

## Layer Two – An elaboration of the Layer One summary content map in Natural Sciences Grades 4-9, with links to FET Life Sciences and Physical Sciences in Grade 10 onward

Similar versions for Agricultural Sciences and Geography follow on pages 14 and 20

Sections	Page
<b>Life and Living</b> .....	2
<b>Planet Earth and Beyond</b> .....	7
<b>Matter and Materials</b> .....	10
<b>Energy and Change</b> .....	12
<b>Life and living matched to Agricultural Science Grade 10</b> ..	14
<b>Planet Earth and Beyond matched to Geography Grade 10</b> .	20

### Notes

- 1** The topics have been created to ensure coverage of all parts of the Core Knowledge section of the NCS. The Foundation Phase science content is integrated into Life Skills in Grades R to 3, but it has also been taken up in this document in the Grade 4 topics so that it is reinforced as the learners begin Natural Sciences.
- 2** The NCS unifying statements in the boxes in Layer One no longer appear because their underlined concepts are addressed in Layer Two and Three.
- 3 Progression** from Grade to Grade is from left to right, and **conceptual linkages** within a Grade go down a column. Within a Grade, curriculum developers can combine and sequence concepts

to create new learning sequences. For example, Topic 7.2 can be started before Topic 7.1, so that learners see the need to simplify the great diversity of living things they find. Mining and minerals extraction (Topic 9.5) can be started before chemistry (Topic 9.7) to provide a reason for learning the chemistry.

**4 Layer Three** provides extra detail about concepts in the topics that were created from the core knowledge section of the NCS, reasons for their allocation to the Grade, research on learning and examples of suitable activities.

**5 The Grade 10 and 11 columns** in this Layer show only representative sections of the Learning Area statements: the full list cannot be treated in a table like this.

**6** The concepts listed here should suggest ideas to curriculum developers, who will invent activities that excite learners' minds, invite them to use process skills and let them show evidence of their abilities in the outcomes. The Map should never be seen as a catalogue of "facts to be covered".

**7 A note about the terms "humans" and "animals":** Scientists generally view humans as animals from a physiological point of view. However, we teach science in a context where most citizens make a clear distinction between humans and animals, and if school teachers talk of a person as "an animal" it usually creates confusion in learners' minds. For that reason this document uses the term "humans", as distinct from "animals".

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
The three rows below cover the <b>Life and Living strand</b> .							
<p><b><u>4.1 Living things that share the world with us</u></b></p> <p>The emphasis must be on activities that use process skills like observing differences, sorting and classifying, describing, drawing.</p> <ul style="list-style-type: none"> <li>• Variety of plants; visible differences between them.</li> <li>• Variety of animals and visible differences between them. Differences in behaviours of some familiar animals</li> <li>• Existence of fossils, as signs that other kinds of plants or animals lived in SA long ago.</li> </ul>	[Remember that other topics can be done under the local options provision in the NCS]	[Remember that other topics can be done under the local options provision in the NCS]	<p><b><u>7.1 Simplifying the great variety of living things on Earth</u></b></p> <ul style="list-style-type: none"> <li>• Classifications of animals as vertebrates (animals with backbones) and invertebrates (animals with no backbones).</li> <li>• The vertebrates are classified into fish, amphibians, reptiles, birds and mammals.</li> <li>• The invertebrates have no backbone but an exoskeleton instead. Include insects, spiders and crabs.</li> <li>• The fossil record gives evidence for different animals and plants long ago, in particular parts of SA. (Link with topic <a href="#">7.4 Structure of changing Earth</a>, below)</li> <li>• Classification of plants as seed plants and plants without seeds.</li> <li>• Seed plants are further classified as angiosperms (seeds in ovaries) and gymnosperms (seeds not in ovaries). Angiosperms are further classified into monocotyledons and dicotyledons.</li> <li>• Plants without seeds are classified into algae and ferns.</li> <li>• Functions of flowers, sexual parts of flower, pollen and seed. Agents of pollination.</li> <li>• Vegetative reproduction</li> </ul>		<p><b><u>9.1 The microscopic world of living things</u></b></p> <ul style="list-style-type: none"> <li>• The existence of micro-organisms. There is a great variety of them and they generally live in great numbers but are too small to see with the naked eye.</li> <li>• Micro-organisms have life processes, such as reproduction, respiration, etc.</li> <li>• Their life processes are crucial to other processes of life on Earth, such as maintaining the fertility of the soil, the purification of water or humans' digestion of food.</li> <li>• Micro-organisms reproduce very much more quickly than larger organisms.</li> <li>• Micro-organisms may also be harmful to plants, animals and humans, and cause disease.</li> <li>• Medical drugs can be used against some micro-organisms. However, micro-organisms show variation and so natural selection occurs in micro-organisms. (Link back to adaptation in topic <a href="#">8.2 Natural selection and adaptation</a>)</li> </ul>	<p><b><u>Enormous biodiversity on Earth at present,</u></b></p> <p>emphasizing the extent of biodiversity and endemism in southern Africa</p> <p><b><u>Classification schemes</u></b> as a way of organizing biodiversity.</p> <p><b><u>Main groupings of living organisms</u></b> are bacteria, protists, fungi, plants and animals . . .</p> <p><b><u>Plants:</u></b> Multicellular terrestrial organisms; cells have cell walls; obtain energy through photosynthesis</p> <p><b><u>Animals:</u></b> Multicellular aquatic and terrestrial organisms; cells have no cell walls; feed on other organisms.</p> <p><b><u>History of life on Earth</u></b></p> <p>Fossil formation and methods of dating e.g. radiometric dating and relative dating.</p> <p>Life's history: different representations of life's history and its relationship to climatic change</p> <p>Mass extinctions –</p> <p>Life-forms have gradually become more similar to present life-forms, . . .</p>	<p><b><u>Viruses, bacteria, protists and fungi</u></b></p> <p>viruses – e.g. rabies, HIV/AIDS, influenza</p> <p>bacteria – e.g. blight, cholera, tuberculosis, anthrax</p> <p>protists- e.g. malaria</p> <p>fungi – e.g. rusts, thrush, ringworm</p> <p><b><u>Plant and animal diversity in South Africa</u></b></p> <p><b><u>Plant diversity</u></b></p> <p><b><u>Animal diversity</u></b></p> <p><b><u>Biogeography</u></b></p> <p>Diversity exists within continents, but is even more striking on different landmasses and islands.</p>

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
<p><b><u>4.2 How plants and animals live, and the places where they live</u></b></p> <ul style="list-style-type: none"> <li>Plants make their own food using sunlight, water and the air.</li> <li>Some animals eat plants, some animals eat plant-eating animals, and some animals eat both plants and other animals.</li> <li>Habitats for animals (= places where they can survive) to feed, get water, shelter/escape and reproduce</li> <li>Dependence of animals and humans on plants; simple food chains.</li> <li>Dependence of plants, animals and humans on water.</li> </ul>	<p><b><u>5.1 How living things depend on their environment</u></b></p> <ul style="list-style-type: none"> <li>Animals depend on the soil, plants and other animals in their environment, for food, shelter and places to breed.</li> <li>Animals cannot make their own food, and so some animals eat plants for food while some animals eat other animals. All animals ultimately depend on green plants for their food which gives them energy.</li> <li>Plants make their own food, but plants depend on air, on the soil for water and anchorage for their roots, and on the Sun for energy to help the leaves make the food.</li> <li>Soil forms from broken-down (= weathered) rock and the remains of living organisms. (Refer back to topic <u>4.3 Rocks of the Earth</u>)</li> <li>Soil types are clay, sandy soil and loam.</li> <li>A habitat for each kind of living thing is the kind of place where it can find or make food, find shelter and reproduce.</li> </ul>	<p><b><u>6.1 Environments and water resources</u></b></p> <ul style="list-style-type: none"> <li>The functions of water in ecosystems for plant and animal life and biodiversity.</li> <li>Wetlands as habitats for many animals and as sponges that regulate the flow of water.</li> <li>Groundwater and wetlands as resources for humans.</li> <li>Catchment areas and factors in catchment areas that affect the quality of water.</li> <li>Protecting catchment areas. Ground water: boreholes, springs. Protecting springs against pollution.</li> <li>Water supply systems and sewerage systems - how they work. Emphasis on how to avoid damage to water supply and sewerage systems</li> <li>Ways of storing water and cleaning it (simple filtration, use of chlorine).</li> <li>Electricity generation uses vast amounts of water, and so saving electricity means saving water (Link with topic <u>6.8 Energy from electricity</u>)</li> </ul>	<p><b><u>7.2 Description of the living and non-living things in a small environment</u></b></p> <p>This section of the Grade 7 curriculum is an investigation of some part of the local environment, and the activity will be determined by the resources available to the teacher. However the following concepts should be part of the discussion and reporting:</p> <ul style="list-style-type: none"> <li>Habitat, and the living and non-living components of the habitat</li> <li>Reproduction of any of the living things in the habitat</li> <li>Food chain, food web, producer, consumer</li> <li>Remains of dead plants and animals, cyclic processes that return nutrients to the soil</li> <li>Interdependence of plants and animals.</li> </ul> <p>Learners should also be able to use the classifications of plant and animal to describe specimens they observe.</p>	<p><b><u>8.1 Interdependence in ecosystems</u></b></p> <ul style="list-style-type: none"> <li>Biotic factors in ecosystems: (the effects of all living parts) and abiotic factors (effects of soil, water, air, light/shade, warmth/cold)</li> <li>Sun provides the energy for life. Photosynthesis in green plants produces food.</li> <li>Plants as producers and other organisms as consumers. Food chains and food webs.</li> <li>Herbivores, carnivores and omnivores. Predators and prey.</li> <li>Respiration releases the energy in food.</li> <li>Examples of basic energy flows in an ecosystem. Food chains and food webs.</li> <li>Soil types and their characteristics. Role of decomposers and micro-organisms in maintaining the fertility of the soil</li> <li>Concept of survival in ecosystems.</li> <li>Adaptations of organisms that help them to survive in their habitat.</li> <li>Interdependence. A change to any part of an ecosystem affects all the other parts.</li> <li>Human impacts on ecosystems as people seek resources for their own use.</li> <li>Value of ecosystems in cultural, spiritual, recreational and economic terms</li> </ul>		<p><b><u>Biosphere to ecosystems</u></b></p> <p><b>Biosphere</b></p> <p>Concept of the biosphere. Inter-connectedness of components of global ecosystem.</p> <p><b>Biomes</b></p> <p>Terrestrial and aquatic biomes of southern Africa: describe in terms of climate, soils and vegetation</p> <p><b>Ecosystems</b></p> <p>Theoretical understanding of ecosystems.</p> <p>Abiotic and biotic factors: effects on community structure and ecosystem function</p> <p>Energy flow through ecosystems and relationship to trophic structure</p> <p><b>Trophic levels:</b> producers, consumers (herbivores and carnivores), decomposers</p> <p>Food chains, food webs and food pyramids</p> <p>Nutrient cycles: water, oxygen, carbon and nitrogen</p>	<p><b><u>Human influences on the environment</u></b></p> <p>Local, national and global issues:</p> <ul style="list-style-type: none"> <li>ozone depletion</li> <li>greenhouse effect and its importance for sustaining life on earth; enhanced greenhouse effect leading to global warming</li> <li>desertification, deforestation</li> <li>effects of overgrazing, crops and commercial forests on biodiversity.</li> <li>Deposits of poisonous substances in rivers and the water table.</li> </ul>

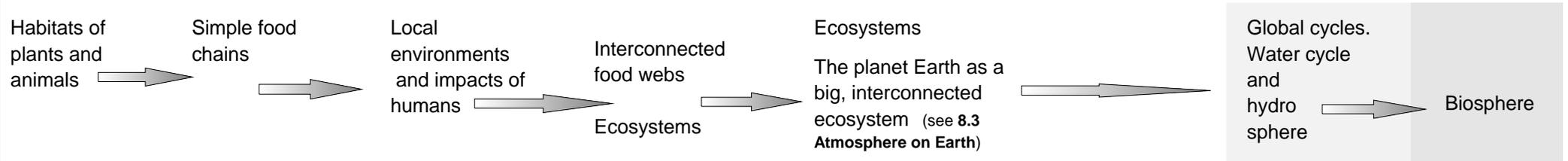
Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
				<p><b><u>8.2 Natural selection and adaptation</u></b></p> <ul style="list-style-type: none"> <li>• Populations in an ecosystem</li> <li>• Factors that affect a population, e.g. Predation, abundance of food, drought, climate change, disease.</li> <li>• Variation in a population as the random small differences between individuals.</li> <li>• Natural selection, as an explanation of how a population changes to adapt to their habitat (Looks forward to Topic 9.1 on adaptation in micro-organisms).</li> <li>• Extinctions, natural and man-made.</li> </ul>			
	<p><b><u>5.2 Plant and animal reproduction</u></b></p> <ul style="list-style-type: none"> <li>• Plant reproduction from seeds. Plant growth and life cycle.</li> <li>• Vegetative reproduction. Its importance for agriculture because daughter plants are all the same.</li> <li>• Importance of indigenous plants for medicinal and other uses; need to conserve them and their habitats.</li> <li>• Reproduction in birds, fish, reptiles, amphibians, mammals.</li> <li>• Habitats that are needed by some of the animals above and the protection afforded to breeding animals by habitats; the impact of loss of habitat.</li> <li>• Social organisation of animals and patterns of behaviour. For example, being solitary, pairing for life, or living in packs, prides, herds, troops</li> </ul>	<p><b><u>6.2 Nutrition and digestion</u></b></p> <ul style="list-style-type: none"> <li>• Balanced diets. Simple classification of food types as protective foods, foods for growth and repair, and foods for energy.</li> <li>• Food must have enough micro-nutrients, i.e. vitamins, trace elements.</li> <li>• Examples of balanced diets from different cultures. Proportions of food types needed for health..</li> <li>• Emphasise foods which boost the human immune system and are valuable for people with HIV.</li> <li>• Digestive system in simple terms; its function as the breaking down of food into a solution which can pass through the wall of the intestine into the blood.</li> </ul>	<p><b><u>7.3 Changes that happen to young people in puberty; understanding sexuality and human reproduction</u></b></p> <ul style="list-style-type: none"> <li>• Physical growth and changes that are triggered by changing body chemistry from about age 11 (girls) and 13 (boys).</li> <li>• The range of normal physical development, and the range of ages for normal development</li> <li>• The psychological changes that come with puberty.</li> <li>• Variation in the human race, such as skin colour, hair, etc; The fallacy of using physical characteristics to judge people's intelligence or worth.</li> <li>• Menstruation, fertile stages of the cycle. Sexual intercourse, conception.</li> </ul>		<p><b><u>9.2 Cells as the basic units of life</u></b></p> <ul style="list-style-type: none"> <li>• All living things carry out their life processes such as growth, repair, reproduction etc. by means of the activity in cells.</li> <li>• Cells are extremely small (but much bigger than molecules).</li> <li>• Cells carry out nutrition, repair, respiration, excretion, etc. They die and are replaced.</li> <li>• Cells have a wall or membrane that allows some substances through and blocks other substances.</li> <li>• Cells are specialised to the function they perform in the larger organism.</li> </ul>	<p><b><u>Life at the molecular, cellular and tissue level:</u></b></p> <p>Cells, the basic unit of life Cell division - mitosis Plant and animal tissues Organs Chemistry of life</p>	<p><b><u>Viruses, bacteria, protists and fungi</u></b></p> <p>viruses – e.g. rabies, HIV/AIDS, influenza bacteria – e.g. blight, cholera, tuberculosis, anthrax protists- e.g. malaria fungi – e.g. rusts, thrush, ringworm</p>

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
	<p>or colonies. (Link with reproduction and care for the young)</p>	<p><b><u>6.3 Plants' and animals' responses to their environment</u></b></p> <ul style="list-style-type: none"> <li>• Living things can respond to changes in their environment. Examples of response to stimuli by plants and animals.</li> <li>• Humans and animals have senses of hearing, vision, taste, smell, touch. (Structure of the sense organs only so far as needed to understand how they receive stimuli from the environment.)</li> </ul> <p><b><u>6.4 How animals and humans move themselves</u></b></p> <ul style="list-style-type: none"> <li>• Humans and animals are able to move their body parts and move themselves from place to place because they have a skeleton and muscles to move the parts of that skeleton.</li> <li>• Muscles can only shorten (contract) pull on bones, they cannot push.</li> <li>• In humans and some animals, skeletons are inside the body (these are called endoskeletons) and in other animals the skeletons are outside, with the muscles inside (exoskeletons).</li> </ul>	<ul style="list-style-type: none"> <li>• Pregnancy and factors that affect the health of the unborn baby. Birth.</li> <li>• Myths about avoiding pregnancy.</li> <li>• Contraception: a few methods and their relative effectiveness.</li> <li>• Sexually Transmitted Diseases (S.T.D.s) including AIDS.</li> </ul>		<p><b><u>9.3 Life processes and systems of humans</u></b></p> <ul style="list-style-type: none"> <li>• Human life processes and body systems (treated as health education rather than physiology).</li> </ul> <p>Digestion, circulation, respiration, excretion. Movement and locomotion. Sensing and response in the nervous system. Reproduction.</p> <ul style="list-style-type: none"> <li>• Link life processes to relevant systems and organs. Structures of systems as far as they are required to understand how the life processes are carried out. Refer back to topic <b><u>8.8 Light</u></b> to reinforce the structure and functioning of the eye.</li> <li>• These body systems are interdependent and work together as one complex system.</li> <li>• How to recognise certain conditions e.g. dehydration, diabetes.</li> <li>• Components of a balanced diet and the long-term effects of diet.</li> <li>• Exercise, drugs, alcohol and other life-style choices that have a long-term affect on health.</li> <li>• Occupational health and safety, related to body systems and life processes.</li> </ul> <p><b><u>9.4 Pregnancy, birth, parenting and adult sexuality</u></b></p> <ul style="list-style-type: none"> <li>• Review and extend Grade 7 concepts. Physical and psychological changes in boys and girls at puberty</li> </ul>	<p><b><u>Energy trans-formations that sustain life</u></b></p> <p>photosynthesis cellular respiration aerobic and anaerobic respiration</p> <p><b><u>Animal nutrition</u></b></p> <p>Balanced diet digestion and absorption assimilation</p> <p><b><u>Gaseous exchange</u></b></p> <p>Gaseous exchange organs Human gaseous exchange</p>	<p><b><u>Support and transport in plants</u></b></p> <p><b><u>Supporting systems and movement in animals</u></b></p> <p><b><u>Transport in animals</u></b></p> <p><b><u>Excretion</u></b></p>

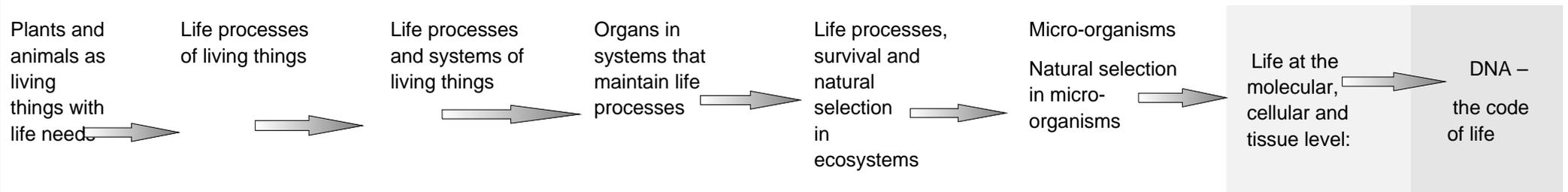
Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 ...
					<ul style="list-style-type: none"> <li>• Menstrual cycle, fertile stages.</li> <li>• Sexual intercourse, conception, pregnancy, birth.</li> <li>• Contraception</li> <li>• Myths about sex</li> <li>• Sexually transmitted diseases.</li> <li>• Application of life-processes knowledge to parenting and child-care.</li> <li>• Basic physical and psychological needs of babies and young children; responsibility of parents / care-givers for young children.</li> </ul>		

The development of some major ideas in Life and Living, across the Phases ... (The sequence corresponds *approximately* to Grades)

**Beginning from the local scale and developing ideas up to planetary scale**



**Beginning from the macro-scale and developing ideas down to the micro-scale ... (The sequence corresponds *approximately* to Grades)**



Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
<p>The three rows below cover the <b>Planet Earth and Beyond</b> strand</p>							
<p>In Grade 4, learners work on topic <u>4.3 Rocks of the Earth</u>) and there they can link wind and moving water to erosion and deposition.</p>	<p><b><u>5.3 Atmosphere and weather</u></b></p> <ul style="list-style-type: none"> <li>• Wind as moving air. Air as a substance that exists even when the wind is not blowing</li> <li>• Directions of the winds defined in terms of east, west, north and south</li> <li>• A few different kinds of clouds, and their relationship to weather conditions.</li> <li>• Height of water in a container as a measure of rainfall.</li> <li>• Water changes its state with temperature changes – liquid, solid ice and water-vapour.</li> <li>• Evaporation and ways to slow down evaporation or speed it up</li> <li>• Water-vapour in air can condense from the gas state and form drops of liquid</li> <li>• A “cycle” as a series of events that occur again and again. The water cycle - various examples of it.</li> <li>• Seasons as a predictable annual change in weather patterns,</li> <li>• Air temperatures</li> <li>• The equatorial region and the polar regions on the Earth</li> <li>• Limits of land and drinkable water</li> </ul>	<p>In Grade 6, learners work on the strand <i>The Earth in Space</i> under the topic <u>6.5 Simple astronomy</u>. Teachers can add activities which relate to the atmosphere (e.g. the protective layer over the Earth which burns up fast-moving objects arriving from above the atmosphere).</p>	<p>In Grade 7, learners may produce outcomes using concepts of atmosphere and weather when they work on the topic, <u>7.4 The Structure of the changing Earth</u></p>	<p><b><u>8.3 The atmosphere on Earth</u></b></p> <ul style="list-style-type: none"> <li>• The atmosphere is all the air around the planet</li> <li>• The composition of the atmosphere</li> <li>• The Earth’s atmosphere protects living things against harmful radiation from the Sun</li> <li>• The greenhouse effect</li> <li>• The “enhanced greenhouse effect” and global warming.</li> <li>• The climate is different in different parts of the world because sunshine is more intense towards the equator and more spread out towards the poles.</li> <li>• Plants and animals have adapted to these varying climates, and are distinctly different in the different regions of the world</li> </ul>		<p><b><u>Global cycles:</u></b></p> <p><b><u>The water cycle</u></b></p> <ul style="list-style-type: none"> <li>• Physical changes and energy transfers:</li> <li>• Movement of water from ocean and land surfaces, controlled by energy in sunlight. Reservoirs for water on Earth.</li> <li>• Macroscopic properties of the three phases of water related to their microscopic structure</li> </ul> <p><b><u>The nitrogen cycle</u></b></p> <p>. . . The movement of nitrogen between interrelated biological and geological systems. Industrial fixation of nitrogen</p> <p><b><u>The Hydrosphere</u></b></p> <ul style="list-style-type: none"> <li>• Identify the different reservoirs of water on Earth</li> <li>• Explain how sunlight drives the movement of water in the water cycle to set up weather systems in the atmosphere</li> <li>• List the importance of the water cycle for life on Earth</li> </ul>	<p><b><u>The atmosphere</u></b></p> <ul style="list-style-type: none"> <li>• Atmospheric chemistry;</li> <li>• Global warming and the environmental impact of population growth.</li> </ul>

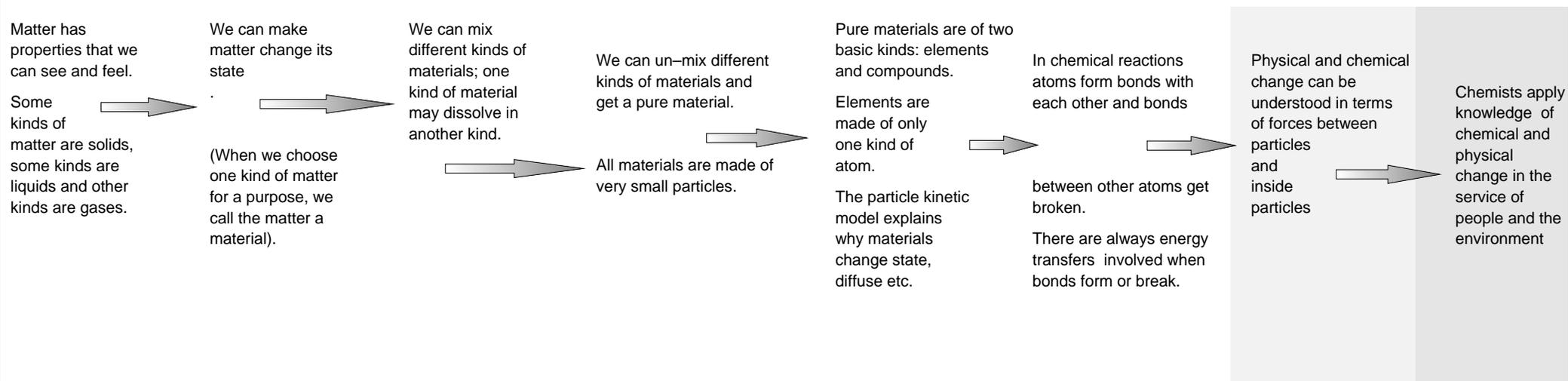
Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
<p><b><u>4.3 The rocks of Earth</u></b></p> <p>In this topic learners will produce <b>descriptions and collections</b> rather than explanations.</p> <ul style="list-style-type: none"> <li>• Below the surface we stand on, there is a great depth of rock.</li> <li>• Earth is hot, deep down.</li> <li>• Igneous rocks formed as hot molten rock cooled and hardened. (granite is only required example).</li> <li>• Weathering of rocks' surfaces. (Make the link with soil - broken-up rock becomes soil. See topic 5.1)</li> <li>• Erosion of rock particles</li> <li>• Deposition of rock particles</li> <li>• Sediment (Layer of particles) .</li> <li>• Sedimentary rock. Hardening of the sediment to form sedimentary rock.</li> <li>• Some sedimentary rocks contain fossils. Fossils tell us that other kinds of animals and plants lived in South Africa very long ago.</li> <li>• Sedimentary rock can be changed to metamorphic rock. (Mention. Only required example is shale changed to slate.)</li> </ul>	<p>[ In Grade 5, learners should relate weathering of rock, soil formation and erosion of soil to the <i>Life and Living</i> topics ]</p>		<p><b><u>7.4 The structure of the changing Earth</u></b></p> <ul style="list-style-type: none"> <li>• Earth is ball-shaped. Gravity force and the meaning of “up” and “down”..</li> <li>• The planet Earth has a geosphere made up of the hot metallic core, hot, convecting mantle and rocky crust called the lithosphere.</li> <li>• The hydrosphere and the atmosphere, The biosphere is all living things that interact with the hydrosphere and atmosphere.</li> <li>• The Sun is the main source of energy for life in the biosphere and change in the atmosphere, hydrosphere and lithosphere.</li> <li>• Plate tectonics is the concept that the crust of the planet is made of plates that are moving.</li> <li>• The hot core is the main source of the Earth's internal energy that causes the movements of plates,</li> <li>• Earthquakes, volcanoes, faulting, folding and uplift.</li> <li>• earthquakes as an effect of potential energy in plate boundaries</li> <li>• volcanoes in simple terms as an effect of disturbance along the plate boundaries plus the heat of the Earth interior melting rock in the mantle</li> <li>• long-term forces are changing the surface of the Earth, all acting at the same time.</li> <li>• Deep time: the Earth is very old.</li> <li>• Geomagnetism and the use of a magnetic compass.</li> </ul>		<p><b><u>9.5 Minerals and mining in South Africa</u></b></p> <ul style="list-style-type: none"> <li>• Review the structure of the Earth; movement in the crust and resulting magma</li> <li>• Volcanoes and magma intrusions, as well as sedimentation processes, have concentrated minerals in certain places</li> <li>• “Deep time” and the great age of mineral deposits in South Africa</li> <li>• Origins of deposits of coal in SA; origins of diamonds and minerals of the Bushveld Igneous Complex</li> <li>• Ores as concentrations of the compounds in rock, that contain the valuable metal.</li> <li>• Oxides and reactions of metals with oxygen (Link with chemical reactions in topic 9.7)</li> <li>• Methods of extracting metals from ores – simulations in lessons</li> <li>• Indigenous technologies for extraction of metals</li> <li>• The environmental impacts of mining. The existence of laws to control these impacts.</li> </ul> <p>It is possible to use this topic as a project in which learners apply knowledge of chemical reactions done in <u>9.7 Some important chemical reactions</u></p>	<p><b><u>Chemical systems</u></b></p> <p>The impact of science on human development and environment</p>	<p><b><u>Exploiting the lithosphere, Earth's crust</u></b></p> <ul style="list-style-type: none"> <li>• Mining and mineral processing – gold, iron, phosphate, (South Africa's strengths); environmental impact of these activities;</li> <li>• Energy resources and their use</li> </ul>

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
<p>[Remember that other topics can be done in Grade 4 under the local options provision in the NCS]</p>	<p>[Remember that other topics can be done in Grade 5 under the local options provision in the NCS]</p>	<p><b><u>6.5 Simple astronomy</u></b></p> <ul style="list-style-type: none"> <li>• The planet as a rocky ball in limitless space</li> <li>• The “down” direction and gravity</li> <li>• The Earth spins (rotates) on its axis</li> <li>• The Sun and stars only appear to move across the sky; in fact the Earth is spinning.</li> <li>• Day and night occur because each part of the Earth moves into shadow and then into sunlight</li> <li>• The time is different in different parts of the Earth that lie on an East-West line.</li> <li>• Horizon as the limit of what we see on the curve</li> <li>• N-S-E-W directions inside and outside the classroom, in terms of sunrise and sunset, and related to a globe model of the Earth</li> <li>• Objects in the sky shine for different reasons.</li> <li>• The Moon’s apparent shape changes during its cycle</li> <li>• People use the Moon, stars or star patterns for navigation or to mark a culturally significant event such as planting time or religious festival.</li> </ul>	<p>[Remember that other topics can be done in Grade 7 under the local options provision in the NCS]</p>	<p><b><u>8.4 Exploring beyond Planet Earth</u></b></p> <ul style="list-style-type: none"> <li>• Planet Earth as a rocky ball in limitless space</li> <li>• gravity as the force that acts towards the centre of the Earth and defines “up” and “down” directions</li> <li>• Objects in the sky</li> <li>• The solar system, with Sun (a star) holding planets and other bodies going around in orbits around the Sun.</li> <li>• Earth is the only place in the solar system where life as we know it can exist</li> <li>• Earth’s Moon and its phases</li> <li>• Eclipses of Sun and Moon occur when the Moon passes between the Earth and Sun, or the Earth passes between the Sun and Moon</li> <li>• Exploration of the solar system by robotic craft and manned craft.</li> <li>• Southern African Large Telescope and exploration of universe by telescopes</li> </ul>		<p><b><u>Gravity and mechanical energy</u></b></p> <ul style="list-style-type: none"> <li>• Weight (force exerted by the Earth on an object);</li> <li>• Acceleration due to gravity (acceleration resulting from the force exerted by the Earth);</li> <li>• Gravitational potential energy;</li> </ul> <p>[ Note that the Earth in Space is not followed through in FET, except for a mention of SALT in relation to lenses and geometrical optics. This means that GET is the learners’ only opportunity to learn this knowledge ]</p>	

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
<p>The row below covers the GET strand <b>Matter and Materials</b>, with many links to <b>Energy and Change</b></p>							
<p><b><u>4.4 Choosing and changing materials</u></b></p> <ul style="list-style-type: none"> <li>Materials as substances we choose for particular uses</li> <li>Properties of materials that learners can see, feel, hear, etc. ("Properties" as adjectives that describe materials)</li> <li>Combining materials to get a new material that has new, different properties</li> <li>Differences between solids, liquids and gases.</li> </ul> <p><b>Note:</b> Technology Grade 4 - <i>Processing and materials</i> - can complement this section</p>	<p><b><u>5.4 Fair testing and comparison of materials</u></b></p> <ul style="list-style-type: none"> <li>Matter is any kind of solid, liquid or gas. A material is any kind of matter that we choose to use for a particular purpose.</li> <li>Properties of materials may be colour, smell, hardness, toughness, flexibility, strength in tension,</li> <li>To compare materials on one of these properties, we have to test them in the same way. This is known as fair testing.</li> </ul>	<p><b><u>6.6 Melting and dissolving, solutions and mixtures</u></b></p> <ul style="list-style-type: none"> <li>Melting contrasted with dissolving.</li> <li>Melting and dissolving as examples of temporary changes.</li> <li>A solution is an even mixture. Solvent, solute and solution. Water is one solvent but not the only solvent.</li> <li>Soluble and insoluble substances.</li> <li>Saturated solutions.</li> <li>Factors of temperature and grain size in the rate of dissolving.</li> <li>Conservation of matter means that when we can no longer see a solute, it still exists but as particles of solute among particles of the solvent.</li> </ul> <p><b>(Note:</b> This topic must be integrated with the Processing project in Technology at Grade 6.)</p>	<p><b><u>7.5 Mixtures and ways to separate the substances in mixtures</u></b></p> <ul style="list-style-type: none"> <li>Mixture as a substance made up of different substances that have different properties</li> <li>The substances can be separated by physical methods.</li> <li>Identifying physical properties of the substances in a mixture, to plan separations of mixtures, using various physical methods</li> <li>Separation methods applied in problems of recycling waste materials.</li> </ul> <p>This topic should reinforce the Technology curriculum where it deals with processing materials to improve their quality.</p>	<p><b><u>8.5 The particle model of matter</u></b></p> <ul style="list-style-type: none"> <li>Most matter is made of molecules, and molecules are made of atoms that stick together.</li> <li>Molecules and atoms are called "particles", with a special science meaning.</li> <li>Particles (atoms and molecules) are too small to see, attract or repel each other, they move all the time, move faster when given energy, and between them is totally empty space.</li> <li>The model allows us to explain changes of state (phase changes), the differences between solids, liquids and gases, dissolving, diffusion, heating by conduction.</li> <li>The concept of models in science.</li> </ul> <p><b><u>8.6 Elements and compounds</u></b></p> <ul style="list-style-type: none"> <li>Pure substances.</li> <li>Most pure substances are compounds.</li> <li>Compounds can break down into elements. Two methods to break down compounds are heating and electrolysis.</li> <li>Elements are made of just one kind of atom, whereas each compound is made of two or more kinds of atoms bonded together in unchanging proportions.</li> </ul>	<p><b><u>9.6 The particle model of matter in chemical reactions</u></b></p> <ul style="list-style-type: none"> <li>Review all particle model of matter concepts done in Grade 8..</li> <li>Models of molecules of common compounds.</li> <li>Model simple reactions using beads, etc.</li> <li>Represent reactions of elements and compounds in models, pictures, words and balanced chemical equations.</li> </ul> <p><b><u>9.7 Some important chemical reactions</u></b></p> <ul style="list-style-type: none"> <li>Review Grade 8 work on elements and compounds</li> <li>Models and symbolic representations of chemical change, chemical equations.</li> <li>Examples of acids and bases. Reactions of acids and bases. Neutralisation. Indicators</li> <li>Chemical equations, balancing. Begin with modelling.</li> <li>Reactions of metals and non-metals with oxygen.</li> </ul>	<p><b><u>. . . materials - a macroscopic view</u></b></p> <p>Includes</p> <ul style="list-style-type: none"> <li>Mixtures: heterogeneous and homogeneous.</li> <li>Pure substances: elements, compounds. Names and formulae of substances.</li> <li>Metals, semimetals and non-metals, electrical conductors, semiconductors, insulators. Thermal conductors and insulators</li> </ul> <p>Magnetic and non-magnetic materials.</p> <p><b><u>Particles substances are made of</u></b></p> <ul style="list-style-type: none"> <li>Atoms and molecules (simple and giant)</li> <li>Linking macroscopic properties of materials to micro (particle) structure, intermolecular and intramolecular forces (chemical bonds). Physical state &amp; density in terms of these. Particle KE and temperature</li> </ul> <p><b><u>The Atom: basic building block of all matter</u></b></p> <ul style="list-style-type: none"> <li>Models of the atom.</li> <li>Atomic structure, mass, diameter</li> </ul>	<p><b><u>Quantitative aspects of chemical change:</u></b></p> <p>Atomic weights; Molecular and formula weights; Determining the composition of substances; Amount of substance (mole), molar volume of gases, concentration; Stoichiometric calculations</p> <p><b><u>Energy and chemical change:</u></b></p> <p>Energy changes in reactions related to bond energy changes; Exothermic and endothermic reactions; Activation energy.</p> <p><b><u>Types of reaction:</u></b></p> <p>Acid-base and redox reactions; Substitution, addition and elimination reactions.</p> <p><b><u>Rate and Extent of Reaction</u></b></p> <p>Rates of reaction and factors affecting rate; Measuring rates of reaction; Mechanism of reaction and of catalysis;.</p> <p>Chemical equilibrium and factors affecting equilibrium;</p>

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
				<ul style="list-style-type: none"> <li>• Elements may react to form compounds</li> <li>• Chemical reactions, models or other representations of the reactions</li> <li>• Symbolic representations, chemical equations</li> <li>• Application of reactions to produce and collect the gases oxygen, hydrogen and carbon dioxide</li> <li>• Properties of CO<sub>2</sub>, O<sub>2</sub>, H<sub>2</sub>, N<sub>2</sub>, Cl<sub>2</sub> ; this knowledge helps us distinguish the gases</li> <li>• Uses and importance of gases CO<sub>2</sub>, O<sub>2</sub> in health, industry, environment, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Exothermic and endothermic reactions</li> <li>• Reactions of acids with metals, metal oxides, metal carbonates.</li> <li>• Differences in the reactivity of metals, reactivity series</li> <li>• Rusting as a reaction of iron with oxygen in water. Prevention of rusting.</li> <li>• Example of the reactions in a process to extract a metal from its ore. For example, displacement of a less reactive metal by a more reactive metal. (Link to <a href="#">9.5 Mining and minerals</a>)</li> </ul>	<p>(Continues to periodic table concepts )</p> <p><b><u>Physical and Chemical Change</u></b></p> <ul style="list-style-type: none"> <li>• Microscopic interpretation of macroscopic changes (for example changes in conductivity and temperature)</li> </ul> <p>(Continues to law of constant composition, conservation of energy, volume relationships in gaseous reactions)</p> <p><b><u>Representing chemical change</u></b></p> <ul style="list-style-type: none"> <li>• Balanced chemical equations</li> </ul>	<p>Equilibrium constant; Application of equilibrium principles.</p> <p><b><u>Electrochemical reactions:</u></b></p> <p>Electrolytic and galvanic cells; processes and redox reactions taking place in cells; Standard electrode potentials . . .</p> <p><b><u>Chemical systems</u></b></p> <ul style="list-style-type: none"> <li>• impacts of human activity on society and environment</li> <li>• competing knowledge claims</li> </ul>

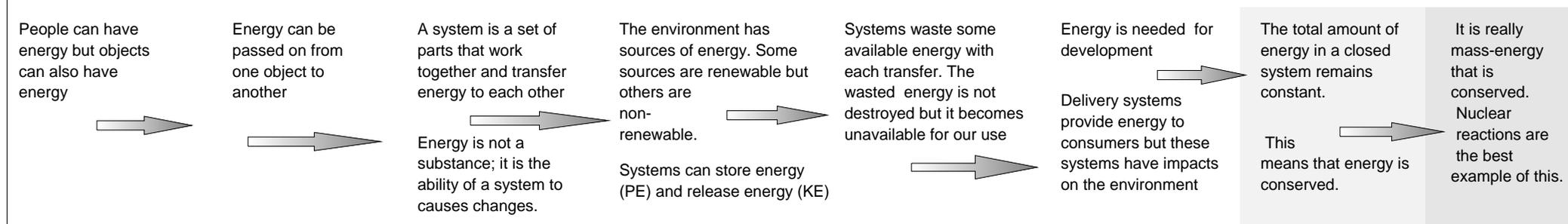
**The development of some major ideas in Matter and Materials, across the Phases.** The sequence corresponds *approximately* to Grades



Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
The next row covers the strand <b>Energy and change</b> , with many links to <b>Matter and Materials</b>							
<p><b><u>4.5 Air, wind, sound and musical instruments</u></b></p> <ul style="list-style-type: none"> <li>Evidence that air is a real substance.</li> <li>Air and wind as moving air.</li> <li>We can use the energy of the wind.</li> <li>Sound travels through materials.</li> <li>The concept of vibration.. We can feel and hear vibrations in materials.</li> <li>Vibrations pass energy on to other things.</li> <li>Quick and slow vibrations give high notes and low notes.</li> <li>Musical notes are good vibrations Musical instruments can give sounds (notes) ranging from high notes to low notes.</li> <li>Boxes and tubes on musical instruments make the sound louder.</li> </ul>	<p><b><u>5.5 Energy for heating things</u></b></p> <ul style="list-style-type: none"> <li>We can heat materials by using fuel-burning systems like gas, wood and paraffin stoves.</li> <li>We can also heat materials by using the Sun's energy.</li> <li>Concept of energy sources..</li> <li>Fire needs fuel, heat and air.</li> <li>Safety with fires – safe use of candles, paraffin, gas and braziers</li> <li>How to behave in the event of clothing catching alight or being in a burning building.</li> </ul> <p><b><u>5.6 Heating and cooling causes changes in materials</u></b></p> <ul style="list-style-type: none"> <li>Heating materials can make them change state e.g. from solid to liquid to gas. Cooling can reverse those changes of state.</li> <li>Gaining and losing energy</li> <li>Most substances (solids, liquids and gases) expand when they become hot, and they contract when they become cold.</li> </ul>	<p><b><u>6.7 Energy from electricity</u></b></p> <p>(This topic must reinforce NCS Grade 6 Technology content, in Electrical Systems &amp; Control)</p> <ul style="list-style-type: none"> <li>Electric circuits with cells, bulbs, conducting materials, switches. Complete circuit needed for bulb to glow.</li> <li>Concept of energy transfer from cell to circuit parts.</li> <li>Current as a flow of electricity (charges).</li> <li>Testing, comparing and classifying materials as conductors and insulators.</li> <li>Energy transfer from a device to its surroundings by means of heat, light, sound. Concept of output devices such as heating wires, incandescent bulbs, beepers.</li> <li>Simple understanding of dangers of mains electricity supply</li> <li>Understanding of relative safety of high and low voltages, and the different sorts of appliances that work at differing voltages.</li> </ul>	<p><b><u>7.6 Forces, energy sources and energy transfers in systems</u></b></p> <ul style="list-style-type: none"> <li>Forces as pushes and pulls.</li> <li>Contact forces, in which two bodies touch each other.</li> <li>Field forces, also called non-contact forces, field forces and forces-at-a-distance: gravity, electrical and magnetic forces (link magnetic force with geomagnetism in <u>7.4 Structure of the changing Earth</u> )</li> <li>Force of object A on object B = Force of B on A, but in the opposite direction.</li> <li>Energy as the ability of living and non-living things to cause changes..</li> <li>Concept of a system, as a set of parts which interact and transfer energy to each other and the surroundings.</li> <li>Concept that energy is available in just <b>two forms</b>: PE as the energy a system has due to its position/ configuration, and KE as the energy that a system has, due to its motion.</li> <li>Energy transfer between parts of a system. Concept that none of the energy is lost but is transferred to other parts of the system or its surroundings.</li> <li>The national electricity supply system; energy transfer from energy sources to dynamos that supply electricity.</li> <li>Renewable and non-renewable sources of energy. Coal, oil, biomass, nuclear, etc. and solar, hydro, wind power</li> </ul>	<p><b><u>8.7 Cells and electrical circuits</u></b></p> <ul style="list-style-type: none"> <li>Cells as chemical systems that store and release energy</li> <li>Concept that an energy source such as a cell creates a voltage, which may cause a current.</li> <li>The quantity of current depends on the resistance in the circuit.</li> <li>Resistors, variable resistors and heating wires / elements. Switches</li> <li>Working of incandescent bulbs. A filament wire glows because it is hot; the colour indicates the temperature. (Link with topic <u>8.8 Light</u> and refer back to radiation in topic <u>7.7 Conduction convection and radiation</u>)</li> <li>Effects of current: magnetic, heating, chemical effects. (Link to decompositions in <u>8.6 Elements and compounds</u> )</li> <li>Bulbs may be replaced with other output devices <i>such as</i> beepers, LEDs, electro-magnets.</li> <li>Series and parallel circuits, with parallel circuits in simplest form</li> <li>Short-circuit paths, fuses.</li> <li>Environmental impacts of used, discarded batteries and electricity generation by coal-fired power-stations.</li> </ul>	<p><b><u>9.8 Electrical systems</u></b></p> <ul style="list-style-type: none"> <li>Electrostatics, electric forces between charged bodies, high voltages and lightning.</li> <li>Mechanical systems that transfer energy to electrical systems: vd Graaff generator, dynamos.</li> <li>National electricity grid and local supply systems. Calculation of costs of energy from electrical systems, measured in kWh.</li> <li>Cells as chemical systems that store and transfer energy.</li> <li>Resistance and resistors</li> <li>Factors that affect resistance; kind of material, diameter, length and temperature.. (Link to Technology - electronic systems and control)</li> <li>Series and parallel circuits. Voltage and current relationships in series and parallel circuits. Calculations with relationship <math>V = R \times I</math>.</li> <li>Wiring in homes and cars. Safety practices, with reasons.</li> <li>Examples of parallel connection causing overload of mains circuits. Illegal connections to mains supply.</li> </ul>	<p><b><u>Magnetism</u></b></p> <ul style="list-style-type: none"> <li>Magnetic field of permanent magnets;</li> <li>Poles of permanent magnets, attraction and repulsion;</li> <li>Earth's magnetic field, compass</li> </ul> <p><b><u>Electrostatics</u></b></p> <ul style="list-style-type: none"> <li>Two kinds of charge;</li> <li>Force charges exert on each other (descriptive);</li> <li>Attraction between charged and uncharged objects (polarisation);</li> <li>Conductors and insulators</li> </ul> <p><b><u>Electric circuits</u></b></p> <p>Need for a closed circuit . Electrical potential difference (voltage), current, resistance. Measurements.</p> <p><b><u>Motion in one dimension:</u></b></p> <ul style="list-style-type: none"> <li>Kinetic energy;</li> <li>Mechanical energy (sum of gravitational potential energy and kinetic energy);</li> </ul> <p>Conservation of mechanical energy (in the absence of dissipative forces)</p>	<p><b><u>Force, momentum and impulse:</u></b></p> <ul style="list-style-type: none"> <li>Pairs of interacting objects exert equal forces on each other ;</li> <li>Momentum and change in momentum.; impulse, net forces &amp; acceleration.</li> <li>Objects in contact exert forces on each other (e.g. normal force, frictional force);</li> <li>Masses can exert non-contact forces on each other, fields;</li> </ul> <p>Moment of force, mechanical advantage</p> <p><b><u>Electrostatics:</u></b></p> <ul style="list-style-type: none"> <li>Forces charges exert on each other (Coulomb's Law). Continues to electric fields, electric PE and potential, capacitance, capacitors.</li> </ul> <p><b><u>Electro-magnetism</u></b></p> <p>Currents induce fields; transformers, charged particles in magnetic fields.</p> <p><b><u>Electric circuits:</u></b></p> <p>Current, voltage, resistance, Ohm's law, series and parallel networks.</p>

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11 . . .
	<ul style="list-style-type: none"> <li>• Thermometers use expansion and contraction of materials to show changes in the temperatures of things.</li> <li>• When liquids evaporate, they take energy from their surroundings and this leaves the surroundings cooler than before. (Note links with <a href="#">5.3 Atmosphere &amp; weather</a>, and evaporation of water)</li> </ul>		<ul style="list-style-type: none"> <li>• Environmental impacts of using energy sources.</li> </ul> <p><b><u>7.7 Controlling heating and cooling: conduction convection and radiation</u></b></p> <ul style="list-style-type: none"> <li>• Heating as the process by which energy is transferred in a system, from hotter to cooler parts</li> <li>• Conduction, convection and radiation as three ways of heating materials</li> <li>• Conductors and insulators of heat.</li> <li>• Good and poor reflectors of radiated heat.</li> <li>• Radiated heat and light are similar means of transferring energy, but we sense them with different sense organs. (Refer back to topic <a href="#">6.3 Plants and animals responses to environment</a>)</li> <li>• Application to conserving useful energy in heating and cooling homes, in cooking, making the best use of energy from the Sun. Good solar design of houses, Sun-energy devices such as water heaters, stoves and distillers</li> </ul>	<p><b><u>8.8 Light</u></b></p> <ul style="list-style-type: none"> <li>• Light is energy that is radiated from luminous objects, or reflected from objects, and travels through space. (Refer back to radiation in topic <a href="#">7.7 Conduction, convection and radiation</a>)</li> <li>• The basic structure of the eye and how we perceive light.</li> <li>• Surfaces can transmit and/or absorb light.</li> <li>• Transparent or opaque substances. Formation of shadows behind opaque substances. Introduce ray diagrams as needed.</li> <li>• Smooth and irregular surfaces reflect light differently.</li> <li>• Surfaces of transparent media can refract light. Only two examples required: water and perspex (or glass).</li> <li>• Dispersion of white light into the colours of the rainbow when the light is refracted by prisms.</li> <li>• Concept of a spectrum, focusing on the visible spectrum but including heat (infra-red radiation)</li> </ul>		<p><b><u>Transverse pulses on a string or spring:</u></b></p> <ul style="list-style-type: none"> <li>• Pulse length, amplitude, speed; Graphs of particle and pulse position, and velocity.</li> <li>• Transmission and reflection at a boundary</li> <li>• Relation of pulse speed to medium; Reflection from a fixed end and a free end; Superposition.</li> </ul> <p><b><u>Transverse waves:</u></b></p> <ul style="list-style-type: none"> <li>• Wavelength, frequency, amplitude, period, wave speed; standing waves</li> </ul> <p><b><u>Geometrical optics:</u></b></p> <ul style="list-style-type: none"> <li>• Light rays; Reflection, Refraction (change of wave speed in different media); • Mirrors;</li> <li>• Total internal reflection, fibre optics in endoscopes</li> </ul>	<p><b><u>Geometrical optics:</u></b></p> <ul style="list-style-type: none"> <li>• lenses, image formation, spectacles, the eye;</li> <li>• Telescopes, (SALT); microscopes</li> </ul> <p><b><u>Longitudinal waves:</u></b></p> <ul style="list-style-type: none"> <li>• Wavelength, frequency, amplitude, period, wave speed; particle position, displacement, . . . Sound waves.</li> </ul> <p><b><u>Sound:</u></b></p> <ul style="list-style-type: none"> <li>• Pitch, loudness, quality (tone); physics of the ear and hearing; Ultrasound.</li> </ul> <p>Physics of music: Standing waves in different kinds of instruments.</p>

**The development of some major ideas in Energy and Change, across the Phases.** The sequence corresponds *approximately* to Grades



## Layer Two – An elaboration of the Layer One summary content map in Natural Sciences Grades 4-9, showing further development of concepts in FET Agricultural Sciences in Grade 10

### Notes

**1** The topics in this section were created to ensure coverage of the relevant parts of the Core Knowledge section of the NCS. The Foundation Phase science content is integrated into Life Skills in Grades R to 3, but it has also been taken up in the Grade 4 topics so that it is reinforced when the learners begin Natural Sciences.

**2 Progression** from Grade to Grade is from left to right, **conceptual linkages** within a Grade go down a column. Within a Grade, curriculum developers can combine and sequence concepts to create new learning sequences. For example, Topic 7.2 can be started before Topic 7.1, to demonstrate the need to simplify the great diversity learners may find.

**3 Layer Three** provides extra detail about concepts in the topics that were created from the core knowledge section of the NCS, reasons for their allocation to the Grade, research on learning and examples of suitable activities.

**4** The **Grade 10 Agricultural Sciences column** in this Layer shows only representative sections of the Learning Area statement

**5** The concepts listed here should suggest ideas to curriculum developers, who will invent activities that excite learners' minds, invite them to use process skills and let them show evidence of their abilities in the outcomes. The Map should never be seen as a catalogue of "facts to be covered".

**6 A note about the terms "humans" and "animals"**  
Scientists generally view humans as animals from a physiological point of view. However, we teach science in a context where most citizens make a clear distinction between humans and animals, and if school teachers talk of a person as "an animal" it usually creates confusion in learners' minds. For that reason this document uses the term "humans", as distinct from "animals".

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	
<p>The three rows below cover the <b>Life and Living strand</b>.</p>							<p><b>Agricultural Science</b></p>
<p><b><u>4.1 Living things that share the world with us</u></b></p> <p>The emphasis must be on activities that use process skills like observing differences, sorting and classifying, describing, drawing.</p> <ul style="list-style-type: none"> <li>• Variety of plants; visible differences between them.</li> <li>• Variety of animals and visible differences between them. Differences in behaviours of some familiar animals</li> <li>• Existence of fossils, as signs that other kinds of plants or animals lived in SA long ago.</li> </ul>	<p>[Remember that other topics can be done under the local options provision in the NCS]</p>	<p>[Remember that other topics can be done under the local options provision in the NCS]</p>	<p><b><u>7.1 Simplifying the great variety of living things on Earth</u></b></p> <ul style="list-style-type: none"> <li>• Classifications of animals as vertebrates (animals with backbones) and invertebrates (animals with no backbones).</li> <li>• The vertebrates are classified into fish, amphibians, reptiles, birds and mammals.</li> <li>• The invertebrates have no backbone but an exoskeleton instead. Include insects, spiders and crabs.</li> <li>• The fossil record gives evidence for different animals and plants long ago, in particular parts of SA. (Link with <a href="#">7.4 Changing Earth</a>)</li> <li>• Classification of plants as seed plants and plants without seeds.</li> <li>• Seed plants are further classified as angiosperms (seeds in ovaries) and gymnosperms (seeds not in ovaries). Angiosperms are further classified into monocotyledons and dicotyledons.</li> <li>• Plants without seeds are classified into algae and ferns.</li> <li>• Functions of flowers, sexual parts of flower, pollen and seed. Agents of pollination.</li> <li>• Vegetative reproduction</li> </ul>		<p><b><u>9.1 The microscopic world of living things</u></b></p> <ul style="list-style-type: none"> <li>• The existence of micro-organisms. There is a great variety of them and they generally live in great numbers but are too small to see with the naked eye.</li> <li>• Micro-organisms have life processes, such as reproduction, respiration, etc.</li> <li>• Their life processes are crucial to other processes of life on Earth, such as maintaining the fertility of the soil, the purification of water or humans' digestion of food.</li> <li>• Micro-organisms reproduce very much more quickly than larger organisms.</li> <li>• Micro-organisms may also be harmful to plants, animals and humans, and cause disease.</li> <li>• Medical drugs can be used against some micro-organisms. However, micro-organisms show variation and so natural selection occurs in micro-organisms. (Link back to adaptation in <a href="#">Topic 8.2 Natural selection and adaptation</a>)</li> </ul>	<p><b><u>Plant sciences</u></b></p> <p>General classification, importance and economic value of plants:</p> <ul style="list-style-type: none"> <li>o field crops;</li> <li>o horticultural crops;</li> <li>o fodder crops;</li> <li>o forests (wood production).</li> </ul> <p><b><u>Animal sciences</u></b></p> <p>General classification, importance and economic value of animals:</p> <ul style="list-style-type: none"> <li>o beef;</li> <li>o dairy;</li> <li>o sheep;</li> <li>o pigs;</li> <li>o goats;</li> <li>o horses;</li> <li>o chickens</li> </ul>	

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10
<p><b><u>4.2 How plants and animals live, and the places where they live</u></b></p> <ul style="list-style-type: none"> <li>Plants make their own food using sunlight, water and the air.</li> <li>Some animals eat plants, some animals eat plant-eating animals, and some animals eat both plants and other animals.</li> <li>Habitats for animals (= places where they can survive) to feed, get water, shelter/escape and reproduce</li> <li>Dependence of animals and humans on plants; simple food chains.</li> <li>Dependence of plants, animals and humans on water.</li> </ul>	<p><b><u>5.1 How living things depend on their environment</u></b></p> <ul style="list-style-type: none"> <li>Animals depend on the soil, plants and other animals in their environment, for food, shelter and places to breed.</li> <li>Animals cannot make their own food, and so some animals eat plants for food while some animals eat other animals. All animals ultimately depend on green plants for their food which gives them energy.</li> <li>Plants make their own food, but plants depend on air, on the soil for water and anchorage for their roots, and on the Sun for energy to help the leaves make the food.</li> <li>Soil forms from broken-down (= weathered) rock and the remains of living organisms. (Refer back to topic <u>4.3 Rocks of the Earth</u> )</li> <li>Soil types are clay, sandy soil and loam.</li> <li>A habitat for each kind of living thing is the kind of place where it can find or make food, find shelter and reproduce.</li> </ul>	<p><b><u>6.1 Environments and water resources</u></b></p> <ul style="list-style-type: none"> <li>The functions of water in ecosystems for plant and animal life and biodiversity.</li> <li>Wetlands as habitats for many animals and as sponges that regulate the flow of water.</li> <li>Groundwater and wetlands as resources for humans.</li> <li>Catchment areas and factors in catchment areas that affect the quality of water.</li> <li>Protecting catchment areas. Ground water: boreholes, springs. Protecting springs against pollution.</li> <li>Water supply systems and sewerage systems - how they work. Emphasis on how to avoid damage to water supply and sewerage systems</li> <li>Ways of storing water and cleaning it (simple filtration, use of chlorine).</li> <li>Electricity generation uses vast amounts of water, and so saving electricity means saving water (Link with <u>6.8 Energy from electricity</u>)</li> </ul>	<p><b><u>7.2 Description of the living and non-living things in a small environment</u></b></p> <p>This section of the Grade 7 curriculum is an investigation of some part of the local environment, and the activity will be determined by the resources available to the teacher. However the following concepts should be part of the discussion and reporting:</p> <ul style="list-style-type: none"> <li>Habitat, and the living and non-living components of the habitat</li> <li>Reproduction of any of the living things in the habitat</li> <li>Food chain, food web, producer, consumer</li> <li>Remains of dead plants and animals, cyclic processes that return nutrients to the soil</li> <li>Interdependence of plants and animals.</li> </ul> <p>Learners should also be able to use the classifications of plant and animal to describe specimens they observe.</p>	<p><b><u>8.1 Interdependence in ecosystems</u></b></p> <ul style="list-style-type: none"> <li>Biotic factors in ecosystems: (the effects of all living parts) and abiotic factors (effects of soil, water, air, light/shade, warmth/cold)</li> <li>Sun provides the energy for life. Photosynthesis in green plants produces food.</li> <li>Plants as producers and other organisms as consumers. Food chains and food webs.</li> <li>Herbivores, carnivores and omnivores. Predators and prey.</li> <li>Respiration releases the energy in food.</li> <li>Examples of basic energy flows in an ecosystem. Food chains and food webs.</li> <li>Role of decomposers and micro-organisms in maintaining the fertility of the soil</li> <li>Concept of survival in ecosystems.</li> <li>Adaptations of organisms that help them to survive in their habitat.</li> <li>Interdependence. A change to any part of an ecosystem affects all the other parts.</li> <li>Human impacts on ecosystems as people seek resources for their own use.</li> <li>Value of ecosystems in cultural, spiritual, recreational and economic terms</li> </ul>		<p><b><u>Agro-ecology</u></b></p> <p>Ecological regions of the world: outline of various regions.</p> <p>Ecological regions in South Africa: geographical distribution and veld types.</p> <p>Adaptations to ecosystems:</p> <ul style="list-style-type: none"> <li>o adaptations of animals to specific regions;</li> <li>o effect of weather phenomena (e.g. El Niño).</li> </ul> <p>Veld management:</p> <ul style="list-style-type: none"> <li>o foundation of the livestock industry;</li> <li>o principles of utilisation.</li> </ul> <p><b><u>Optimum resource utilisation</u></b></p> <p>Agricultural resources:</p> <ul style="list-style-type: none"> <li>o soil and water control and conservation;</li> <li>o water quality;</li> <li>o agricultural pollution;</li> <li>o soil degradation</li> </ul> <p><b><u>Soil science</u></b></p> <p>Basic and components:</p> <ul style="list-style-type: none"> <li>o components;</li> <li>o rock minerals (primary and secondary).</li> </ul> <p>Soil forming factors and process:</p> <ul style="list-style-type: none"> <li>o geographical factors;</li> <li>o climate;</li> <li>o biological factors;</li> <li>o weathering of rocks.</li> </ul> <p><b><u>Agri-industry</u></b></p> <p>Key importance: provider of food,</p>

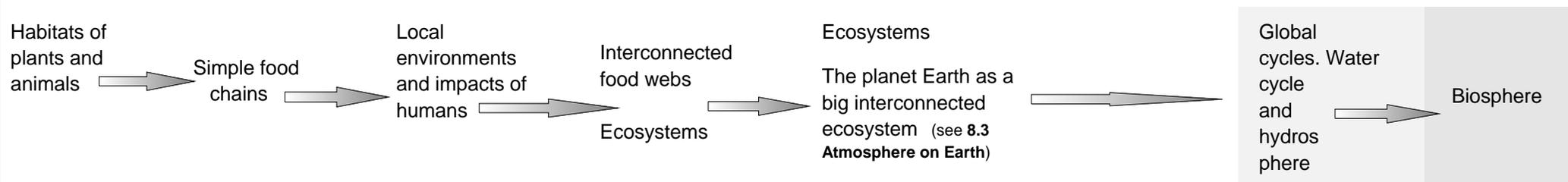
Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10
				<p><b><u>8.2 Natural selection and adaptation</u></b></p> <ul style="list-style-type: none"> <li>• Populations in an ecosystem</li> <li>• Factors that affect a population, e.g. Predation, abundance of food, drought, climate change, disease.</li> <li>• Variation in a population as the random small differences between individuals.</li> <li>• Natural selection, as an explanation of how a population changes to adapt to their habitat (Looks forward to Topic 9.1 on adaptation in micro-organisms).</li> <li>• Extinctions, natural and man-made.</li> </ul>		<p>raw materials, jobs, economic stability.</p> <p>Demand for foodstuffs: determined by natural resources.</p> <p>Overview of agricultural development:</p> <ul style="list-style-type: none"> <li>o population growth and shift;</li> <li>o land redistribution and development;</li> <li>o land ownership;</li> <li>o industries;</li> <li>o indigenous knowledge.</li> </ul> <p>Organisations in the farming industry: roles and examples.</p> <p>Agricultural legislation: water, soil conservation.</p>
	<p><b><u>5.2 Plant and animal reproduction</u></b></p> <ul style="list-style-type: none"> <li>• Plant reproduction from seeds. Plant growth and life cycle.</li> <li>• Vegetative reproduction. Its importance for agriculture because daughter plants are all the same.</li> <li>• Importance of indigenous plants for medicinal and other uses; need to conserve them and their habitats.</li> <li>• Reproduction in birds, fish, reptiles, amphibians, mammals.</li> <li>• Habitats that are needed by some of the animals above and the protection afforded to breeding animals by habitats; the impact of loss of habitat.</li> <li>• Social organisation of animals and patterns of behaviour. For example, being solitary, pairing</li> </ul>	<p><b><u>6.2 Nutrition and digestion</u></b></p> <ul style="list-style-type: none"> <li>• Balanced diets. Simple classification of food types as protective foods, foods for growth and repair, and foods for energy.</li> <li>• Food must have enough micro-nutrients, i.e. vitamins, trace elements.</li> <li>• Examples of balanced diets from different cultures. Proportions of food types needed for health..</li> <li>• Emphasise foods which boost the human immune system and are valuable for people with HIV.</li> <li>• Digestive system; its function as the breaking down of food into very small particles which can pass through the wall of the intestine.</li> </ul>	<p><b><u>7.3 Changes that happen to young people in puberty; understanding sexuality and human reproduction</u></b></p> <ul style="list-style-type: none"> <li>• Physical growth and changes that are triggered by changing body chemistry from about age 11 (girls) and 13 (boys).</li> <li>• The range of normal physical development, and the range of ages for normal development</li> <li>• The psychological changes that come with puberty.</li> <li>• Variation in the human race, such as skin colour, hair, etc; The fallacy of using physical characteristics to judge people's intelligence or worth.</li> </ul>		<p><b><u>9.2 Cells as the basic units of life</u></b></p> <ul style="list-style-type: none"> <li>• All living things carry out their life processes such as growth, repair, reproduction etc. by means of the activity in cells.</li> <li>• Cells are extremely small (but much bigger than molecules).</li> <li>• Cells carry out nutrition, repair, respiration, excretion, etc. They die and are replaced.</li> <li>• Cells have a wall or membrane that allows some substances through and blocks other substances.</li> <li>• Cells are specialised to the function they perform in the larger organism.</li> </ul>	<p><b><u>Biological concepts</u></b></p> <p>An overview of the cell and its components and properties.</p> <p>The cell division process and why it is necessary.</p>

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10
	<p>for life, or living in packs, prides, herds, troops or colonies. (Link with reproduction and care for the young)</p>	<p><b><u>6.3 Plants' and animals' responses to their environment</u></b></p> <ul style="list-style-type: none"> <li>• Living things can respond to changes in their environment. Examples of response to stimuli by plants and animals.</li> <li>• Human and animal sense organs of hearing, vision, taste, smell, touch. The emphasis must be on their functioning and capabilities, rather than on their structure, which will be done in Grade 9.</li> </ul> <p><b><u>6.4 How animals and humans move themselves</u></b></p> <ul style="list-style-type: none"> <li>• Humans and animals are able to move their body parts and move themselves from place to place because they have a skeleton and muscles to move the parts of that skeleton.</li> <li>• Muscles can only shorten (contract) pull on bones, they cannot push.</li> <li>• In humans and some animals, skeletons are inside the body (these are called endoskeletons) and in other animals the skeletons are outside, with the muscles inside (exoskeletons).</li> </ul>	<ul style="list-style-type: none"> <li>• Menstruation, fertile stages of the cycle. Sexual intercourse, conception.</li> <li>• Pregnancy and factors that affect the health of the unborn baby. Birth.</li> <li>• Myths about avoiding pregnancy.</li> <li>• Contraception: a few methods and their relative effectiveness.</li> <li>• Sexually Transmitted Diseases (S.T.D.s) including AIDS.</li> </ul>		<p><b><u>9.3 Life processes and systems of humans</u></b></p> <ul style="list-style-type: none"> <li>• Human life processes and body systems (treated as health education rather than physiology). Digestion, circulation, respiration, excretion. Movement and locomotion. Sensing and response in the nervous system. Reproduction.</li> <li>• Link life processes to relevant systems and organs. Structures of systems as far as they are required to understand how the life processes are carried out. Refer back to topic <u>8.8 Light</u> to reinforce the structure and functioning of the eye.</li> <li>• These body systems are interdependent and work together as one complex system.</li> <li>• How to recognise certain conditions e.g. dehydration, diabetes.</li> <li>• Components of a balanced diet and the long-term effects of diet.</li> <li>• Exercise, drugs, alcohol and other life-style choices that have a long-term affect on health.</li> <li>• Occupational health and safety, related to body systems and life processes.</li> </ul> <p><b><u>9.4 Pregnancy, birth, parenting and adult sexuality</u></b></p> <p>Review and extend Grade 7 concepts.</p> <ul style="list-style-type: none"> <li>• Physical and psychological changes in boys and girls at puberty</li> <li>• Menstrual cycle, fertile stages.</li> </ul>	

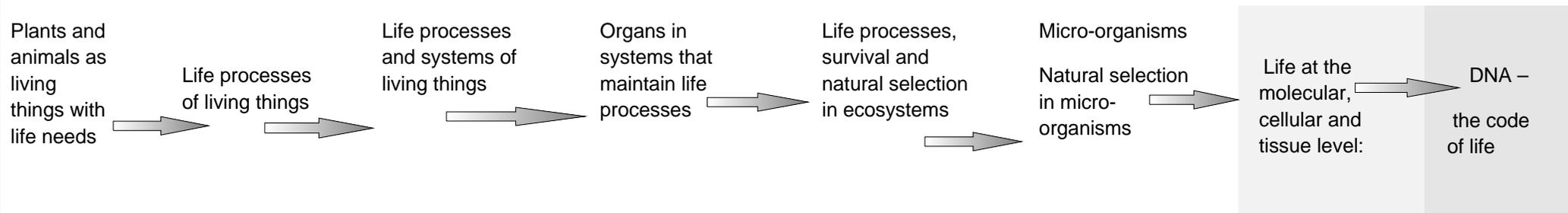
Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10
					<ul style="list-style-type: none"> <li>• Sexual intercourse, conception, pregnancy, birth.</li> <li>• Contraception</li> <li>• Myths about sex</li> <li>• Sexually transmitted diseases.</li> <li>• Application of life-processes knowledge to parenting and child-care.</li> <li>• Basic physical and psychological needs of babies and young children; responsibility of parents and care-givers for young children.</li> </ul>	

The development of some major ideas in Life and Living, across the Phases . . . (The sequence corresponds *approximately* to Grades)

**Beginning from the local scale and developing ideas up to planetary scale**



**Beginning from the macro-scale and developing ideas down to the micro-scale . . . (The sequence corresponds *approximately* to Grades)**



## Layer Two – An elaboration of the Layer One summary content map in Natural Sciences Grades 4-9, showing further development of concepts in FET Geography in Grade 10

### Notes

**1** The topics included in this section have been created to ensure coverage of the relevant parts of the Core Knowledge section of the NCS. The Foundation Phase science content must be integrated into Life Skills in Grades R to 3, but it has also been taken up in the Grade 4 topics so that it is reinforced when the learners begin Natural Sciences.

**2 Progression** from Grade to Grade is from left to right, **conceptual linkages** within a Grade go down a column. Within a Grade, curriculum developers can combine and sequence concepts to create new learning sequences.

**3 Layer Three** provides extra detail about concepts in the topics that were created from the core knowledge section of the NCS, gives reasons for their allocation to the Grade, lists research on learning and offers examples of suitable activities.

**4 The Grade 10 Geography column** in this Layer shows only representative sections of the Learning Area statement

**5** The concepts listed here should suggest ideas to curriculum developers, who will invent activities that excite learners' minds, invite them to use process skills and let them show evidence of their abilities in the outcomes. The Map should never be seen as a catalogue of "facts to be covered".

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10
<p>The topics below address the <b>Planet Earth and Beyond</b> strand, but not including <i>The Earth in Space</i></p>						
<p><b><u>4.3 The rocks of Earth</u></b></p> <p>In this topic learners will produce <b>descriptions and collections</b> rather than explanations.</p> <ul style="list-style-type: none"> <li>• Below the surface we stand on, there is a great depth of rock.</li> <li>• Earth is hot, deep down.</li> <li>• Igneous rocks formed as hot molten rock cooled and hardened. (granite is only required example).</li> <li>• Weathering of rocks' surfaces. (Make the link with soil - broken-up rock becomes soil. See topic 5.1)</li> <li>• Erosion of rock particles</li> <li>• Deposition of rock particles</li> <li>• Sediment (Layer of particles) .</li> <li>• Sedimentary rock. Hardening of the sediment to form sedimentary rock.</li> <li>• Some sedimentary rocks contain fossils. Fossils tell us that other kinds of animals and plants lived in South Africa very long ago.</li> <li>• Sedimentary rock can be changed to metamorphic rock. (Mention. Only required example is shale changed to slate.)</li> </ul>	<p><b><u>5.3 Atmosphere and weather</u></b></p> <ul style="list-style-type: none"> <li>• Wind as moving air. Air as a substance that exists even when the wind is not blowing</li> <li>• Directions of the winds defined in terms of east, west, north and south</li> <li>• A few different kinds of clouds, and their relationship to weather conditions.</li> <li>• Height of water in a container as a measure of rainfall.</li> <li>• Water changes its state with temperature changes – liquid, solid ice and water-vapour.</li> <li>• Evaporation and ways to slow down evaporation or speed it up</li> <li>• Water-vapour in air can condense from the gas state and form drops of liquid</li> </ul>	<p>In Grade 6, learners work on the strand <i>The Earth in Space</i> under the topic <u>6.5 Simple astronomy</u>. Teachers can add activities which relate to the atmosphere (e.g. the atmosphere as the protective layer over the Earth which burns up fast-moving objects arriving from above the atmosphere).</p> <p>In Grade 7, learners may produce outcomes using concepts of atmosphere and weather when they work on the topic, <u>7.4 The Structure of the changing Earth</u></p>	<p><b><u>7.4 The structure of the changing Earth</u></b></p> <ul style="list-style-type: none"> <li>• Earth is ball-shaped. Gravity force and the meaning of “up” and “down”..</li> <li>• The planet Earth has a geosphere made up of the hot metallic core, hot, convecting mantle and rocky crust called the lithosphere.</li> <li>• The hydrosphere and the atmosphere, The biosphere is all living things that interact with the hydrosphere and atmosphere.</li> <li>• The Sun is the main source of energy for life in the biosphere and change in the atmosphere, hydrosphere and lithosphere.</li> <li>• Plate tectonics is the concept that the crust of the planet is made of plates that are moving.</li> <li>• The hot core is the main source of the Earth's internal energy that causes the movements of plates,</li> <li>• Earthquakes, volcanoes, faulting, folding and uplift.</li> <li>• earthquakes as an effect of potential energy in plate boundaries</li> <li>• volcanoes in simple terms as an effect of disturbance along the plate boundaries plus the heat of the Earth interior melting rock in the mantle</li> </ul>	<p><b><u>8.3 The atmosphere on Earth</u></b></p> <ul style="list-style-type: none"> <li>• The atmosphere is all the air around the planet</li> <li>• The composition of the atmosphere</li> <li>• The Earth's atmosphere protects living things against harmful radiation from the Sun</li> <li>• The greenhouse effect</li> <li>• The “enhanced greenhouse effect” and global warming.</li> <li>• The climate is different in different parts of the world</li> </ul>	<p><b><u>9.5 Minerals and mining in South Africa</u></b></p> <ul style="list-style-type: none"> <li>• Review the structure of the Earth; movement in the crust and resulting magma</li> <li>• Volcanoes and magma intrusions, as well as sedimentation processes, have concentrated minerals in certain places</li> <li>• “Deep time” and the great age of mineral deposits in South Africa</li> <li>• Origins of deposits of coal in SA; origins of diamonds and minerals of the Bushveld Igneous Complex</li> <li>• Ores as concentrations of the compounds in rock, that contain the valuable metal.</li> <li>• Oxides and reactions of metals with oxygen (Link with chemical reactions in topic 9.7)</li> <li>• Methods of extracting metals from ores – simulations in lessons</li> <li>• Indigenous technologies for extraction of metals</li> <li>• The environmental impacts of mining. The existence of laws to control these impacts.</li> </ul> <p>It is possible to use this topic as a project in which learners apply knowledge of chemical reactions done in <u>9.7 Some important chemical reactions</u></p>	<p><b>Geography</b></p> <p><b><u>The structure and changing landforms of the Earth</u></b></p> <ul style="list-style-type: none"> <li>• Gain an understanding of the time perspective within the geomorphical context.</li> </ul> <p><b>Internal forces:</b></p> <ul style="list-style-type: none"> <li>• plate tectonics, faulting and resultant landforms, earthquakes and vulcanism;</li> <li>• response of humans to these hazards and opportunities.</li> </ul> <p><b>External forces:</b></p> <ul style="list-style-type: none"> <li>• weathering and erosion: processes that shape the Earth's surface;</li> <li>• the influence of weathering and erosion on human activities;</li> <li>• the significance of the resultant landforms;</li> <li>• the impact (positive and negative) of humans on weathering and erosion processes.</li> <li>• Rock types, formations, characteristics, uses and associated landforms.</li> </ul> <p><b><u>The atmosphere: weather and climate</u></b></p> <ul style="list-style-type: none"> <li>• composition and structure of the atmosphere;</li> <li>• heating of the atmosphere;</li> <li>• moisture in the atmosphere;</li> <li>• macro/meso weather systems over Africa;</li> <li>• the impact of weather systems</li> </ul>

Grade R-4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10
	<ul style="list-style-type: none"> <li>• A "cycle" as a series of events that occur again and again. The water cycle - various examples of it.</li> <li>• Seasons as a predictable annual change in weather patterns,</li> <li>• Air temperatures</li> <li>• The equatorial region and the polar regions on the Earth</li> <li>• Limits of land and drinkable water</li> </ul>		<ul style="list-style-type: none"> <li>• long-term forces are changing the surface of the Earth, all acting at the same time.</li> <li>• Deep time: the Earth is very old.</li> <li>• Geomagnetism and the use of a magnetic compass.</li> </ul>	<p>because sunshine is more intense towards the equator and more spread out towards the poles.</p> <ul style="list-style-type: none"> <li>• Plants and animals have adapted to these varying climates, and are distinctly different in the different regions of the world</li> </ul>		<p>on vegetation and human activities;</p> <ul style="list-style-type: none"> <li>• impact of humans on the atmosphere and weather (e.g. the ozone issue, global warming, acid rain, the greenhouse effect – use case studies from African states);</li> <li>• deserts: formation, distribution, arid processes and resultant landforms.</li> </ul>