

SYLLABUS FOR NSF SSC SCIENCE (Grade 6-8)
(Adapted from GLENCOE SCIENCE – Level Red, Green and Blue)

LIFE SCIENCES

- I. **Cell Biology:** What are the main components and functions of animal and plant cells? How are proteins made? What are genes? Know the difference: Light and electron microscopes; Mitosis and Meiosis; Haploid and Diploid cells; DNA and RNA.
- II. **Classification of Living organisms:** How do viruses multiply and cause disease? Terms to understand: Kingdom, Phylum, Class, Order, Family, Genus, Species, origins of Life, Binomial nomenclature.
- III. **Plants:**
 - a. What are vascular tissues made up of? What are the main features of vascular and non-vascular plants? Seedless and seed plants? Know the difference: monocots and dicots.
 - b. Leaf: How is a leaf constructed? What are the light and dark reactions in photosynthesis? What are photoperiods? Terms to understand: Cellular respiration; plant tropisms and plant hormones.
 - c. Life cycles: Terms to understand: gametophyte and sporophyte stages. How do these plants reproduce - non-vascular seedless plants (moss), vascular seedless plants (ferns), and seed plants (gymnosperms and angiosperms)? How is seed dispersed? How does a seed develop?
- IV. **Animals:**
 - a. Bacteria and fungi: What are the characteristics of bacteria, eubacteria and archaeobacteria? How are bacteria beneficial and harmful? What are the main features of the 3 types of protists? Different types of fungi? How are fungi beneficial? What are lichens?
 - b. Invertebrates: What are key features (and examples) of sponges, cnidarians, mollusks, echinoderms, arthropods, flatworms, roundworms and segmented worms?
 - c. Vertebrates: What are key features (and examples) of mammals, birds, amphibians, and reptiles, fish? What are bony, jawless and cartilaginous fish? What adaptations of birds are useful for flight? What are different types of feathers and their functions? Compare the features of monotremes, marsupials and placentals.
- V. **Life Processes:**
 - a. Skeletal and Integumentary systems: What are the key aspects of skeletal (including types of bones and joints), and muscular (including types of muscles) systems? What are the main layers and functions of skin (integumentary system)?

- b.** Digestive system: What happens in different organs of the digestive system? How are enzymes compartmentalized? Terms to understand: the food pyramid, different classes of nutrients.
- c.** Respiratory and Excretory systems: What happens in different organs of the respiratory and excretory systems? What are some common diseases that affect these systems?
- d.** Circulatory system: What are the functions of the heart, arteries, capillaries and veins? What is coronary, pulmonary and systemic blood circulation? What are the main components of blood? What are the blood groups? Measuring blood pressure. Discuss some common diseases.
- e.** Immune system: What is the immune system? What is active and passive immunity? What is vaccination? Examples of infectious diseases caused by viruses, bacteria, protozoa and fungi. What is AIDS?
- f.** Nervous system: What are the components of the nervous system? How many types of neurons are there? Know the difference: Central and peripheral nervous system. What are the main parts of the brain and their functions? Structure and function of eye and ear.
- g.** Inheritance: What determines traits? What are dominant and recessive traits? How would you use Punnett squares? What are Sex-linked disorders? What is selective breeding? Terms to understand: Genetic engineering, gene therapy and mutations.
- h.** Behavior: Know the difference: innate behavior (reflexes, instinct) and learned behavior (imprinting, conditioning, insight). Terms to understand: social and territorial behavior; communication.

VI. **Ecosystems:**

- a.** Basics: What are the key biotic and abiotic factors? What are key features of the 6 major biomes? In the Ocean ecosystems, what are plankton, nekton and bottom dwellers? How are animal and plant adaptations (with examples) useful for survival? Terms to understand: migration, camouflage, mimicry, hibernation and estivation.
- b.** Species interdependence: How do food chains and food webs operate? What are the roles of producers, consumers, decomposers, and energy pyramid? How may biodiversity be threatened? How is biodiversity being protected? Terms to understand: Population, community, habitat, carrying capacity, biotic potential, endangered species, threatened species, extinction, primary succession, and secondary succession.
- c.** Evolution: What is the theory of Darwin's natural selection? What is relative and absolute (radiometric) dating? What are homologous and vestigial structures? Know the difference: Gradualism vs. Punctuated equilibrium. What clues do fossils provide? How did primates and early humans evolve?

EARTH SCIENCES

I. Geology:

- a.** Landforms: What are the major landforms? What are the key features of the ocean floor? Terms to understand: Plains, plateaus and mountains (folded, upwarped, fault-block).
- b.** Plate tectonics: What is the evidence for continental drift and seafloor spreading? Terms to understand: Divergent, convergent and transform boundaries with features at these boundaries.
- c.** Erosion: What are the different agents and types of erosion? How is soil formed? What are deflation, abrasion, sheet flow, rills and gullies? Terms to understand: Mechanical and chemical weathering; glacial erosion and deposition.
- d.** Rocks: What is the rock cycle? What are the properties of minerals (such as color, hardness, luster, streak, cleavage and fracture)? What are Gems and Ores? What are the soil types and horizons? Know the difference: Intrusive and Extrusive Igneous rocks, Sedimentary (Detrital, Chemical and Organic) and Metamorphic (foliated or non-foliated) rocks.
- e.** Fossils: What are different the types of fossils – mold, cast, imprint, amber? What are their uses? How do you determine relative versus absolute age? What is an Era? What are fossil fuels? What are examples of renewable energy sources?

II. Earth and Space:

- a.** Spin: What are the consequences of Earth's tilted axis? What are seasons, solstices and equinoxes? What causes day and night, seasons? What are the key features of the Moon (both surface and interior)? Terms to understand: Lunar phases, lunar eclipse, and solar eclipse.
- b.** Space probes: What is radiation from space? What is ISS, Hubble Space Telescope? How do we use rockets, satellites and probes, space shuttles and space stations? Know the difference: Reflecting telescope, refracting telescope and radio telescope.
- c.** Solar system: How did solar system originate? How many Sun's layers are there? What are sunspots, prominences, flares and CMEs? What are the special features of inner and outer planets, and their moons? Know the difference: Sun-centered and Earth-centered models; asteroids and meteoroids, comets, Oort Clouds.
- d.** Stellar evolution: How do medium-sized and massive stars evolve? What is the Hertzsprung-Russell diagram? What are circumpolar constellations? What is the Red shift? Know the difference: Spiral, elliptical and irregular galaxies; absolute and apparent magnitude; light year and astronomical unit (AU). What is The Big Bang Theory?

III. Oceans:

Understand what ocean water contains. What is desalination? Recognize the different ocean currents – surface currents, the Gulf Stream, density currents, upwelling. Recognize key features of ocean waves and tides. Identify tidal range, tidal bore, spring tides, and neap tides.

IV. **Weather:**

- a. Atmosphere: What are the key features and temperature changes in the layers of Earth's atmosphere? What is relative humidity and dew point? How do you classify clouds by shape and height in sky? What are Weather Maps?
- b. Wind: What are easterlies, westerlies, trade winds, and jet streams? What is the Coriolis effect? What are air masses and fronts (warm/cold/occluded/stationary)? Know the difference: Sea breeze vs. Land breeze.
- c. Currents and climate: What are climatic changes? What are El Nino, La Nina and Global warming?
- d. Earthquakes: How earthquakes form at faults? What are focus, epicenter, P, S and surface waves of an earthquake? How do you map the epicenter and Earth's interior? What is Liquefaction? Know the difference: the Richter scale and Mercalli intensity scale.
- e. Volcanoes: How may volcanoes form at divergent and convergent boundaries and at hotspots? How can you differentiate types of volcanoes by lava content and shape?
- f. Pressure: How do thunderstorms, hurricanes, tornados and blizzards form? What are high and low pressure centers? What are tornado watches and tornado warnings?
- g. What are the water, carbon and nitrogen cycles?
- h. Pollution: What are the main causes of soil, air and water pollution? How can water and soil be conserved? Terms to understand: ozone layer, smog, acid rain, Global warming.
- i. Conservation: What are the 3 Rs of resource conservation? What are non-renewable and renewable energy sources? What are the main features of wind, water, geothermal, solar, and nuclear energy?

PHYSICAL SCIENCES

I. **Matter:**

- a. States and transitions: What are the different states of matter? How do they transition? Do physical properties depend on size? How do you use physical properties to identify, separate and classify substances? How do physical properties (like viscosity, surface tension) change due to change of state? What are the effects of temperature and pressure on physical properties of matter at a macro- and a micro- (particle) level? Terms to understand: dissolution, vaporization, condensation, sublimation, deposition, and specific heat, different physical properties and units of measurements. Know the difference: elements, compounds and mixtures.
- b. Reactions: How are physical and chemical changes in matter different? What are some common chemical reactions that you can observe in nature? Understand physical factors that affect chemical reactions. How can you identify chemical change(s) and differentiate it from physical change(s)? What are reversible and irreversible reactions? What happens during a chemical reaction? How do catalysts and inhibitors affect a chemical reaction? What is the role of energy in a chemical reaction? Understand chemical equation, reactants, products, activation energy, endothermic reaction, and exothermic reaction. What is balancing of a chemical equation? Why should a chemical equation be balanced? Understand law of conservation of mass in relation to physical or chemical change. Understand some

chemical reactions that occur in everyday life. What are acids, bases, and neutralization? What is pH and what are indications of acidity? How do hydronium ions affect acidity?

- c. The Periodic Table: What is a symbol and a formula? How are elements arranged in a periodic table? What are atoms and its constituents? Understand atomic number, atomic mass, and mass number. Understand electronic configuration. How do atomic and physical properties vary in a periodic table? Understand period, group, representative elements, transition elements, metals, nonmetals, metalloids, alkali metals, alkaline earth metals, carbon group semiconductor metals, Oxygen family, halogens, noble gases, lanthanides, and actinides. Understand the relation between electronic configuration and chemical reactivity? What is bond formation? Understand metallic bonds, ions, covalent bonds, single bond, double bond, and triple bond and how electrons are configured in these cases. What are polar and non-polar molecules? What are isotopes?
- d. Atoms: Why is an atom the basic unit of matter? What are atoms made of? What experiments led scientists to the discovery of subatomic particles, especially electrons, protons and neutrons? Know the scientists: Dalton, Crookes, Thompson, Rutherford, and Bohr. What were the different models for the structure of the atom and how the current accepted model was derived? What do you know about the dual nature of electrons and how it changed the structure of the atom? What are alpha particles? What is meant by radioactive decay and how was it discovered? What is half-life? What are beta rays? What is carbon dating? How are radioactive isotopes made and used for human health? What are quarks?

II. Forces:

- a. Laws of motion: What are distance, speed, velocity, and acceleration (with calculations and graph interpretations)? What are the different types of forces involved in Newton's laws of motion? What are balanced forces, unbalanced forces and combination of forces (with problem-solving involving balance of forces)? What are friction, inertia, action versus reaction, and momentum? What is the law of conservation of momentum (with different types of calculations involving momentum)?
- b. Work: What are work and power and its relation to forces? How is work and power measured (with problem-solving)? What are different types of machines? What is mechanical advantage and efficiency? What is pressure? Terms to Understand: simple machines - pulley, lever and inclined plane, mechanical advantage, efficiency, and balance of forces (with problem-solving); buoyancy - Archimedes' and Pascal's principles; density (with problem-solving).

III. Energy:

- a. Forms, conservation, and transformation: How are energy and work related? What are different forms of energy (potential, kinetic, thermal, electrical, magnetic, and chemical)? What is the law of conservation of energy? How may energy be transformed (graph and data interpretations)? What are the different sources -- renewable and non-renewable -- of energy? What are conduction, convection and radiation? How do you measure heat energy?

- b.** Electricity: What are electric charges? How would you define electric field and electric force? How is lightning caused? What are electric current and its units? How is electrical energy transferred to a circuit? Terms to understand: induction, insulator, conductor, static charge, electric and discharge; Ohms law and the relation between current, resistance and voltage (including problem-solving). Know the difference: series and parallel circuits.
- c.** Magnetism: What is magnetism? How are electricity and magnetism related? What is electromagnetism? What is magnetic domain and electromagnetic induction? What are magnetic declination and its relation to latitude and longitude? Terms to understand: electric generator, direct and alternating currents. What are the advantages of alternating current over direct current? What are transformers and superconductors? What are the applications of magnetism?
- d.** Duality of matter: What are waves and its relationship to energy and matter? How is energy transferred in waves? Understand interaction of waves with particles. What is electromagnetic spectrum and how is energy distributed in it? How is light both a wave and a particle? How do you distinguish constructive and destructive interference? How does the eye perceive light? Know the difference: transverse waves, compressional waves and electromagnetic waves. Terms to understand: wavelength, amplitude, frequency, wave speed, crest, and trough (different wave properties); reflection, refraction, diffraction, and interference.
- e.** Sound: What type of waves are sound waves? How are sound waves produced and propagated? How does ear detect sound waves? Terms to understand: compression, rarefaction, loudness, pitch, intensity and reverberation.

SCIENTIFIC ENQUIRY

I. Scientific Methods:

- a.** Theories and laws: How are knowledge, experiments and observations useful to explain the world around you? What are scientific theories, scientific laws and systems? What are different branches of Science? How do scientists use the scientific method to observe, understand and offer possible explanations for the world around us?
- b.** Elements and models: What do you understand by the different elements of the scientific method: observation, hypothesis, experiment, measure, analysis, inference, and communication? What are controlled experiments, dependent, independent variables and constants? What are different types of models (physical, computational, conceptual) and how are they useful in the scientific method?

II. Units and Measurements:

What are SI units? Define some of the SI units used in measurement of quantities like length, mass, temperature, time, etc. Terms to understand: estimation, precision vs. accuracy, rounding, and significant digits (includes problem-solving).

III. Presentation:

What are some visualization methods used to analyze and communicate results of scientific experiments? How do you make and interpret tables and graphs? What are the different Map projections and how do they compare?