Standard 1: Life Science

No standards apply.

Standard 2: Physical Science

As a basis for understanding Physical Science, students will develop the following knowledge, skills and understandings:

2.1 Students understand the structure and properties of matter.

2.2 Students understand chemical reactions.

2.3 Students understand the sources and properties of energy.

- **2.3.1** Know that nuclear reactions convert a fraction of the mass of interacting particles into energy (fission involves the splitting of a large nucleus into smaller pieces; fusion is the joining of two nuclei at extremely high temperature and pressure) and release much greater amounts of energy than atomic interactions.
- **2.3.2** Know that waves (e.g., sound, seismic, water, light) have energy and can transfer energy when they interact with matter.
- **2.3.3** Know the range of electromagnetic spectrum:
  - 2.3.3.1 Radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, x-rays, gamma rays.
  - 2.3.3.2 Electromagnetic waves result when a charged object is accelerated or decelerated.
  - 2.3.3.3 The energy of electromagnetic waves is carried in packets whose magnitude is inversely proportional to the wavelength.

2.4 Students understand forces and motion.

- **2.4.1** Know that magnetic forces are very closely related to electric forces and can be thought of as different aspects of a single electromagnetic force:
  - 2.4.1.1 Moving electric charges produce magnetic forces and moving magnets produce electric forces.
  - 2.4.1.2 The interplay of these forces is the basis for electric motors, generators, radio, television, and many other modern technologies.
- **2.4.2** Know that the strength of the gravitational force between two masses is proportional to the masses and inversely proportional o the square of the distance between them.
- **2.4.3** Know that the strength of the electric force between two charged objects is proportional to the charges (opposite charges attract whereas like charges repel) and, as with gravitation, inversely proportional to the square of the distance between them.
- **2.4.4** Know that materials that contain equal proportions of positive and negative charges are electrically neutral, but a very small excess or deficit of negative charges in a material produces noticeable electric forces
- **2.4.5** Know that laws of motion can be used to determine the effects of forces on the motion of objects:
  - 2.4.5.1 Objects change their motion only when a net force is applied.
  - 2.4.5.2 Whenever one object exerts force on another, a force equal in magnitude and opposite in direction is exerted on the first object; the magnitude of the change in motion can be calculated using the relationship F=ma, which is independent of the nature of the force.

2.4.6 Know that apparent changes in wavelength can provide information about changes in motion because the observed wavelength of a wave depends upon the relative motion of the sources and the observer; if either the source or observer is moving toward the other, the observed wavelength is shorter; if either is moving away, the wavelength is longer.

2.4.7 Understand general concepts related to the theory of special relativity:

2.4.7.1 In contrast to other moving things, the speed of light is the same for all observers, no matter how they or the light source happen to be moving

2.4.7.2 The laws of physics are the same in any inertial frame of reference.

2.5 Students understand waves and optics.

2.6 Students understand electricity and magnetism.

Standard 3: Earth and Space Science

As a basis for understanding Earth and Space Science, students will develop the following knowledge, skills and understandings:

3.1 Students understand Earth's composition and structure.

3.2 Students understand the composition and structure of the atmosphere.

3.3 Students understand the composition and structure of the universe.

3.3.1 Know that although the origin of the universe remains one of the greatest questions in science, current scientific evidence supports the Big Bang theory, which states that between 10 and 20 billion years ago, the entire contents of the universe expanded explosively into existence from a single, hot, dense chaotic mass; our Solar System formed from a nebular cloud of dust and gas about 4.6 billion years ago.

3.3.2 Know that evidence suggests that our universe is expanding:

3.3.2.1 The Doppler shift of light from distant galaxies reaching telescopes on earth suggests that galaxies are moving away from the Earth and provides support for the Big Bang theory of the origin of the universe.

3.3.3 Know the ongoing processes involved in star formation and destruction:

3.3.3.1 Stars condense by gravity out of clouds of molecules of lightest elements.

3.3.3.2 Nuclear fusion of light elements into heavier ones occurs in the stars' extremely hot, dense cores, releasing great amounts of energy.

3.3.3.3 Some stars eventually explode. Producing clouds of material from which new stars and planets condense.

3.3.4 Know common characteristics of stars in the universe:

3.3.4.1 Types of stars include red and blue giants, white dwarfs, neutron stars.

3.3.4.2 Stars differ in size, temperature and age but they all appear to be made up of the same elements and to behave according to the same principles.

3.3.4.3 Most stars exist in systems of two or more stars orbiting around a common point.

Standard 4: Nature of Science

As a basis for understanding the nature of science as it relates to scientific knowledge, scientific inquiry, and scientific enterprise and to address content in the other standards students will:

4.1 Apply proper scientific measures when solving problems.

4.1.1 Know and employ metric units when measuring and problem solving:
- 4.1.1.1 Identify the seven major SI and laboratory metric units, i.e., meter, kilogram, second, ampere, Kelvin, mole, and candela.
- 4.1.1.2 Convert between prefixes nano to mega within the metric system.
- 4.1.1.3 Differentiate and convert between the two temperature scales; Celsius and Kelvin.
- 4.1.1.4 Contrive and solve derived values (volume and density) using correct SI units.

4.1.2 Use problem solving strategies (including dimensional analysis) to solve mathematical problems.
- 4.1.2.1 Identify the potentially important information given in a problem when choosing an appropriate solution.
- 4.1.2.2 Determine the true question and/or conceptual premise; applying appropriate units when applicable.
- 4.1.2.3 Properly manipulate conversion factors to dimensional analysis questions.

4.1.3 Reason unavoidable sources of error when discussing accuracy and precision (uncertainty) of results; examples include human, instrumental, systematic, and random errors
- 4.1.3.1 Reason the number of significant digits, accuracy, and precision in problems and laboratory tools.
- 4.1.3.2 Answer mathematical operations using scientific notation.

4.1.4 Demonstrate safety procedures within lab situations:
- 4.1.4.1 Demonstrate proper lab safety.
- 4.1.4.2 Locate and explain how to properly use safety equipment in the lab.

4.1.5 Use technology and mathematics (e.g., measurement, formulas, charts, graphs) to perform accurate scientific investigations and communications.
- 4.1.5.1 Select and use appropriate lab tools, measuring devises, calculators, computers, Probeware, etc. correctly during investigations.
- 4.1.5.2 Utilize appropriate measurements, formulas, charts, graphs, etc. when analyzing laboratory data.

4.2 Investigate the natural world using scientific inquiry.

4.2.1 Effectively contribute to a collaborative group; including accepting roles, following norms, and successfully communicating.

4.2.2 Design and conduct open ended scientific investigations; confirming scientific laws, theories, and models; or to explore new aspects of the natural world and new areas of science.

4.2.3 Devise investigations that:
- 4.2.3.1 Identify a focused problem or research question.
- 4.2.3.2 Formulate testable hypotheses that relate to the research question; supporting it quantitatively when appropriate.
- 4.2.3.3 Select relevant independent and dependent variables.
- 4.2.3.4 Identify and clarify the method and controls; using appropriate apparatus.
- 4.2.3.5 Demonstrate competence in using laboratory equipment (seeking assistance when required); paying attention to safety issues.
- 4.2.3.6 Adapt to new and unforeseen circumstances while following instructions.

4.2.3.7 Employ methods that collect sufficient and relevant quantitative and/or qualitative data; using appropriate units.
4.2.3.8 Organize and display raw data for easier interpretation and analysis data.
4.2.3.9 Determine errors, their quantitative/qualitative effects they have on results, and calculate percent error when possible.
4.2.3.10 Formulate a conclusion based on interpretation of results with an explanation, and, where appropriate, compare results with literature values.
4.2.3.11 Receive critical response from others.

4.2.4 Reason that when conditions of an investigation cannot be controlled, it may be necessary to discern patterns by observing a wide range of natural occurrences.

4.2.5 Know that conceptual principles and knowledge guide scientific inquiries; historical and current scientific knowledge influence the design and interpretation. of investigations and the evaluation of proposed explanations made by other scientists.

4.2.6 Comprehend why scientists conduct investigations:
4.2.6.1 To discover new aspects of the natural world
4.2.6.2 To explain recently observed phenomena
4.2.6.3 To test the conclusions of prior investigations
4.2.6.4 To test predictions of current theories

4.2.7 Appreciate that investigations and public communication among scientists must meet specific criteria in order to be accepted as new knowledge and methods:
4.2.7.1 Strive for certainty of proposed solutions using experimental standards.
4.2.7.2 Pursue arguments that are logical and do demonstrate connections between natural phenomena, investigations, and the historical body of scientific knowledge.
4.2.7.3 Convey explanations with logical structure and rules of evidence.
4.2.7.4 Show commitment to making public their methods, procedures, and conclusions.
4.2.7.5 Report methods and procedures used to obtain evidence to enhance opportunities for further research.
4.2.7.6 Understand the logical and empirical communication among scientists and the public leads to new accountable information.
4.2.7.7 Continually test, revise, and occasionally discard theories to allow for critical response from others.
4.2.7.8 Know that all current scientific knowledge in principle is subject to change as new evidence become available.

4.2.8 Understand the Nature of Science Inquiry is driven by the desire to understand the natural world and seeks to answer questions that may or may not directly influence humans.

4.3 Evaluate the acquisition, development, and modification of scientific knowledge in the past, present, and future.

4.3.1 Know ways in which science distinguishes itself from other bodies of knowledge, through use of empirical standards and logical arguments.

4.3.2 Be aware that scientific explanations must meet certain criteria to be considered valid:
4.3.2.1 Must be consistent with experimental and observational evidence about nature
4.3.2.2 Make accurate predictions about systems being studied
4.3.2.3 Be logical
4.3.2.4 Respect rules of evidence
4.3.2.5 Be open to criticism

4.3.2.6 Report methods and procedures
4.3.2.7 Make a commitment to making knowledge public

4.3.3 Reason how scientific knowledge changes and accumulates over time:
4.3.3.1 Comprehend that all scientific knowledge is subject to change as new evidence becomes available.
4.3.3.2 Know that some scientific ideas are incomplete and opportunity exists in these areas for new advances.
4.3.3.3 Know that scientific knowledge is continually tested, revised, and occasionally discarded as new evidence is obtained.

4.3.4 Accept and anticipate that from time to time, major shifts occur in the scientific view of how the world works, but usually the changes that take place in the body of scientific knowledge are usually small modifications of prior knowledge.

4.4 Examine how science and its enterprises impact society.

4.4.1 Compare and contrast Science and Technology

4.4.2 Reflect that, throughout history, diverse cultures have developed scientific ideas and solved human problems through technology .

4.4.3 Understand that individuals and teams contribute to scientific knowledge and understanding at different levels of complexity:
4.4.3.1 Conducting basic field studies or improving advanced technology
4.4.3.2 Creating New Technologies
4.4.3.3 Solving technological problems
4.4.3.4 Collaborating (sometimes between hundreds of people) on a major scientific question or technological problem

4.4.4 Comprehend the free and rapid interplay of theoretical ideas and experiments results in published scientific literature maintains crucial links between scientific fields.

4.4.5 Develop information and technology skills which are essential in modern scientific endeavors.

4.4.6 Appreciate that progress in Science/Technology can relate to social issues and challenges (e.g., funding priorities, health problems)

4.4.7 Understand that there are ethical traditions associated with the scientific enterprise:
4.4.7.1 Be committed to peer review.
4.4.7.2 Report truthfully about methods and outcomes of investigations.
4.4.7.3 Publish results of work with the expectation of peer review.
4.4.7.4 Scientists who violate these traditions are censored by their peers.

4.4.8 Consider that scientists and engineers can only conduct research on human subjects or stem cells if they have the consent of the subjects or governing bodies.

4.4.9 Accept that technology is often driven by the desire to help meet human needs, solve human problems, and fulfill human aspirations.

4.4.10 Be able to assess a proposal from a scientific enterprise; including questions about: alternatives, risks, costs, benefits, consideration of who benefits, who suffers, who pays, who gains, and who bears the risks.

4.4.11 Validate that credible technological resources come from professional presentations, journal publications, and data bases.

4.4.12 Understand that science and technology are essential social enterprises, but alone they can only indicate what can happen, not what should happen.

4.4.13 Acknowledge science is interdependent on different fields of study in different disciplines.
4.4.13.1 Scientists in different disciplines ask different questions, use different methods of investigation and accept different types of evidence to support their explanations
4.4.13.2 Many scientific investigations require the contributions of individuals from different disciplines.

4.4.13.3 New disciplines of science (such as geophysics, biochemistry, and genomics) often emerge at the interface of older disciplines.

4.4.14 Undergo searches for current areas where data, information, and understanding are incomplete; therefore providing the best opportunity for students to advance in the science related career opportunities.

4.4.15 Comprehend that creativity, imagination, and a good knowledge base are all required in the work of science and engineering.

4.5 Students understand the connections among science, global issues and sustainable solutions.

As a basis for this, students will understand:

4.5.1 Climate Change (Global Warming)
4.5.2 Biodiversity and Ecosystem Losses
4.5.3 Fisheries Depletion
4.5.4 Deforestation
4.5.5 Water Deficits
4.5.6 Air, Water and Soil Pollution
4.5.7 Global Infectious Diseases
4.5.8 Natural Disaster Prevention and Mitigation
4.5.9 Human Population Dynamics
4.5.10 Unsustainable Land Use (unsustainable agriculture, livestock grazing, urban sprawl, landfills, hazardous waste, mining and mineral extraction)
4.5.11 Solid Waste Management (waste minimization, recycling, closed loop systems)
4.5.12 Energy Conservation, alternative energy, alternative fuels