AMERICAN INTERNATIONAL
SCHOOL OF LAGOS

High School Science Standards

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AISL HS BIOLOGY ACADEMIC STANDARDS

Biology

Standard 1
Life Science

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

B.1.1 Students understand the principles of heredity and related concepts.

1.1.1 Describe the structure of DNA and relate this to its function (genetic code).

1.1.2 List and label the major stages of Mitosis.

1.1.3 Define mutation with respect to the genetic code.

1.1.4 Demonstrate a functional understanding of the following concepts in Mendelian genetics: dominant and recessive traits, monohybrid crosses, sex linkage, pedigree

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

1.2.1 Identify the structures of different types of cell parts and explain the functions they perform.

1.2.2 Understand the chemical reactions involved in cell functions.

1.2.3 Describe the process of photosynthesis and cell respiration in plants.

1.2.4 Explain how cells' functions are regulated through selective gene expression, protein production and activity, and controls of cell growth and division.

1.2.5 Understand that the complexity and organization of organisms accommodates the need for obtaining, transforming transporting, releasing and eliminating the matter and energy used to sustain the organism.

1.2.6 Explain the processes of cell division and differentiation.

1.2.7 Discern differences n the levels of protein structure and functions of proteins in cell processes.

1.2.8 Understand specialized cells comprise tissues that form organs and organ systems for a specific function.

B 1.3 Students understand relationships among organisms and their physical environment.

1.3.1 Discern between organized and disorganized states of matter as they apply to living systems.

1.3.2 Compare and contrast the interrelationships/interdependencies that help generate stable ecosystems.

1.3.3 Estimate the amount of life an ecosystem can support if given the amount of matter and energy present.

1.3.4 Classify how chemical elements are recombined into new states of matter as they flow through different levels of organization in ecosystems.

1.3.5 Evaluate the various ways humans have altered the equilibrium of ecosystems causing potentially irreversible effects.

B1.4 Students understand biological evolution and diversity of life.

1.4.1 Show that heritable characteristics, which can be biochemical and anatomical, largely determine what capabilities an organism will have, how it will behave and how likely it is to survive and reproduce.

1.4.2 Understand the concept of natural selection.

1.4.3 Comprehend how variation of organisms within a species increases the chance of survival of the species, and how the great diversity of species on earth increases the chance of survival of life in the event of major global changes.

1.4.4 Explain the basic idea of evolution is that the earth's present-day life forms have evolved from earlier, distinctly different species as a consequence of the interactions of :

1. The potential for a species to increase its numbers.

2. The genetic variability of offspring due to mutation and recombination of genes.

3. A finite supply of the resources required for life.

4. The ensuing selection by the environment of those offspring better able to survive and leave offspring.

1.4.5 Understand the history of the origin and evolution of life on earth.

1.4.6 Identify how natural selection and its evolutionary consequences provide a scientific explanation for the diversity and unity of past and present life forms on earth.

1.4.7 Demonstrate how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships.

AISL HS BIOLOGY ACADEMIC STANDARDS

Standard 2
Physical Science

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

B.2.1 Students understand the structure and the properties of matter.

2.1.1 Know that chemical reactions can be accelerated by catalysts such as enzymes and metallic surfaces

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

B.4.1 Apply proper scientific measures when solving problems.

4.1.1 Know and employ metric units when measuring and problem solving.

4.1.2 Use problem solving strategies including dimensional analysis using correct SI units.

4.1.3 Reason sources of error when discussing accuracy and precision (uncertainty) of results; e,g., human, instrumental, systematic and random errors.

4.1.4 Demonstrate safety procedures within lab situations.

4.1.5 Use technology and mathematics to perform accurate scientific investigations and communications. (e.g., measurement, formulas, charts, graphs)

B4.2 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:

1. Identify a focused problem or research question.
2. Formulate testable hypotheses that relate to the research question; supporting it quantitatively when appropriate.
3. Select relevant independent and dependent variables
4. Identify and clarify the method and controls; using appropriate apparatus.

5. Demonstrate competence in using laboratory equipment seeking assistance when required; paying attention to safety issues.

6. Adapt to new and unforeseen circumstances while following instructions.

7. Employ methods that collect sufficient and relevant quantitative and/or qualitative data; using appropriate units.

8. Organize and display raw data for easier interpretation and analysis data.

9. Determine errors, their quantitative/qualitative effects they have on results, and calculate percent error when possible.

10. Formulate a conclusion based on interpretation of results with an explanation, and, where appropriate, compare results with literature values.

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

4.2.7 Appreciate that investigations and public communication among scientists must meet specific criteria in order to be accepted as new knowledge and methods.

4.2.8 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.

B4.4 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.

4.4.4 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.

4.4.8 Consider that scientists and engineers can only conduct research on human subjects or stem ells 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 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 tat 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.

4.4.14 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.

B4.5 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

4.5.11 Solid Waste Management

4.5.12 Energy Conservation, alternative energy alternative fuels

Chemistry

Standard I: Structures and Properties of Matter

Students understand the structure and the properties of matter.

C1.1 Matter can be classified between pure substances (elements and compounds) and heterogeneous and homogeneous mixtures.

1.1.1 Differentiate between solutions (homogenous mixtures) and suspensions; including colloids.

1.1.2 Separate, purify, and identify pure substance through the process of filtration, chromatography, distillation, and reverse osmosis

C1.2 Early and Modern Atomic Theories have impacted current atomic models.

1.2.1 Understand Dalton's atomic theory and the major contributions leading up to his theory

1.2.2 Use experimental basis to account for Thomson's discovery of the electron and Rutherford's discovery of the nucleus.

1.2.3 Understand the experimental basis for the development of the quantum theory of atomic structure including the significance and limitations of the Bohr model, spectral lines and contributions of Planck, DeBroglie, Heisenberg and Schrödinger.

1.2.4 Rutherford – Bohr models incorporate protons, neutrons, and electrons in their appropriate locations.

1.2.4.1 Relate the size and mass of the nucleus to the size and mass of the atom; factoring the magnitude of difference.

1.2.4.2 Know the relationship between atom numbers (Z), atomic mass number (A)

1.2.4.3 Know that most elements have two or more isotopes (having little effect on how the atom chemically interacts with others) effecting the mass and stability of the nucleus.

1.2.4.4 Connect the charge of sub atomic particles to the electric force holding the atom together.

C1.3 Modern atomic structure can be derived using information off the periodic table, quantum analysis and probability.

1.3.1 The quantum energy levels of atoms can be used to derive their structure

and as a "fingerprint" for identification.

1.3.2 Use the relationship among the four quantum numbers (n, l, m and s) to describe atomic orbitals and electron configurations.

1.3.3 Use Aufbau's Principle, Pauli's Exclusion principle, and Hund's Rule to construct electron spin diagrams differentiating between energy level, sublevel, and orbital.

1.3.4 Determine electron configurations for atoms and relate the position of an element in the periodic table to its quantum electronic configuration and reactivity with other elements in the table.

C1.4 The periodic table shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.

1.4.1 Understand the history and development of the periodic table; starting with Mendeleev's vision.

1.4.2 Compare and contrast families, groups, periods, and/or series of elements on the Periodic Table.

1.4.3 Use the periodic tables to identify representative and transition elements, metals, nonmetals, metalloids, the alkali metals, alkaline earth metals, halogens, noble gases and lanthanide and actinide series.

1.4.4 Use the periodic table to identify tends in atomic and ionic radii, ionization energy, electronegativity; including predicting oxidation states.

1.4.5 Know the nature and properties of ionic and covalent bonding between atoms and predict, using the periodic table, the general nature of bonding between atoms.

C1.5 Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.

1.5.1 Know that salt crystals are repeating patterns (lattices) of cations and anions held together by electrostatic attractions.

1.5.2 Using ionization energies and electronegativity data, predict bond formation.

1.5.3 Use electronegativity to predict bond polarity.

1.5.4 Explain the nature of network covalent and metallic bonding.

1.5.5 Explain the general characteristics of compounds formed by ionic, covalent, metallic and network covalent bonds.

1.5.6 Identify and explain inter-particle forces of attraction such as hydrogen bonding, diapole-dipole attractions, and van der Waals forces including London dispersion forces.

1.5.7 Draw Lewis dot structures to predict the shape and polarity of molecules (VSEPR)

1.5.8 Predict the boiling and melting temperatures of solids, liquids, and gases using knowledge of the relationship between the types of inter-particle attractions involved.

1.5.9 Use bond energies to predict heats of reaction.

1.5.10 Use concepts of hybridization to explain sigma and pi bonding in molecules.

1.5.11 Use molecular orbital theory (MO-LCAO) to predict bond order, bond length,bond strength, paramagnetism and diamagnetism.

C1.6 The kinetic Molecular Theory explains the properties of gases.

1.6.1 Know the random motion of gas particles and their collisions with a surface create observable pressure on that surface.

1.6.2 Know the values and understand the meanings of standard temperature and pressure (STP).

1.6.3 Apply the gas laws (including the Ideal Gas Law and Dalton's Law) to relations between the pressure, temperature, volume, and amount of ideal gas or any mixture of ideal gases.

1.6.4 Interpret the ideal gas laws using the kinetic molecular theory.

1.6.5 Understand how the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.

1.6.6 Describe the characteristics of condensed states of matter using the kinetic molecular theory.

C1.7 Phase diagrams interpret changes of state under different conditions.

1.7.1 Relate vapor pressure and temperature.

1.7.2 Relate energetics of phase changes to attractive forces between representative particles.

C1.8 Solutions are homogeneous mixtures or two or more substances.

1.8.1 Describe the dissolving process at the molecular level using concepts of molecular motions and attractive forces between solute and solvent.

1.8.2 Qualify and quantify colligative properties in terms of electrolytes.

1.8.3 Understand how structural, temperature, pressure and surface area affect the dissolving process.

1.8.4 Calculate the concentration of a solute in solution in terms of solubility, molarity, and mole fraction.

C1.9 The chemical nomenclature system is used to descriptively name binary ionic, binary covalent, polyatomic and acidic compounds.

C1.10 Nuclear Processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fissions and nuclear fusion.

1.10.1 Know that protons and neutrons in the nucleus are held together by nuclear forces that overcome proton-proton repulsion.

1.10.2 Know that the energy release in fission and fusion reactions is several magnitudes greater than energy releases in chemical and physical processes.

1.10.3 Identify the three most common forms of radioactive decay (alpha, beta, and gamma) and understand how the nucleus changes in each type of decay; including balancing nuclear equations.

1.10.4 Understand that alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrating effects.

1.10.5 Calculate the amount of radioactive substance remaining after a specific integral number of half-lives have passed.

1.10.6 Know neutrons and protons are made up of smaller constituents.

AISL HS CHEMISTRY ACADEMIC STANDARDS

Standard 2: Chemical Reactions

Students understand chemical reactions.

C 2.1 Chemical reactions are processes in which reactants are re-arranged into products.

2.2.1 Identify reacting ionic and/or molecular species in chemical reactions; predicting their products.

2.2.2 Classify relevant chemicals into Acids and bases and predict the Salt (based on their ions) formed in when they neutralize in a water solution.

2.2.3 Distinguish among acid-base constituents of Arrhenius, Bronsted-lowry, and Lewis.

C 2.2 The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants, stoichiometry.

2.2.1 Understand how Avogadro's hypothesis is integral to the mole concept.

2.2.2 Determine molar mass of representative particles from chemical formulas.

2.2.3 Convert among mass, volume at STP, Avogadro's number of particles and moles.

2.2.4 Calculate the masses of reactants in chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.

2.2.5 Determine limiting reactants in chemical reactions and calculate percentage yields.

C 2.3 Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules.

C 2.4 Chemical equilibrium is a dynamic process at the molecular level.

2.4.1 Apply Le Chatelier's Principle and relate shifts in chemical systems at equilibrium to stresses applied such as change in temperature, change in concentration or reactants, and change in pressure of gases.

2.4.2 Write and calculate equilibrium constants and use K values to predict and explain the equilibrium.

C 2.5 Acids, bases and salts are three classes of compounds that form ions in water solutions.

AISL HS CHEMISTRY ACADEMIC STANDARDS

Standard 3: Energy

Students understand that energy is stored in chemical bonds, and may be absorbed or released during chemical reactions and phase changes.

C 3.1 Each kind of atom or molecule can gain or lose energy only in particular discrete amounts.

3.1.1 Know the arrangement of the electromagnetic spectrum.

3.12 Know that energy in electromagnetic waves is carried in packets called photons.

C 3.2 Energy is exchanged or transformed in all chemical reactions and physical changes of matter.

3.2.1 Understand chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules such as concentration, temperature and pressure.

3.2.2 Interpret the relationship between temperature and reaction rates using graphical data.

3.2.3 Explain the role of activation energy in chemical reactions.

3.2.4 Explain the role of a catalyst in chemical reactions; including metallic surfaces and enzymes.

Standard 4: The 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:

C 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 Convert between prefixes nano to mega within the metric system.

4.1.1.2 Differentiate and convert between the two temperature.

4.1.1.3 Contrive and solve derived value (volume and density) using correct SI units.

4.1.2 Use problem solving strategies including dimensional analysis using correct SI units.

4.1.2.1 Identify the potentially important information given in a problem when choosing an application solution.

4.1.2.2 Determine the true question and/or conceptual premise; applying a

4.1.2.3 Properly manipulate conversion factors to dimensional analysis questions

4.1.3 Determine sources of error when discussing accuracy and precision (uncertainty) of results; e.g., 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 in the lab.

4.1.5 Use technology and mathematics to perform accurate scientific investigations and communications. (e.g., measurement, formulas, charts, graphs).

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.

C 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 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.

4.2.4 Comprehend why scientists conduct investigations:
- 4.2.4.1 To discover new aspects of the natural world.
- 4.2.4.2 To explain recently observed phenomena.
- 4.2.4.3 To test the conclusions of prior investigations
- 4.2.4.4 To test predictions of current theories.

4.2.5 Appreciate that investigations and public communication among scientists must meet specific criteria in order to be accepted as new knowledge and methods:
- 4.2.5.1 Strive for certainty of proposed solutions using experimental standards.
- 4.2.5.2 Pursue arguments that are logical and do demonstrate connections between natural phenomena, investigations, and the historical body of scientific knowledge.
- 4.2.5.3 Convey explanations with logical structure and rules of evidence.
- 4.2.5.4 Show commitment to making public their methods, procedures and conclusions.
- 4.2.5.5 Report methods and procedures used to obtain evidence to enhance opportunities for further research.
- 4.2.5.6 Understand the logical and empirical communication among scientists and the public leads to new accountable information.
- 4.2.5.7 Continuity test, revise, and occasionally discards theories, therefore allow for continual critical response from others.
- 4.2.5.8 Know that all current scientific knowledge in principle in principle is subject to change, as new evidence becomes available.

AISL HS CHEMISTRY ACADEMIC STANDARDS

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

1. Be aware that scientific explanations must meet certain criteria to be considered valid:
2. Make accurate predictions about systems being studied.
3. Be logical.
4. Respect rules of evidence.
5. Be open to criticism
6. Report methods and procedures.
7. Make a commitment to making knowledge public.

B. Reason how scientific knowledge changes and accumulates over time:

1. Comprehend that all scientific knowledge is subject to change as new evidence becomes available.
2. Know that some scientific ideas are incomplete and opportunity exists in these areas for new advances.
3. Know that scientific knowledge is continually tested, revised, and occasionally discarded as new evidence is obtained.

C. 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.

AISL HS PHYSICS ACADEMIC STANDARDS

Physics

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:

P2.1 Students understand the structure and the properties of matter.

P2.1.1 Know the structure of an atom.

P2.1.2 Know that the number of electrons in an atom determines whether the atom is electrically neutral or an iron.

P2.1.3 Understand atomic physics.

P2.2 Students understand that sources and properties of energy.

P2.2.1 Understand energy s the ability to cause change.

P2.2.2 Distinguish between Kinetic energy and Potential energy

P2.2.3 Solve problems on Kinetic energy and Potential energy

P2.2.4 Understand wave motion, and apply the principle of conservation of energy.

P2.3 Students understand forces and motion.

P2.3.1 Understand kinematics and dynamics.

P2.3.2 Understand Newton's Laws of Motion.

P2.3.3 Understand circular motion, work and energy.

P2.3.4 Know that laws of motion can be used to determine the effects of forces on the motion of objects.

P2.3.5 Analyze velocity as a rate of change of position.

P2.3.6 Analyze acceleration as rate of change in velocity.

P2.3.7 Analyze free-fall motion

P2.3.8 Using graphical and mathematical tools, design and conduct investigations of linear motion and the relationship among position, average velocity, instantaneous velocity, acceleration and time, and free-fall motion

P2.3.8 Understand impulse and momentum.

P2.3.9 Understand oscillatory motion and mechanical waves.

P2.3.10 Understand the characteristics of waves

P2.4 Students understand waves and optics.

P2.4.1 Understand wave motion and the wave nature of sound and light.

P2.5 Students understand electricity and magnetism.

P2.5.1 Understand static electricity and direct current electrical circuits.

P2.5.2 Understand magnetic forces and fields.

P2.5.3 Understand electromagnetic radiation.

P2.5.4 Know that waves have energy and can transfer energy when they interact with matter.

P2.5.5 Know the range of the electromagnetic spectrum.

P2.5.6 Know that magnetic forces are very closely related to electric forces and can be thought of as different aspects of a single electromagnetic force.

P2.5.7 Know that nuclear forces are much stronger than electromagnetic forces, which are vastly stronger than gravitational forces, and the strength of nuclear forces explains why great amounts of energy are released from the nuclear reactions in atomic or hydrogen bombs, and in the sun and other stars.

P2.5.8 Know that the strength of the gravitational force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.

P2.5.9 Know that the strength of the electric force between two charged objects is proportional to the charges and, as with gravitation, inversely proportional to the square of the distance between them.

P2.5.10 Know that electromagnetic forces exist within and between atoms.

P2.5.11 Know how different kinds of materials respond to electric forces.

P2.5.12 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.

Standard 3
Earth and Space Science

No standards apply.

Standard 4
Nature of Science

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