System (GIS), weather balloons, buoys, water testing kits, water quality test kits, water intake and outtake adapters, graduated cylinders, standard laboratory glassware, balances, timing devices, air, water, or probe, various data collecting probes, thermometers, calculators, computers, internal access, turbidity testing devices, hand magnification, work and disposal gloves, hammers, checks, field guides, water quality test kits or probes, Stinger rakes, sponges, tapes, apple tanks, crowd, screens, buckets, sediment samples equipment, cameras, flow meters, cast nets, kick nets, screens, computer models, stereomicroscopes, thermometers, compound microscopes, clinometers, and field journals, vernier, integrated slides, hand lens, hot plates, Petri dishes, sampling nets, scales, leveling grade, and flame sticks, gradicators, microscopes and height distance calculators, spades or biological specimens or structures, core sampling equipment, fish tanks and associated supplies, and hydrometers.</td>
<td>AQUA.2.G</td>
<td>Demonstrates the use of course apparatuses, equipment, techniques, and procedures.</td>
</tr>
<tr>
<td><strong>AQUA.1.B</strong></td>
<td>Use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards.</td>
<td>AQUA.1.A</td>
<td></td>
</tr>
<tr>
<td><strong>AQUA.1.C</strong></td>
<td>Collect quantitative data using the international system of units (SI) and qualitative data as evidence.</td>
<td>AQUA.2.F</td>
<td>Collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate mathematically relevant quantities for descriptive data, including mean, median, and range.</td>
</tr>
<tr>
<td><strong>AQUA.1.D</strong></td>
<td>Collect quantitative and qualitative data using software, spreadsheets, lab notebooks or journals, models, diagrams, graphs, paper, computers, or cellular phone applications.</td>
<td>AQUA.2.H</td>
<td>Organize, analyze, evaluate, build models, make inferences, and predict trends from data.</td>
</tr>
<tr>
<td><strong>AQUA.1.E</strong></td>
<td>Develop and use models to represent phenomena, systems, processes, or solutions to engineering problems.</td>
<td>AQUA.2.D</td>
<td>Distinguish between scientific hypotheses and scientific theories.</td>
</tr>
<tr>
<td><strong>AQUA.1.F</strong></td>
<td>Distinguish between scientific hypotheses, theories, and laws.</td>
<td>AQUA.2.B</td>
<td>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.</td>
</tr>
<tr>
<td>AQUA.2.A</td>
<td>Know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AQUA.2.B</td>
<td>Demonstrate an understanding of the use and conservation of resources and the proper disposal of recycling of materials.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AQUA.2.C</td>
<td>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 they may be subject to change as new areas of science and new technologies are developed.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SCIENCE.AQUA.2**

Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify factors and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate design. The student is expected to:

**SCIENCE.AQUA.2.A** Identify advantages and limitations of models such as their size, scale, properties, and materials.

**SCIENCE.AQUA.2.B** Analyze data by identifying significant statistical features, patterns, sources of error, and limitations.

**SCIENCE.AQUA.2.C** Use mathematical calculations to assess quantitative relationships in data, and

**SCIENCE.AQUA.2.D** Evaluate experimental and engineering designs.

**SCIENCE.AQUA.2.I** Communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

**SCIENCE.AQUA.2.J** Communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials.

**SCIENCE.AQUA.3** Communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials.

**SCIENCE.AQUA.3.A** Develop explorations and propose solutions supported by data and models consistent with scientific ideas, principles, and theories.

**SCIENCE.AQUA.3.B** Draw inferences based on data related to questionable materials for products and services.

**SCIENCE.AQUA.3.C** Communicate, 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;

**SCIENCE.AQUA.3.D** Analyze the impact of past and current research on scientific thought and society, including scientific methodology, cost-benefit analysis, and contributions of diverse scientists related to the content and

**SCIENCE.AQUA.3.F** Research and describe the history of aquatic science and contributions of scientists.
The student understands how the properties of water build the foundation of aquatic ecosystems. The student is expected to:

- Research and explore resources such as museums, planetariums, observatories, libraries, professional organizations, private companies, online platforms, and mentors employed in science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.

- Describe the connection between aquatic science and future careers; and

- Technology, (STEM) in order to investigate STEM careers.

- Student the properties of water the molecule make it a "universal solvent" in aquatic systems.

- Identify how aquatic ecosystems are affected by water’s properties of adhesion, cohesion, surface tension, heat capacity, and thermal conductivity; and

- Explain how the density of water is critical for organisms in cold environments.

- Students know that aquatic environments are the product of interactions among Earth systems. The student is expected to:

- Identify key features and characteristics of atmospheric, geological, hydrological, and biological systems as they relate to aquatic environments;

- Describe the interrelationships of atmospheric, geological, hydrological, and biological systems in aquatic ecosystems, including positive and negative feedback loops; and

- 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.

- The student knows about the interdependence and interactions that occur in aquatic environments. The student is expected to:

- Identify how energy flows and matter cycles through both freshwater and marine aquatic systems, including food webs, chains, and pyramids;

- Identify biological, chemical, geological, and physical components of an aquatic life zone as they relate to the organisms in it;

- Identify variables that affect the solubility of carbon dioxide and oxygen in water;

- Evaluate factors affecting aquatic population cycles such as lunar cycles, temperature, salinity, and ozone layer breakdown; and

- Identify the interdependence of organisms in an aquatic environment such as in a pond, river, lake, ocean, or aquifer and the biosphere.

- 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:

- Evaluate data over a period of time from an established aquatic environment documenting seasonal changes and the behavior of organisms; and

- Evaluate data over a period of time from an established aquatic environment documenting seasonal changes and the behavior of organisms;
collect and analyze pH, salinity, temperature, mineral content, nitrogen compounds, dissolved oxygen, and turbidity data periodically, starting with baseline measurements; and collect baseline quantitative data, including pH, salinity, temperature, mineral content, nitrogen compounds, and turbidity from an aquatic environment.

analyze interrelationships among producers, consumers, and decomposers in aquatic ecosystems. analyze interrelationships among producers, consumers, and decomposers in a local aquatic ecosystem; and

The student knows the role of cycles in an aquatic environment. The student is expected to: Science concepts. The student knows the role of cycles in an aquatic environment. The student is expected to:

identify the role of carbon, nitrogen, water, and nutrient cycles in an aquatic environment, including upwellings and turnovers; identify the role of carbon, nitrogen, water, and nutrient cycles in an aquatic environment, including upwellings and turnovers; and

examine the interrelationships between aquatic systems and climate and weather, including El Niño and La Niña, currents, and hurricanes; examine the interrelationships between aquatic systems and climate and weather, including El Niño and La Niña, currents, and hurricanes.

Science student knows the role of cycles in an aquatic environment. The student is expected to:

identify nitrogen, water, and nutrient cycles in an aquatic environment, including upwellings and turnovers; identify nitrogen, water, and nutrient cycles in an aquatic environment, including upwellings and turnovers; and

examine water quantity and quality in a local watershed or aquifer; and examine water quantity and quality in a local watershed.

describe human uses of freshwater and how humans use water competes with that of other organisms. describe human uses of freshwater and how humans use water competes with that of other organisms.

The student knows that geological phenomena and fluid dynamics affect aquatic systems. The student is expected to: Science concepts. The student knows that geological phenomena and fluid dynamics affect aquatic systems. The student is expected to:

identify basic principles of fluid dynamics, including hydrostatic pressure, density, and buoyancy; identify basic principles of fluid dynamics, including hydrostatic pressure, density, salinity, and buoyancy;

identify interrelationships between ocean currents, climates, and geologic features such as continental margins, active and passive margins, physical plains, island arches, peninsulas, barrier islands, and hydrothermal vents; identify interrelationships between ocean currents, climates, and geologic features; and

explain how fluid dynamics cause upwelling and lake turnover; and explain how fluid dynamics cause upwelling and lake turnover.

describe how erosion and deposition in near-shore systems lead to formation of ecosystems. describe how erosion and deposition in near-shore systems lead to formation of ecosystems.

The student understands the types of aquatic ecosystems. The student is expected to: Science concepts. The student knows the types and components of aquatic ecosystems. The student is expected to:

differentiate among freshwater, brackish, and marine ecosystems; and differentiate among freshwater, brackish, and marine ecosystems;

identify the major properties and components of different marine and freshwater life zones; and identify the major properties and components of different marine and freshwater life zones; and

identify biological, chemical, geological, and physical components of an aquatic life zone in these aquatic life zones.
The student knows environmental adaptations of aquatic organisms. The student is expected to:

- compare different traits in aquatic organisms using tools such as dichotomous keys; AQUA.10.A describe how adaptations allow an organism to exist within an aquatic environment; and
- describe how adaptations allow an organism to exist within an aquatic environment; and

The student is expected to:

- SCIENCE.AQUA.13.A compare different traits in aquatic organisms using tools such as dichotomous keys; AQUA.10.A describe how adaptations allow an organism to exist within an aquatic environment; and
- describe how adaptations allow an organism to exist within an aquatic environment; and

SCIENCE.AQUA.14 The student understands how human activities impact aquatic environments. The student is expected to:

- analyze the cumulative impact of human population growth on an aquatic ecosystem; AQUA.12.B analyze the cumulative impact of human population growth on an aquatic ecosystem; AQUA.12.B
- predict effects of chemical, organic, physical, and thermal changes due to humans on the living and nonliving components of an aquatic ecosystem; AQUA.12.A predict effects of chemical, organic, physical, and thermal changes due to humans on the living and nonliving components of an aquatic ecosystem; AQUA.12.A
- investigate the role of humans in unbalanced systems. analyze components such as invasive species, fish farming, cultural eutrophication, or red tides; AQUA.12.C investigate the role of humans in unbalanced systems such as invasive species, fish farming, cultural eutrophication, or red tides; AQUA.12.C
- analyze and discuss how human activities such as fishing, transportation, dams, and recreation influence aquatic environments; AQUA.12.D analyze and discuss how human activities such as fishing, transportation, dams, and recreation influence aquatic environments; and
- 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 AQUA.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. AQUA.12.E
- analyze the purpose and effectiveness of human efforts to restore aquatic ecosystems affected by human activities. AQUA.12.E

SCIENCE.AQUA.14 The student understands how human activities impact aquatic environments. The student is expected to:

- analyze the cumulative impact of human population growth on an aquatic ecosystem; AQUA.12.B analyze the cumulative impact of human population growth on an aquatic ecosystem; AQUA.12.B
- predict effects of chemical, organic, physical, and thermal changes due to humans on the living and nonliving components of an aquatic ecosystem; AQUA.12.A predict effects of chemical, organic, physical, and thermal changes due to humans on the living and nonliving components of an aquatic ecosystem; AQUA.12.A
- investigate the role of humans in unbalanced systems. analyze components such as invasive species, fish farming, cultural eutrophication, or red tides; AQUA.12.C investigate the role of humans in unbalanced systems such as invasive species, fish farming, cultural eutrophication, or red tides; AQUA.12.C
- analyze and discuss how human activities such as fishing, transportation, dams, and recreation influence aquatic environments; AQUA.12.D analyze and discuss how human activities such as fishing, transportation, dams, and recreation influence aquatic environments; and
- 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 AQUA.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. AQUA.12.E
- analyze the purpose and effectiveness of human efforts to restore aquatic ecosystems affected by human activities. AQUA.12.E

KEY Blue double underline: indicates content new to the grade level Orange strike-through: indicates content was deleted.