Standard 1: Life Science

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

1.1 Students understand the principles of heredity and related concepts.

1.1.1 State the chemical and structural properties of DNA and its role in specifying the characteristics of an organism:

1.1.1.1 DNA is a large polymer formed from four kinds of subunits; genetic information is encoded in genes as a string of these subunits.

1.1.1.2 Each DNA molecule in a cell forms a single chromosome and is replicated by a templating mechanism.

1.1.1.3 Portions of the DNA structure are as unique to each individual as fingerprints.

1.1.2 Understand ways in which genes (segments of DNA molecules) may be extracted, amplified, and restricted and analyzed to compare samples between suspects and evidential DNA.

1.1.3 Compare and analyze suspect and evidential samples via DNA or Protein Fingerprinting.

1.1.4 Identify locations that DNA evidence could be found at a crime scene.

1.1.5 Explain why DNA as compared to other forms of evidence is considered highly quantitative scientific evidence in a court of law.

1.1.6 List the necessary procedures for proper preservation of biological evidences for laboratory DNA analysis.

1.1.6.1 Biological evidence should not be packaged in plastic or air tight containers because the accumulation of residual moisture could contribute to the growth of blood-destroying bacteria and fungi; thus, each article should be packaged separately in a paper bag or in a well ventilated box.

1.2 Students understand the structure and function of cells and organisms.

1.2.1 Identify the progression of changes that occur in a human body after death that assist in the determination of time of death.

1.2.1.1 Determining time of death is assisted by examining the cornea of the eye and analyzing algor mortis, livor mortis and rigor mortis.

1.2.2 Formulate a predicted time of death by examining evidences on the body which could include:

1.2.2.1 Identifying the type and stage of development of insects feeding on the body

1.2.2.2 Examining the amount of rigor present in the body

1.2.2.3 Determining the change in temperature of the body: algor mortis

1.2.2.4 Examining the change in cornea clarity

1.2.2.5 Identifying the state of lividity in the body

1.2.3 Determine the stages of metamorphosis of a specific insect and their role in forensic science (i.e., beetle or blow fly).

1.2.4 Demonstrate understanding of blood spatter analysis in determining the angle of impact and the height that a blood sample fell.

1.2.4.1 Measure the impact angle of blood dropped on various surfaces and at various heights to distinguish between the effect of velocity and polarity of surface on blood spatter analysis at a crime scene.

1.2.4.2 Measure the area of convergence in a blood spatter to determine the height the blood fell.

1.2.4.3 Use blood spatter analysis formulas to quantitatively determine impact angles and heights that blood fell.

1.2.5 Demonstrate understanding of basic serology analysis.

1.2.5.1 The A-B-O antigens found in the blood for each blood type A, B, AB, and O can be tested for at a crime scene or in a suspect.

1.2.5.2 Blood's presence can be determined using presumptive blood tests: phenolphthalein, luminol, or malachite green tests.

1.2.5.3 Blood smears can be used to determine abnormalities in blood cells assisting in identifying disease or in identifying the species of a blood sample.

1.2.6 Measure the presence of blood using presumptive blood testing.

1.2.7 Determine estimated amount of time past by observing the condition of blood at a crime scene.

1.2.8 Screen evidence and suspect samples to make a judgment of comparisons between two or more samples of human tissue or fluids.

1.2.8.1 Examine human and animal hair to determine differences between species and differences between human races.

1.2.8.2 Compare human and animal blood to determine differences between species.

1.2.8.3 Examine DNA samples from different individuals to compare differences in the restriction fragment length polymorphisms.

1.2.8.4 Analyze fluids using thin layer chromatography or forensic toxicology techniques to determine if drugs or poisons are present.

1.2.9 Understand the structure and the anatomical differences between odontology in humans.

1.2.9.1 Identify how odontology is used in criminal investigations to identify matches between evidence collected and suspects.

1.2.10 Compare samples of exemplar and evidence to determine possible matches including samples of: fingerprints, handwriting, hair, blood, foot impressions, fibers or other.

1.2.11 Evaluate hair sample comparisons based on cuticle type, class and pattern of the medulla, and presence of ovoid bodies, cortical fusi and pigment granules.

1.2.12 Identify the classes and minutiae of fingerprints.

1.2.13 Understand the basic procedure in conducting an autopsy.

1.3 Students understand relationships among organisms and their physical environment.

1.3.1 Identify the metamorphic changes that occur during an insect's life cycle.

1.3.1.1 It is important to appraise how the physical environment can interrupt the normal life cycle of the organism.

1.3.2 Evaluate the impact of the physical environment (humidity, temperature, pressure) on decomposition of a body.

1.3.3 Understand that transient evidence is affected by environmental conditions.

1.3.4 Determine how the physical environment impacts the search for and collection of physical evidence in a crime scene.

1.3.4.1 Physical evidence can be destroyed by sudden changes in the weather or by organisms that interrupt the crime scene.

1.3.4.2 Securing and recording an outdoor crime scene has time pressures due to the type of environment and the activities of organisms in that environment.

1.3.4.3 Determining time of death of a body is dependent on knowing the conditions of the physical environment and calculating for those specific conditions.

1.4 Students understand biological evolution and the diversity of life.

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 the properties of matter.

2.1.1 Differentiate between natural and synthetic fibers and biological tissues such as hair
2.1.2 Compare types of matter to determine origin including types of glass, paint, soil or metals

2.2 Students understand chemical reactions.

2.3 Students understand the sources and properties and energy.

2.4 Students understand forces and motion.

2.5 Students understand waves and optics.

2.6 Students understand electricity and magnetism.

Standard 3: Earth and Space Science

No standards apply.

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 Fahrenheit.
- 4.1.1.4 Contrive and solve derived values (volume and density) using correct SI units.

4.1.2 Use problem solving strategies (including trigonometry) to solve 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 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 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 Arguments are logical and 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 Methods and procedures used to obtain evidence are clearly reported to enhance opportunities for further investigation.
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 discards theories, therefore allow for continual critical response from others.
4.2.7.8 Know that all current scientific knowledge in principle is subject to change, as new evidence becomes 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 t he 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 All scientific knowledge is subject to change as new evidence becomes available
4.3.3.2 Some scientific ideas are incomplete and opportunity exists in these areas for new advances
4.3.3.3 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.
4.4.5.1 **Appreciate** that progress in Science/Technology can relate to social issues and challenges (e.g., funding priorities, health problems)

4.4.6 Understand that there are ethical traditions associated with the scientific enterprise:
4.4.6.1 Be committed to peer review.
4.4.6.2 Report truthfully about methods and outcomes of investigations.
4.4.6.3 Publish results of work with the expectation of peer review.
4.4.6.4 Scientists who violate these traditions are censored by their peers.

4.4.7 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.
4.4.8 Accept that technology is often driven by the desire to help meet human needs, solve human problems, and fulfill human aspirations.
4.4.9 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.
4.4.10 Validate that credible technological resources come from professional presentations, journal publications, and data bases.
4.4.11 Understand that science and technology are essential social enterprises, but alone they can only indicate what can happen, not what should happen.
4.4.12 Acknowledge science is interdependent on different fields of study in different disciplines.

4.4.12.1 Scientists in different disciplines ask different questions, use different methods of investigation and accept different types of evidence to support their explanations.
4.4.12.2 Many scientific investigations require the contributions of individuals from different disciplines.
4.4.12.3 New disciplines of science (such as geophysics, biochemistry, and genomics) often emerge at the interface of older disciplines.

4.4.13 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.

4.4.14 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