

Science

Aims

Science contributes to the development of young people as:

- Good citizens of South Sudan
- Successful life-long learners
- Creative and productive individuals
- Environmentally aware members of society

Rationale

Science is relevant to the life of every human being. The context, content and the teaching and learning of Science should enable the learner to keep up with the fast pace of technological change in the global world. Scientific methods provide tools and skills for discovery and problem solving as well as enhancing motivation. Science provides utilitarian skills and attitude for coping with the current and future challenges. It must enable the learner to make good use of natural resources and guard against environmental damage and destruction. Most importantly for the Republic of South Sudan as a developing country, Science learning must encourage responsible industrialization and minimal exports of raw natural resources as opposed to finished industrial goods.

Science within the Framework

Science helps learners develop all four of the Framework competencies.

As a practical subject calling for planning of investigations, analysis of results and evaluation of evidence, Science has a particular focus on critical thinking. Group practical work provides opportunities for co-operation, and good Science depends upon effective communication through the use of questioning, debating, presentation and writing skills. The links between Science and a range of issues including, for example, agriculture, animals and plants, health, diet, natural resources, the environment and industry present considerable scope for examination of South Sudanese culture and heritage in relation to the wider world.

Teaching and Learning Science

Science incorporates the three traditional science subjects: Biology, Chemistry and Physics. Younger learners normally learn Science as an integrated subject whereas, in secondary schools, learners preparing for further study or careers in Sciences are likely to take separate Science subjects. Those not wishing to specialise in this way will continue to study Science as an integrated subject.

In the overview below, the learning is set out as three strands: Living things and life processes; Materials and their properties; Physical processes.

Some of the learning experiences will reflect just one of three strands but, where possible, learners will benefit if the learning is thematic, spanning the boundaries between strands. The Units of Study detail some of these connections and enable learners to deepen their understanding. However, detailing the requirements under each strand separately ensures that all essential learning is covered.

Opportunities to exploit the practical nature of Science can make a considerable difference to learners' motivation and learning and hence they should form a regular feature of Science lessons. Practical Science skills need to be developed in a structured manner with steady progression from year to year. The learning experiences required to achieve this are set out in the units for each strand.

In addition to experiments and the use of text books, learning experiences in Science should be rich and varied and should include, for example, field work; observations of the natural world; practical problem solving; the use of new technologies; data analysis; engagement with practitioners from agriculture, business and industry; plus opportunities to develop skills and confidence through questioning, discussion, drawing conclusions and evaluating.

There is scope for teachers to use local materials and opportunities in order to engage learners in first-hand and practical experiences. It is not always necessary to have specialist equipment to learn science.

Strands

There are three strands in Science:

- Living things and life processes
- Materials and their properties
- Physical processes

Younger learners will learn these in an integrated way with greater separation of the strands in higher grades.

Across all three strands, learners should be developing a scientific approach through investigation, forming and testing hypotheses and experimentation. They need to realise that science is about thinking creatively to try to explain how living and non-living things work, and to establish links between cause and effect.

Science is an ideal context for learners to develop ICT skills whilst studying the subject. Every opportunity should be taken for learners to use calculators, computers and other devices as part of their learning. The programme of ICT appropriate for each stage is set out in Annex 2.

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| Living things and life processes | Learners learn about the variety of plants and animals, including humans, which inhabit our planet and the processes which enable them to remain alive. They also learn about the interrelationships between living things and the environment. |
| Materials and their properties | Learners learn about the materials which make up everything in our world, the composition and the properties of these materials. Furthermore they learn how we make use of this knowledge. |
| Physical processes | Learners learn about the processes resulting from the effect of energy on matter. These processes relate to mechanics, heat, light, other radiation, sound, electricity, magnetism and atomic structure. |
| <p>In all strands, learners should be developing a scientific approach by:</p> <ul style="list-style-type: none"> • Asking questions that can be investigated scientifically, and deciding how to find answers • Considering what sources of information they will use to answer questions, including first-hand experience and a range of other sources • Forming hypotheses and thinking about what might happen • Planning and carrying out investigations, trying out possible approaches and deciding what evidence to collect and what sort of equipment or materials to use • Making a fair test or comparison by changing one factor and observing or measuring the effect whilst keeping other factors the same • Making systematic measurements and observations • Checking measurements and observations by repeating them where appropriate | |

| | P1 | P2 | P3 | P4 |
|---|--|--|--|---|
| Living things and life processes | <p>Identify main parts of body, know how to keep them clean, and know about proper use of the latrine</p> <p>Understand the role of bones, joints, muscles in movement and the importance of healthy exercise</p> <p>Identify plants and animals in their locality and their importance</p> <p>Understand the role of the senses in daily life</p> | <p>Understand the importance of keeping body clean and the dangers of micro-organisms / 'germs'</p> <p>Understand similarities and differences between animals according to their habitats</p> <p>Identify different types of plants and their parts</p> <p>Use the sense organs to explore our world and distinguish between substances</p> | <p>Appreciate the importance of food, exercise, washing clothes, sleep and rest for a healthy life</p> <p>Classify animals and plants according to their habitat.</p> <p>Distinguish between fruits and seeds and state their uses</p> <p>Identify objects, symbols and gestures using the five senses</p> <p>Investigate living things found in water</p> | <p>Care for and appreciate the importance of a clean environment</p> <p>Group animals according to their eating habits, food chains</p> <p>Appreciate the importance of conservation of animals and plants</p> <p>Understand the structure of a seed and the process of seed germination</p> |
| Materials and their properties | <p>Recognise sources of water and its uses, measurement of quantities of water</p> <p>Know basic weather conditions</p> <p>Appreciate the presence of air and its movement in air currents / wind</p> <p>Perform simple activities using soil / sand <i>eg sieving, moulding, mixing</i></p> | <p>Explain importance of clean water, and methods of making water clean and safe</p> <p>Understand how animals and humans respond to different weather conditions</p> <p>Understand importance of air in daily life</p> <p>Investigate structure / composition of soil</p> | <p>Investigate water, solubility, and the ways of conserving water</p> <p>Understand changes in the weather and record the changes</p> <p>Understand the concept of air pressure, pressure differences and wind</p> <p>Identify types, formation and uses of soil</p> | <p>Investigate physical properties of water and what happens to water under different conditions</p> <p>Further investigate and understand why certain objects float and others sink in water</p> <p>Understand the concept of matter</p> <p>Simple methods of separating materials <i>eg sieving, winnowing, dissolving, use of magnetism</i></p> |
| Physical processes | <p>Understand sources of light & sound in the environment</p> <p>Understand use of simple machines like wheels</p> <p>Investigate which objects float and sink in water</p> | <p>Understand the concept of shadow</p> <p>Produce sound using local materials and produce sounds of different pitches & understand echoes</p> <p>Construct and use simple rollers to make work easier</p> | <p>Understand concept of image formation</p> <p>Identify sounds produced by different objects, changing volume and pitch;</p> <p>Investigate air pressure as a force</p> <p>Construct and use levers to make work easier</p> | <p>Investigate how light travels and its uses</p> <p>Describe the shape of the earth and discuss the concept of gravity</p> <p>Explore the sources of heat and its uses</p> <p>State sources of electricity and carry out simple activities with electricity and magnetism</p> <p>Construct and make use of simple machines (pulley and inclined plane)</p> |

| | P5 | P6 | P7 | P8 |
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| Living things and life processes | <p>Understand the relationship between germs and sanitation</p> <p>Know about common human parasites, how they are spread and controlled</p> <p>Understand a healthy lifestyle and the concept of health hazards, common drugs and their types</p> <p>Understand the internal structures of sense organs (eye and ear) and their uses</p> | <p>Explain the causes of drug abuse and its impacts on life</p> <p>Understand the nature of changes occurring in humans at puberty, (<i>sexual relationships, sexual intercourse, conception, pregnancy, childbirth, contraception</i>)</p> <p>Understand the levels of organisation of living things: cells, tissues, organs, systems</p> <p>Know the food types and understand the importance of a balanced diet</p> <p>Understand structures of plants and their functions</p> | <p>Explain structures and functions of human excretory and circulatory system.</p> <p>Explain how reproduction takes place in flowering plants</p> <p>Name some common water and air-borne diseases, describe their causes, effects and prevention; stress and depression; home nursing</p> <p>Explain the structures and functions of human digestive and respiratory systems</p> <p>Understand hygienic food preparation techniques; nutrition needs for good health and for special groups</p> | <p>Apply knowledge of hygiene and disease to personal and home sanitation, food preservation</p> <p>Explain how reproduction takes place in mammals and birds</p> <p>Describe effective pre- and post-natal care in humans</p> <p>Understand processes of respiration and photosynthesis, and describe the differences between plants and animals, explain inter-dependency between plants and animals</p> <p>Understand the structure and function of the nervous system.</p> |
| Materials and their properties | <p>Describe the importance and uses of water in agriculture</p> <p>Appreciate the importance of minerals and manure in agriculture</p> <p>Construct and use simple weather instruments</p> <p>Understand the concept and causes of wind and uses of wind energy</p> <p>Describe and explain the behaviour of materials under different temperatures</p> | <p>Describe water cycle and understand the effects of weather on human activities</p> <p>Describe the components of air and their properties and understand that air supports burning</p> <p>Explain properties of metals and non-metals</p> <p>Explain the states of matter and changes of state, and understand concepts of atoms, elements, mixtures and compounds.</p> <p>Understand the concepts of mass flow and diffusion</p> | <p>Outline the sources of water, methods of collection & purification; pollution and its impact</p> <p>Understand humidity and how to measure it</p> <p>Recognise difference between mass and weight and their measurement</p> <p>Explain the term 'chemical reaction' and describe how reactions involve energy changes</p> | <p>Explain the environmental concern about water and describe conservation strategies</p> <p>Differentiate between weather and climate; describe their effects on land use and human populations</p> <p>Explain the relationship between temperature, pressure and volume of air, the concept of a vacuum</p> <p>Describe common properties and uses of acids and bases: the uses of indicators</p> |
| Physical processes | <p>Differentiate between transparent, translucent and opaque objects</p> <p>Understand the nature of sound and its uses</p> <p>Understand rotation of earth and day night</p> <p>Describe simple common tools and their classifications as machines e.g. first class, second etc</p> | <p>Understand concepts of reflection and refraction of light</p> <p>Understand how light and sound travel through different media</p> <p>Understand earth and space in relation to solar system; explain seasons</p> <p>Understand concept of heat and how it is measured</p> | <p>Understand forces and the different types of forces and units for measuring force</p> <p>Identify different forms of energy, describe energy transformations</p> <p>Describe components of solar system, orbits of planets and moons</p> <p>Understand the use gears, and multiple pulleys in making work easier</p> | <p>Understand parallel between human eye and pin-hole camera</p> <p>Understand how sound is produced and how human ear perceives it</p> <p>Explain concept of constellations, galaxies, the universe</p> <p>Describe how heat is conserved</p> <p>Explain how magnets can be made from electricity and the applications of electro-magnetism</p> |

| | S1 | S2 |
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| Biology | <p>Appreciate the diversity of living things</p> <p>Understand cell structure, organization and function</p> <p>Describe movement of substances across cells</p> <p>Understand the diversity of cell types and their organization into tissues and organs</p> | <p>Describe how organisms interact with their environment</p> <p>Understand photosynthesis and plant nutrition; the importance of photosynthesis to all living things</p> <p>Understand nutrition in animals</p> <p>Outline the impact of climate change on populations of animals and plants</p> <p>Understand the processes of transport, respiration, gaseous exchange, excretion and homeostasis in animals and plants</p> |
| Chemistry | <p>Name common laboratory apparatus and understand safety rules in laboratory</p> <p>Explain techniques of separating mixtures and compounds (link the concepts of separation to industry, especially crude oil)</p> <p>Understand particulate nature of matter, formulae and chemical equations</p> <p>Explain the properties and uses of acids, bases, indicators and salts</p> <p>Understand redox reactions</p> | <p>Describe the composition of the atmosphere</p> <p>Investigate the properties of common gases</p> <p>Understand simple atomic structure, the periodic table and bonding</p> <p>Understand how salts are formed</p> <p>Explain how and why electrolysis can be used to separate some salts</p> <p>Understand carbon, its atomic structure and compounds</p> |
| Physics | <p>Understand measurement, states of matter and types of forces</p> <p>Understand the effects of temperature changes on matter</p> <p>Explain the behavior of light on plane surfaces</p> <p>Understand the concept of static electricity and the flow of electricity around circuits</p> | <p>Explain the effects of forces and the concepts of work, energy and power</p> <p>Define machines and explain the dynamics of objects</p> <p>Understand the nature of heat and describe its effects on matter</p> <p>Explain the behavior of light at curved surfaces</p> <p>Understand and explain the motion, types and properties of waves</p> <p>Describe the theory of magnetism and explain the properties of magnets</p> |

| | S3 | S4 |
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| Biology | <ul style="list-style-type: none"> Understand the variety, classification and the interdependence of living things Detail the impact of humans on the natural environment and conservation Explain biodiversity, habitat, ecosystems, populations and the impact of climate change Explain the role of pathogens in causing disease Understand exchange between organisms and the environment Explain the structure and function of the digestive, respiratory and circulatory systems | <ul style="list-style-type: none"> Compare and contrast the biochemistry of respiration and photosynthesis Detail the processes of reproduction, growth and development in plants Detail the processes of reproduction, growth and development in animals Understand how coordination takes place in plants and animals Describe the role and operation of homeostasis in animals and plants Understand how support is provided and movement takes place in plants and animals Understand basic genetics and inheritance; modern uses of knowledge of genetics Describe how organisms are adapted to their environment, selection, evolution and evidence for it |
| Chemistry | <ul style="list-style-type: none"> Understand volumetric analysis and identification of gases Understand the mole concept and be able to apply the gas laws Write balanced equations, full and ionic Explain the properties of elements in Period 3 and Groups 2 and 7 of the periodic table including sulphur, chlorine, nitrogen and their compounds Explain the properties of the transition metals Further explain the properties of acids, bases and salts, understand the properties of amphoteric oxides and hydroxides Explain the hardness of water and the solubility of salts in water | <ul style="list-style-type: none"> Describe how to identify ions and gases Understand and explain energy changes in chemical reactions Explain kinetics, rates of reactions, equilibria, redox reactions and electro-chemistry Name and know the composition of ores of some common metals and appropriate methods of extraction Describe analytical techniques and methods of determination of structure Understand organic chemistry, including isomerism, fractional distillation and cracking of alkanes, chloroalkanes, alkenes, alcohols, carbonyl group compounds, aromatic chemistry, amines, amino acids, polymers, synthesis and analysis Introduction to nuclear chemistry |
| Physics | <ul style="list-style-type: none"> Use understanding of particles to explain radiation, electromagnetic radiation and quantum phenomena Understand the nature of electrostatic and current electricity and their applications including electronics Understand mechanics, motion and laws of linear motion Explain the bulk properties of solids and fluids and their applications Understand gas laws; explain the relationship between pressure, volume, temperature and mass of a gas Understand thermal physics, heat capacity of a substance, carry out energy calculations | <ul style="list-style-type: none"> Use understanding of waves to explain refraction, wave interaction, interference and diffraction Understand momentum, circular and harmonic motion Understand Newton's Law of Gravitation, and the orbits of planets and satellites Explain electric fields, capacitance, magnetic fields and electromagnetic induction Explain cathode rays and the structure and function of cathode ray tubes Use knowledge of nuclear physics to explain radioactivity and its use in providing nuclear energy |