



basic education

Department:
Basic Education
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CURRICULUM AND ASSESSMENT POLICY STATEMENT

(CAPS)

NATURAL SCIENCES

GRADES 7 8, 9

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SECTION 1

NATIONAL CURRICULUM AND ASSESSMENT POLICY STATEMENT

FOR NATURAL SCIENCES

GRADES 7, 8, 9

1.1 Background

The *National Curriculum Statement Grades R – 12 (NCS)* stipulates policy on curriculum and assessment in the schooling sector.

To improve implementation, the National Curriculum Statement was amended, with the amendments coming into effect in January 2012. A single comprehensive Curriculum and Assessment Policy document was developed for each subject to replace Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines in Grades R - 12.

1.2 Overview

- (a) The *National Curriculum Statement Grades R – 12 (January 2012)* represents a policy statement for learning and teaching in South African schools and comprises the following:
 - (i) National Curriculum and Assessment Policy Statements for each approved school subject;
 - (ii) The policy document, National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R – 12; and
 - (iii) The policy document, National Protocol for Assessment Grades R – 12 (January 2012).
- (b) The *National Curriculum Statement Grades R – 12 (January 2012)* replaces the two current national curricula statements, namely the
 - (i) *Revised National Curriculum Statement Grades R - 9, Government Gazette No. 23406 of 31 May 2002*, and
 - (ii) *National Curriculum Statement Grades 10 - 12 Government Gazettes, No. 25545 of 6 October 2003 and No. 27594 of 17 May 2005.*

- (c) The national curriculum statements contemplated in subparagraphs (a) and (b) comprise the following policy documents which will be incrementally repealed by the *National Curriculum Statement Grades R – 12 (January 2012)* during the period 2012-2014:
- (i) The Learning Area/Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines for Grades R - 9 and Grades 10 – 12;
 - (ii) The policy document, *National Policy on assessment and qualifications for schools in the General Education and Training Band d*, promulgated in *Government Notice No. 124 in Government Gazette No. 29626* of 12 February 2007;
 - (iii) The policy document, the *National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF)*, promulgated in *Government Gazette No.27819* of 20 July 2005;
 - (iv) The policy document, *An addendum to the policy document, the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF), regarding learners with special needs*, published in *Government Gazette, No.29466* of 11 December 2006, is incorporated in the policy document, *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R – 12; and*
 - (v) The policy document, *An addendum to the policy document, the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF), regarding the National Protocol for Assessment (Grades R – 12)*, promulgated in *Government Notice No.1267 in Government Gazette No. 29467* of 11 December 2006.
- (d) The policy document, *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R – 12*, and the sections on the Curriculum and Assessment Policy as contemplated in Chapters 2, 3 and 4 of this document constitute the norms and standards of the *National Curriculum Statement Grades R – 12*. It will therefore, in terms of section 6A of the *South African Schools Act, 1996 (Act No. 84 of 1996,)* form the basis for the Minister of Basic Education to determine minimum outcomes and standards, as well as the processes and procedures for the assessment of learner achievement to be applicable to public and independent schools.

1.3 General aims of the South African Curriculum

- (a) The *National Curriculum Statement Grades R - 12* gives expression to the knowledge, skills and values worth learning in South African schools. This curriculum aims to ensure that children acquire and apply knowledge and skills in ways that are meaningful to their own lives. In this regard, the curriculum promotes knowledge in local contexts, while being sensitive to global imperatives.
- (b) The National Curriculum Statement Grades R - 12 serves the purposes of:
- equipping learners, irrespective of their socio-economic background, race, gender, physical ability or intellectual ability, with the knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society as citizens of a free country;
 - providing access to higher education;
 - facilitating the transition of learners from education institutions to the workplace; and
 - providing employers with a sufficient profile of a learner's competences.
- (c) The National Curriculum Statement Grades R - 12 is based on the following principles:
- Social transformation: ensuring that the educational imbalances of the past are redressed, and that equal educational opportunities are provided for all sections of the population;
 - Active and critical learning: encouraging an active and critical approach to learning, rather than rote and uncritical learning of given truths;
 - High knowledge and high skills: the minimum standards of knowledge and skills to be achieved at each grade are specified and set high, achievable standards in all subjects;
 - Progression: content and context of each grade shows progression from simple to complex;
 - Human rights, inclusivity, environmental and social justice: infusing the principles and practices of social and environmental justice and human rights as defined in the Constitution of the Republic of South Africa. The National Curriculum Statement Grades R – 12 is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors;
 - Valuing indigenous knowledge systems: acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution; and

- Credibility, quality and efficiency: providing an education that is comparable in quality, breadth and depth to those of other countries.
- (d) The National Curriculum Statement Grades R - 12 aims to produce learners that are able to:
- identify and solve problems and make decisions using critical and creative thinking;
 - work effectively as individuals and with others as members of a team;
 - organise and manage themselves and their activities responsibly and effectively;
 - collect, analyse, organise and critically evaluate information;
 - communicate effectively using visual, symbolic and/or language skills in various modes;
 - use science and technology effectively and critically showing responsibility towards the environment and the health of others; and
 - demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation.
- (e) Inclusivity should become a central part of the organisation, planning and teaching at each school. This can only happen if all teachers have a sound understanding of how to recognise and address barriers to learning, and how to plan for diversity.

The key to managing inclusivity is ensuring that barriers are identified and addressed by all the relevant support structures within the school community, including teachers, District-Based Support Teams, Institutional-Level Support Teams, parents and Special Schools as Resource Centres. To address barriers in the classroom, teachers should use various curriculum differentiation strategies such as those included in the Department of Basic Education's *Guidelines for Inclusive Teaching and Learning* (2010).

1.4 Time Allocation

1.4.1 Foundation Phase

(a) The instructional time in the Foundation Phase is as follows:

SUBJECT	GRADE R (HOURS)	GRADES 1-2 (HOURS)	GRADE 3 (HOURS)
Home Language	10	7/8	7/8
First Additional Language		2/3	3/4
Mathematics	7	7	7
Life Skills	6	6	7
▪ Beginning Knowledge	(1)	(1)	(2)
▪ Creative Arts	(2)	(2)	(2)
▪ Physical Education	(2)	(2)	(2)
▪ Personal and Social Well-being	(1)	(1)	(1)
TOTAL	23	23	25

- (b) Instructional time for Grades R, 1 and 2 is 23 hours and for Grade 3 is 25 hours.
- (c) Ten hours are allocated for languages in Grades R-2 and 11 hours in Grade 3. A maximum of 8 hours and a minimum of 7 hours are allocated for Home Language and a minimum of 2 hours and a maximum of 3 hours for Additional Language in Grades R – 2. In Grade 3 a maximum of 8 hours and a minimum of 7 hours are allocated for Home Language and a minimum of 3 hours and a maximum of 4 hours for First Additional Language.
- (d) In Life Skills Beginning Knowledge is allocated 1 hour in Grades R – 2 and 2 hours as indicated by the hours in brackets for Grade 3.

1.4.2 Intermediate Phase

(a) The instructional time in the Intermediate Phase is as follows:

SUBJECT	HOURS
Home Language	6
First Additional Language	5
Mathematics	6
Natural Science and Technology	3,5
Social Sciences	3
Life Skills	4
▪ Creative Arts	(1,5)
▪ Physical Education	(1)
▪ Personal and Social Well-being	(1,5)
TOTAL	27,5

1.4.3 Senior Phase

- The instructional time in the Senior Phase is as follows:

SUBJECT	HOURS
Home Language	5
First Additional Language	4
Mathematics	4,5
Natural Science	3
Social Sciences	3
Technology	2
Economic Management Sciences	2
Life Orientation	2
Arts and Culture	2
TOTAL	27,5

1.4.4 Grades 10-12

(a) The instructional time in Grades 10-12 is as follows:

Subject	Time allocation per week (hours)
I. Home Language	4.5
II. First Additional Language	4.5
III. Mathematics	4.5
IV. Life Orientation	2
V. A minimum of any three subjects selected from Group B <u>Annexure B, Tables B1-B8</u> of the policy document, <i>National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R – 12</i> , subject to the provisos stipulated in paragraph 28 of the said policy document.	12 (3x4h)

The allocated time per week may be utilised only for the minimum required NCS subjects as specified above, and may not be used for any additional subjects added to the list of minimum subjects. Should a learner wish to offer additional subjects, additional time must be allocated for the offering of these subjects.

SECTION 2

2.1 WHAT IS NATURAL SCIENCES?

To be accepted as science, certain methods of inquiry are generally used. These methods lend themselves to replication, attempts at objectivity and a systematic approach to scientific inquiry. The methods include formulating hypotheses, and designing and carrying out experiments to test the hypotheses. Repeated investigations are undertaken, and the methods and results are carefully analysed and debated before they are accepted as valid. Knowledge production in science is an ongoing endeavour that usually happens gradually but, occasionally, knowledge leaps forward as a new theory replaces the dominant view. As with all other knowledge, scientific knowledge changes over time as scientists acquire new information and people change their ways of viewing the world.

In all cultures and in all times people have wanted to understand how the world works. Sometimes their lives depend on understanding it and, sometimes, people want to make sense of the physical world and they need explanations that satisfy them.

Science is a systematic way of looking for explanations and connecting up the ideas we have. Over many centuries, people in science have come to agree that they need to write down and publicise the investigations they do, that their claims and ideas need to be tested by other scientists and that other people should be able to repeat investigations to see whether the results turn out the same.

Scientific investigations are often about things that nobody really understands yet, so scientists are frequently involved in debates and disagreements. However, as more and more people work on the same questions, they tend to reach a consensus about what is really happening in nature.

The science knowledge we teach at school is not in doubt as most of it has been tested and has become generally accepted but a good teacher will tell the learners something of the debates, the arguments and confusion among the people who were the first to investigate such phenomena.

Scientists continue to explore the frontiers of the unknown. Why is climate changing around the world? What is making the universe expand? What causes the earth's magnetic field to change? Nobody knows for sure.

2.2 NATURAL SCIENCES AS A SCHOOL SUBJECT

Natural Sciences in the Senior Phase is compulsory for all learners. It is therefore critical for promoting and developing scientific literacy as learners may elect not to continue with one of the science subjects beyond Grade 9. Natural Sciences serves a dual purpose: it must enable learners to make sense of the world in scientific terms and prepare learners for continuing with a science(s) into the FET phase ... and beyond.

2.3 ORGANISATION OF NATURAL SCIENCES

In the Natural Sciences Curriculum, four “Knowledge Strands” are used as organisers for the Physical Sciences, Life Sciences and Earth Sciences components of the subject. They are intended to serve as a broad introduction to the specialisations (and the Knowledge Strands) of sciences in the Further Education and Training Phase.

Each Knowledge Strand is developed progressively across the three years of the Senior Phase. The Knowledge Strands are:

- Life and Living (which leads on to the Knowledge Strands for Life Sciences in FET).
- Matter and Materials (which leads on to the Knowledge Strands for Physical Sciences in FET).
- Energy and Change (which leads on to Knowledge Strands in both Life Sciences and Physical Sciences).
- Earth and Beyond (which leads on to Knowledge Strands in both Life Sciences and Geography).

The Knowledge Strands are a tool for organising the subject content. When teaching Natural Sciences, it is important to emphasise the links learners need to make with related topics to help them achieve a thorough understanding of the nature of and connectedness in the sciences. Links must also be made progressively, across grades to all four Knowledge Strands.

MATRIX

SENIOR PHASE CONCEPT AND CONTENT PROGRESSION: GRADES 7, 8, 9

Strands	Matter and materials	Energy and change	Earth and beyond	Life and living
GRADE 7	• Properties of material • Mixtures • Separating mixtures	• Energy systems and transfers • Potential and Kinetic Energy • Heating as a transfer of Energy • Saving energy • National electricity supply • Renewable and non-renewable energy	• Sun and the solar system • Solar system • Planet Earth • Biosphere • Habitats in an ecosystem	• Biodiversity – animals – plants • Sexual reproduction in flowering plants • Sexual reproduction in humans • Variation in human populations
GRADE 8	• Particle kinetic model: particles, elements, compounds – Particles: atoms and molecules – states of matter – physical changes • Models in Science • Compounds and elements • Chemical reactions	• Energy transfer – static electricity – current electricity – effects of current • Series and parallel circuits. • Light energy – radiation – reflection – absorption – refraction and dispersion	• Earth in space – Solar system – Eclipses – Earth's atmosphere • Beyond the solar system.	• Interactions and Interdependence in the environment. • Food chains and food webs: energy flow. • Disruptions in an ecosystem
GRADE 9	• Particle Kinetic model: reactions – Metals and non- metals with oxygen – Acids and bases, neutralisation – Metal oxides and non-metal oxides – Acids with metal hydroxides and metal carbonates – Acids with metals – Reactivity of metals – Periodic table	• Forces – mechanical – gravity – magnetic – electrical • Cells as sources of energy • Series and parallel circuits – Resistors – Safety • National grid – Cost of electricity	• Metal extraction • Renewable and non renewable resources	• Healthy living – Micro-organisms and diseases • Cells as basic units of life • Cells → tissue – organs – systems • Human body and healthy living – Heart – Skeleton and muscles – Lungs – Kidneys – Sense organs – Thermoregulation – Sex and reproduction • Recognising ill health

The content framework focuses on the ideas, skills, concepts and connections between them, rather than a listing of the facts and procedures that need to be learned. Particular instructional strategies or methodologies are not prescribed. Teachers have the freedom to expand concepts and to design and organise learning experiences according to their own local circumstances.

The cognitive and practical skills that have been identified must be taught, and assessed, in an integrated way (and **at the appropriate grade level**) in the context provided by the four Knowledge Strands.

The recommended sequence for the teaching of the four Knowledge Strands in this document for the Senior Phase is:

Grade 7:

1. Matter and Materials (Strand 1)
2. Energy and Change (Strand 2)
3. Earth and Beyond (Strand 3)
4. Life and Living (Strand 4)

Grade 8:

1. Earth and Beyond (Strand 1)
2. Life and Living (Strand 2)
3. Energy and Change (Strand 3)
4. Matter and Materials (Strand 4)

Grade 9:

5. Matter and Materials (Strand 1)
6. Earth and Beyond (Strand 2)
7. Energy and Change (Strand 3)
8. Life and Living (Strand 4)

However, teachers could decide on the sequence within a particular term. In Grade 9, learners are expected to carry out their own investigations to expand on the concepts or knowledge to which they have been introduced and to deepen their understanding of the subject matter.

2.4 PURPOSE OF STUDYING NATURAL SCIENCES

- **Development of scientific knowledge and understanding**

Scientific knowledge and understanding can be used to answer questions about the nature of the world around us. It can prepare learners for economic activity and self-expression. It lays the basis of further studies in science and prepares learners for active participation in a democratic society that values human rights and promotes acting responsibly towards the environment.

- **Development of science process skills (Scientific Investigations)**

The teaching and learning of science involves the development of a range of process skills that may be used in everyday life, in the community and in the workplace. Learners can gain these skills in an environment that supports creativity, responsibility and growing confidence. Learners develop the ability to think objectively and use a variety of forms of reasoning while they use process skills to investigate, reflect, synthesise and communicate.

- **Develop an understanding of the roles of Science in society**

Both Science and technology have made a major impact, both positive and negative, on our world. Careful selection of scientific content, and use of a variety of ways of teaching and learning science, should promote understanding of science as a human activity as well as the history of science and the relationship between Natural Science and other subjects. It also helps learners to understand the contribution of science to social justice and societal development as well as the need for using scientific knowledge responsibly in the interest of ourselves, of society and the environment. Understanding science also helps us to understand the consequences of decisions that involve ethical issues.

2.5 SPECIFIC AIMS

There are **three** broad subject-specific aims in Natural Sciences which relate to the purposes of learning science. These are:

1. Specific Aim 1, which relates to the knowing of the subject content (“theory”).
2. Specific Aim 2, which relates to doing science or practical work and investigations.
3. Specific Aim 3, which relates to understanding the applications of Natural Science in everyday life, as well as understanding the history of scientific discoveries and the relationship between indigenous knowledge and science.

WHAT DO THE THREE AIMS MEAN AND HOW DO THEY RELATE TO ASSESSMENT?

2.5.1 Specific Aim 1: Knowing Natural Sciences (Natural Sciences Concepts, processes, phenomena, mechanisms, principles, theories, laws, models, etcetera).

This involves knowing, understanding, and making meaning of sciences in a way that enables learners to make many connections between the ideas and concepts in their minds. Making such connections enables learners to apply their knowledge in new and unfamiliar contexts. The process of acquiring a deep understanding of Science is about more than just knowing a lot of facts. The scope of the knowledge that learners should acquire includes knowledge of the process skills related to carrying out investigations.

The following cognitive (thinking) skills comprise the **range** of skills that all learners should develop in the context of working through the curriculum in a school year. These skills also indicate what should be assessed, **at the appropriate grade level**, in a variety of different kinds of assessments during the year. Note that not every skill will be assessed in every assessment, but teachers must ensure that, by the end of the year, the assessments provide evidence that learners have been assessed on all of these.

2.5.1.1 Acquire knowledge

In the process of acquiring knowledge learners must...

- **access** information from a variety of sources (teachers, reference books, textbooks, internet, experts, peers, parents, etcetera).
- **select** key ideas.
- **recall** facts
- **describe** concepts, processes, phenomena, mechanisms, principles, theories, laws, models in the Natural Sciences.

Assessment

In order to assess these competences (or cognitive skills), teachers should use the following verbs in the tasks or assessments that they set: state, name, label, list, define, describe and any other verbs that would show that **knowledge** of the subject is being assessed.

2.5.1.2 Understand, comprehend, make connections between ideas and concepts to make meaning of Natural Sciences

In the process of making meaning and achieving understanding learners must...

- **build a conceptual framework** of science ideas.
- **organise** or **reorganise** knowledge to derive new meaning
- **write** summaries

- **develop** flow charts, diagrams and mind maps
- **recognise** patterns and trends

Assessment

In order to assess these competencies (cognitive skills), teachers should use the following verbs in the tasks or assessments they set: explain, compare, rearrange, give an example of, illustrate, calculate, interpret, suggest a reason, make a generalisation, interpret information or data, predict, select, differentiate or any other suitable verbs which would indicate that understanding of the subject is being assessed.

2.5.1.3 Apply knowledge of Natural Sciences in new and unfamiliar contexts Learners must be able to:

- **use** information in a new way.
- **apply** knowledge to new and unfamiliar contexts

Assessment

In order to assess these competencies (cognitive skills), teachers should use the following verbs in the tasks or assessments that they set: demonstrate, interpret, predict, compare, differentiate, illustrate, solve and select, as well as any other appropriate verbs which would assess a learner's ability to apply knowledge. The key is that the learners will have to apply knowledge about something that they have learnt, and which they understand, in a context or situation about which they have not yet acquired specific knowledge, or they must use the knowledge in a new way.

2.5.1.4 Analyse, evaluate and synthesise scientific knowledge, concepts and ideas

In the process of learning science learners must be able to ...

- **analyse** information/data
- **recognise** relationships between existing knowledge and new ideas.
- **critically** evaluate scientific information
- **identify** assumptions
- **categorise** information

In order to assess these competencies (cognitive skills) teachers should use the following verbs in the tasks or assessment that they set: appraise, argue, judge, select, evaluate, defend (a point of view), compare, contrast, criticise (an argument or assumption) differentiate, distinguish,

discuss or any other suitable verbs that would indicate that analysis, evaluation and synthesis have been assessed.

2.5.2 Specific Aim 2: Investigating phenomena in Natural Sciences

Learners must be able to plan and carry out investigations as well as solve problems that require some practical ability. This ability is underpinned by an attitude of curiosity and an interest in wanting to find out how the natural world works.

The following range of skills relate to **doing** practical work in Natural Sciences. All seven skills will not apply to every activity equally. The skills are aligned to what learners would be doing in the normal course of carrying out an investigation. Teachers must select those skills that apply to, and which can be assessed in, the context of specific activities. By the end of each year in the Senior Phase, **at least** the first six skills must have been assessed at a **grade-appropriate** level.

Note:

Whilst **doing** practical investigations involves a specific range of skills, knowledge and understanding of doing science can, and should, be assessed within the context of the cognitive domains of Specific Aim 1.

Learners must be able to:

2.5.2.1 Follow instructions

This is essential, especially in the lower grades and in large classes. Teachers cannot expect all learners to use unfamiliar equipment and to do so independently without giving them a clear set of instructions to follow. The amount of assistance required would indicate the level of performance in this regard. Adherence to safety rules would be part of this.

2.5. 2.2 Handle equipment or apparatus

This should include knowledge of the apparatus, that is, naming it and knowing what it is used for. It includes using a variety of different kinds of equipment. “Handling equipment” is a generic skill and would apply to any equipment used for many different kinds of investigations. Handling improvised equipment requires the same skills as would be required for handling standard laboratory equipment. The emphasis is on **using** equipment appropriately and safely (and not on memorising the names of apparatus only.)

2.5.2.3 Make observations

A variety of different kinds of observations are possible and observations can be recorded in different ways, such as:

- drawings.
- descriptions.
- grouping of materials or examples based on observable similarities and/or differences.
- measurements.
- comparing materials before and after treatment.
- observing results of an experimental investigation which will involve recording information in an appropriate way.
- counting.

2.5.2.4 Record information or data

This should include recording observations or information as drawings, descriptions, in simple table format, as simple graphs, etcetera. Again, the skill of “recording” is transferable across a range of different scientific activities.

2.5.2.5 Measure

Learners should know **what** to measure, **how** to measure it and have a sense of the degree of accuracy that is required. A variety of things could be measured including (but not limited to) length, volume, temperature, weight or mass, numbers (counting). Measuring is a way of quantifying observations and in this process learners should learn to make estimations.

2.5.2.6 Interpret

Learners should be able to convert information from one form in which it was recorded, for instance a table into, for example, an appropriate graph.

Learners should be able to perform **appropriate** simple calculations, to analyse and extract information from tables and graphs, apply knowledge of theory to practical situations, recognise patterns and/or trends, appreciate the limitations of experimental procedures and make deductions based on evidence.

2.5.2.7 Design/plan investigations or experiments

Not all investigations are based on the “classic” dependent-independent variables and controls. For example, an investigation could involve observing soil profiles or counting populations.

Designing an investigation is a different process from planning an investigation. In the design process options need to be considered depending on the hypothesis and variables may have to be identified.

Skills include:

- identifying a problem.
- hypothesising.
- selecting apparatus or equipment and/or materials.
- identifying variables
- suggesting ways of controlling variables
- planning an experiment.
- suggesting ways of recording results.
- understanding the need for replication or verification.

By Grade 9, learners must begin to be able to plan and/or design a simple investigation or experiment.

Note: Skills 2.5.2.1 to 2.5.2.6 (following instructions, handling equipment, making observations, recording information, measuring and interpreting information) would all be required, in one form or another, in order to carry out an experiment or investigation. By separating seven different kinds of skills (2.5.2.1 to 2.5.2.7), these skills can apply to the **variety** of different kinds of investigations that are appropriate for a particular grade in Natural Sciences, including simple investigations or experiments. This approach makes it easier to assess learners in a range of different circumstances and it enables a teacher to judge a learner's ability to **do** science. The skills are based on what learners would do in the normal course of doing practical work. However, there are some circumstances in which only some of these skills would apply and not every skill can be assessed in every practical task.

2.5.3 Specific Aim 3: Appreciating and Understanding the History, Importance and Applications of Natural Sciences in Society

The third aim of Natural Sciences is to enable learners to understand that school science can be relevant to their lives outside of the school and that it enriches their lives.

Learners must be exposed to the history of science and indigenous knowledge systems from other times and other cultures. Scientific knowledge and understanding have been developed over time by people who were curious and who persevered with their quest for knowledge. Our present understanding of science will change and will be improved by modern scientists making new discoveries

The skills that can be developed in the process of achieving Specific Aim 3 are cognitive rather than practical skills. These are the same cognitive skills as the ones identified for Specific Aim1.

Because knowledge that will be acquired in respect of Specific Aim 3 always relates to specific subject content, the content provides the context for learning about various aspects of Science in society. It should therefore be taught in an integrated way in order to both enhance the subject and to clarify the relationship between the subject and society i.e. indigenous knowledge systems that relate to a specific topic, related history of scientific discoveries and the applications of science in everyday life.

2.5.3.1 Understanding the history and relevance of some scientific discoveries

The subject content provides the context for learning about the history of scientific discoveries and their relevance for society. These aspects, the history and relevance, should be linked to and taught with the topics and content that are relate to a particular discovery or a particular scientist.

2.5.3.2 Relationship of indigenous knowledge to natural sciences

All knowledge grows out of a view of how the world works. One of the differences between modern science (and technology) and traditional, indigenous knowledge systems is that they have their origins in different world views. Learners should understand the different cultural contexts in which indigenous knowledge systems were developed.

Examples of indigenous knowledge that are selected for study should, as far as possible, reflect different South African cultural groupings. They **will** also link directly to specific areas in the Natural Sciences subject content.

2.5.3.3 The value and application of natural sciences knowledge in industry, in respect of career opportunities and in everyday life

This is about the applications and relevance that knowledge of Natural Sciences has found in various aspects of society. Examples should be relevant to the subject content that learners are dealing with at a particular time. For example, there are career opportunities in respect of engineering, chemistry, physics, astronomy, production of electricity, electricians and other artisans in technical fields, socio-biology and animal behaviour, plant pathology, game management, environmental impact studies, preservation of biodiversity, palaeontology, paleoanthropology, agriculture, horticulture, environmental law, science journalism, biotechnology, genetic engineering, and many others. Examples of some of the possibilities are included in the appropriate topics. Learners should be made aware of careers, but these should not be discussed or taught in great detail.

Skills

Whilst the kind of knowledge is different for Specific Aims 1 and 3, the content should be taught in an integrated way in order for learners to more easily understand the history, relevance and applications of science. Importantly, the skills that must be developed and assessed for Specific Aim 3 are the same as those of Specific Aim 1.

Learners must

- **access** information.
 - **select** key ideas.
 - **recall** information
 - **describe** knowledge of natural sciences.
 - **build a conceptual framework.**
 - **organise** or **reorganise** knowledge
 - **write** summaries
 - **develop** flow charts and mind maps
 - **recognise** patterns and trends
 - **apply** knowledge in new contexts.
 - **use** knowledge in a new way
 - **analyse** information/data
 - **critically evaluate** scientific information
 - **recognise** relationships between existing knowledge and new ideas
 - **identify** assumptions
 - **categorise** information
-
- The diagram uses curly braces to group the skills into four categories:
- Specific Aim 1.1** includes: access information, select key ideas, recall information, and describe knowledge of natural sciences.
 - Specific Aim 1.2** includes: build a conceptual framework, organise or reorganise knowledge, write summaries, and develop flow charts and mind maps.
 - Specific Aim 1.3** includes: recognise patterns and trends, apply knowledge in new contexts, and use knowledge in a new way.
 - Specific Aim 1.4** includes: analyse information/data, critically evaluate scientific information, recognise relationships between existing knowledge and new ideas, identify assumptions, and categorise information.

The three aims are aligned to the three Learning Outcomes with which teachers are familiar. Within each of these aims, specific skills or competences have been identified. It is not advisable to try to assess each of the skills separately, nor is it possible to report on individual skills separately. However, **well designed assessments** must show **evidence** that, by the end of the year, all of the skills have been assessed **at a grade-appropriate level**. There must be a clear link between the aims and the outcomes of learning. The processes of teaching, learning and assessment will provide the links between the Specific Aims and the achievement of the outcomes.

2.5.4 Developing Language Skills: Reading and Writing

Teachers of Natural Sciences should be aware that they are also engaged in teaching language across the curriculum. This is particularly important for learners for whom the Language of Learning and Teaching (LoLT) is not their home language. It is important to provide learners with opportunities to develop and improve their language skills in the context of learning Natural Sciences. It will therefore be critical to afford learners opportunities to read scientific texts, to write reports, paragraphs and short essays as part of the assessment, especially (but not only) in the informal assessments **for** learning.

2.5 TIME

The time allocated for Natural Sciences is 3 hours per week.

The curricula for Grades 7 and 8 have been designed to be completed within 31 weeks out of the 40 weeks in the school year. This leaves 9 weeks in the year for examinations, tests and disruptions due to other school activities.

The curriculum for Grade 9 has been designed to be completed within 30 weeks out of 40 weeks in the school year. This leaves 10 weeks in the year for examinations, tests and disruptions due to other school activities.

The time allocated per topic is a guideline and it should be applied flexibly according to circumstances in the classroom and to accommodate the interests of the learners. **The time allocated is also an indication of the weighting of each topic.**

In all grades in the Senior Phase, a significant amount of time should be spent on doing practical tasks and investigations which are an integral part of the teaching and learning process.

2.5. RESOURCES

The resources needed for teaching Natural Sciences are listed against each topic in order to assist teachers with planning and preparation.

Every learner must have his/her own textbook. Teachers should ensure that a system is in place for recovering textbooks at the end of every year. Schools must provide secure storage space where textbooks, and other equipment, can be stored safely.

Ideally every learner should have access to sufficient workspace and equipment to carry out investigations. For safety reasons no more than three learners may share space and equipment in instances where space and equipment are limited due to large classes. With regard to equipment, schools must make every effort to ensure that the essential equipment is provided.

Whilst it is acknowledged that it is not ideal to have to improvise equipment, teachers should remember that it is more important for learners to have the experience of carrying out a variety of investigations than to depend on the availability of standard laboratory equipment. In instances where equipment is limited, teachers should be encouraged to improvise. The same skills can be developed using improvised equipment. Also, if there are no alternatives, it is more effective for teachers to demonstrate an investigation than to not do investigations due to a lack of equipment. Secure storage for equipment and chemicals must be provided by the school.

Teachers should ensure that learners are familiar with rules regarding the safe use of equipment and chemicals. The Natural Sciences classroom or laboratory should be equipped with charts, Bunsen burners or spirit lamps, hand lenses, bioviewers and relevant biostrips, microscopes, a set of prepared slides, glass slides and cover slips, reference books, blades or scalpels, models, Field Guides, identification keys, thermometers, glass beakers, test tubes and chemicals, and, if at all possible, access to appropriate DVDs and a DVD player.

Fresh plant material can be obtained from the surroundings and teachers should ensure that appropriate plants (e.g. *Impatiens*) are planted on the school grounds. Fresh animal material can very often be obtained at reasonable cost from the local butcher.

Teachers must be qualified to teach the subject and must familiarise themselves with the equipment and how it is used.

SECTION 3

NATURAL SCIENCES: GRADE 7

The first section in Grade 7, called “Subject Orientation”, is included to prepare learners for the Senior Phase, and is intended to

- familiarise learners with the way the teacher will organise learning activities.
- familiarise learners with the behaviour that will be required and rules for safety.
- connect what learners have learned in the Intermediate Phase with what they will learn, and the skills that they must develop, in the Senior Phase.
- describe how knowledge is constructed in Science and to introduce a scientific approach that both teachers and learners are required to use when teaching and learning Natural Sciences.
- introduce learners to some basic principles related to science.
- familiarise learners with the skills that they must acquire.

This is not part of the assessable curriculum, although the principles and skills will be assessed in the context of specific knowledge, where applicable

TERM 1	
Time	Introduction to Natural Sciences: subject orientation
½ Week (1½ hours)	• Establish links between Natural Sciences and Life Sciences, Physical Sciences and Geography in the FET phase. • Nature of Science: contested knowledge, non-dogmatic, inferences based on evidence, peer review. • How science works: All of the following should be explained in simple terms: – Fundamental knowledge built on scientific evidence and verifying findings. – Observing. – Investigating.

	– Collecting and presenting data/information. – Identifying patterns and relationships in data. – Communicating findings. – Understanding the limitations of scientific evidence. – Beginning to understand variables. • Scientific skills: – Biological drawings and science diagrams. – Interpreting two-dimensional drawings as three-dimensional objects: transverse and longitudinal sections. – Understanding symmetries. – Introduction to graphs, interpreting graphs. – Overview of the skills listed in the Specific Aims. • Class organisation and rules – Using equipment and other resources. – Safety procedures. – Working in groups. – Assessment requirements. Note:: This introduction must not be assessed. The topics covered in the introduction will be assessed in the context of the specific content where they apply.
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TERM 1				
STRAND 1: MATTER AND MATERIALS				
Time	Topic	Content	Investigations	Resources
2 weeks (6 hours)	Properties of materials	• Different properties and uses of matter and materials. • Properties of materials which determine their suitability for specific uses: – strength – flexibility – boiling and melting points – conductivity (thermal and electrical) – mass – colour • Suitability of materials produced or used in local industries (<i>links to Grades 8, 9</i>). (Note: “Local industries” refers not only to factories, mills, etc. There is a wealth of materials used in local industry, in rural areas, in building technologies, utensils, clothing and baskets) – Impact on the environment of the production and/or use of one of the materials: environmental damage caused by accessing the material, its use, waste products and pollution.	• Design simple tests to examine and compare properties of selected materials to determine: - strength - flexibility - boiling and melting points - conductivity - mass. (Note: Materials commonly found and used locally should be the focus of the investigations and will be different in heavily industrialised, urban, semi-urban and rural areas.) • Record observations and make judgements about the suitability and properties of at least three different materials (with different properties).	Textbook. Selection of materials for example: paper cardboard copper wire wood rubber plastic stone/clay brick glass aluminium rope/string Heat source. Thermometer. Wax or Vaseline. Magnets. Torch batteries. Torch bulbs.
5 weeks (15 hours)	Mixtures	• A mixture is made up of two or more substances or materials that have different properties. If the properties differ, the substances can be separated: • Methods of physical separation – hand sorting (e.g. sheep wool and thorns, paper and plastic) – using a magnet to separate iron (or nickel) from non-magnetic components – flotation(e.g. paraffin or oil and water, sawdust and sand) – sieving/filtration, (e.g. sand or soil in water, stones in sand) – evaporation to concentrate or collect a solute (e.g. salt or sugar in water). – distillation to collect a solvent (e.g. water from a salt solution,	• Process skills - Hypothesise about the properties of substances in a mixture. - predict results - test ideas -evaluate methods of separation - improve methods • Test effectiveness of separation techniques/methods: - record observations - report on which methods work for which mixtures.	Variety of mixtures; see examples in the content column. Sieve Filter paper Funnel Glass or plastic jars Magnet Paraffin or oil.

Total 7½ weeks (22 ½ hours)	alcohol from methylated spirits) – chromatography to separate two or more soluble components (e.g. coloured inks) • Indigenous technologies for smelting iron in South Africa. • Problems of recycling waste materials by local authorities: importance of separation of materials for recycling. • Consequences of poor waste management by local authorities. • Careers in chemistry, mining, waste management.	- hypothesise about the properties or size of particles that are too small to see (links to particle model of matter in Gr. 8 and onwards) • Investigate the purification of dirty water using filtration, evaporation and condensation: - design ways of to collect clean water. - evaluate the efficiency of these methods for purifying water.	Methylated spirits Metal filings (or coins) Inks sugar/salt Heat source
ASSESSMENT	One formal recorded class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework, worksheets, reports, summaries and essays etc. Refer to the range of skills specified under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	One practical task Refer to range of skills listed under Specific Aim 2.	

TERM 2				
STRAND 2: ENERGY AND CHANGE:				
Time	Topic	Content	Investigations	Resources
2 weeks (6 hours)	Energy Systems and Energy transfer	Concept of a system: Energy can be transferred in a system when different parts of the system interact with one another and cause changes (Approach should be to provide learners with examples rather than a definition).	- Investigate energy transfers in - mechanical - thermal - electrical - biological systems Observe the effects of energy transfers in different parts of these systems: - Where does the initial energy comes from? (potential energy) - Where does the energy go? (transfer) - What changes are observed in the system? (kinetic energy) - Record observations as flow	Textbook. Heat source Metal container Copper wire Battery Torch bulb or buzzer Lever (e.g. ruler) Rubber bands or elastic
	Potential Energy and Kinetic Energy	- Potential energy is energy that is stored in a system , e.g. a stretched rubber band, a weight balanced on the edge of a table, a cell (battery) Kinetic energy is the energy which causes a change or movement (e.g.) the rubber band snaps back, the weight falls off the table current flows through a circuit). - Potential and kinetic energy in - mechanical systems (e.g. a bent ruler can flick a pellet across the classroom, a cricket ball hit by a bat). - thermal systems (e.g. a candle heats cold water in a can) - electrical systems (e.g. a battery in a circuit can activate a motor, buzzer or a small torch bulb) - biological systems (e.g. a horse eats a plant and can move or pull a cart). The unit in which energy is measured is the Joule (J) (No definition of a Joule is required)		
4weeks (12 hours)	Heating is a transfer of	Heating is a process of transferring energy: heat energy is		Textbook aluminium steel Styrofoam

2 weeks (6 hours)	• Energy cannot be destroyed but can be wasted. Saving energy • The national electricity supply system • Renewable and non-renewable sources of energy	• Radiation: transfer of energy, without contact or movement of particles, across empty space. The sun radiates heat energy across empty space to the earth. Colour affects radiation: reflectors. Radiation from a hot object heats up a matt black surface more quickly than it heats up a shiny silver surface. The silver shiny surface is good reflector and reflects heat energy. Good reflectors radiate heat energy more slowly than a poor reflector. (Links to waves and light in Grade 8 and FET). • Energy that is put into a system is transferred to different parts of the system or to the surrounding environment: systems always give out less useful energy than is put into them. • Apply concepts (conduction, convection and radiation) in the home to help control (limit) heat loss in winter or heat gain in summer. • Using energy wisely: suggestions for reducing waste of useful energy. • Good design to improve conservation of heat energy in the home: indigenous building design and technology and suitability for the South African climate. • Transfer of energy from sources such as coal, oil, gas, nuclear material, falling water or wind to dynamos (generators): dynamos transfer energy to electrons (electricity) in the wires of the national supply grid which transfers energy to power lights and many appliances. • History of the discovery of electricity. • Non-renewable sources of energy: coal, oil, gas, uranium. • Renewable sources of energy: hydro power, wind, sunlight, biofuel, wood. • Careers in power generation: coal, nuclear, wind, water: engineers, scientists (research), artisans.	• Demonstrate heat energy transfer through radiation using a candle. • Investigate/demonstrate the differences in absorption of heat and radiation of heat through matt black and shiny silver surfaces. • Investigate the waste of energy from different machines and appliance , e.g. – a car wastes about 65% of the energy from petrol to heat up the air. – a power station wastes about 50% of the energy from burning coal. • Design, make and test a system for keeping food hot for longer (e.g. “wonder box”) or to keep ice cream cold for longer. • Interpret a diagram for a solar water heater by explaining how conduction, convection and radiation apply in a solar water heating system. • Interpret-diagrams of energy flow through the national electricity grid. Identify the points at which energy is lost. • Compare the advantages and	Metal square: shiny silver surface Metal square: matt black surface (metal squares can be made from aluminium foil, paint one matt black) Thermometer or wax Styrofoam Cardboard Glue
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Total 8 weeks (24 hours)			disadvantages of non-renewable and renewable energy sources.	
ASSESSMENT		One formal recorded class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework, worksheets, reports, summaries, essays etc. Mid-year examination on first two terms' work (1 hour). Refer to the range of the skills specified under specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises, tests and exams. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations..	One selected practical task. Refer to the skills specified under specific Aim 2.	
TERM 3				
STRAND 3: EARTH AND BEYOND AND STRAND 4: LIFE AND LIVING				
Time	Topic	Content	Investigations	Resources
1week (3 hours)	The sun is the centre of our solar system	- The sun lies at the centre of our solar system. - The sun radiates heat and light energy. - The sun is the source of energy for the Earth and all life on it. - Plants absorb light energy and produce energy rich food, as well as oxygen by photosynthesising (links to Grade 8). - All animals depend on plants for food (links to Grade 8). - Under specific circumstances dead plants/animals can eventually form coal, oil or gas (links with Grade 5 Geography). (No details of the process are required). - Heat energy from the sun drives weather systems on earth, (wind, evaporation (water cycle), rain (links with Geography:	- Use shiny silver and matt black surface, placed in the sun, to show that the sun radiates heat energy as well as light energy. - Identify variables that could affect results. - Record the differences regarding the rate at which heat energy from the sun is absorbed by different surfaces (e.g. by placing spots of candle wax on	Text book. Shiny metal sheet Matt black metal sheet Candle wax Watch or cell phone clock.

1 week (3 hours)		weather systems). (No details required. Details will be dealt with in Geography).		
	Solar system	• The Earth in the solar system: Sun, planets, and moons. • Sun, Earth and other planets are pulled towards each other by gravity: gravity prevents the Earth and planets from moving away into deep space. The Earth moves in a more or less circular path (orbit) around the sun because of gravity (links with Grade 6) • The moon is also held in a circular motion (orbit) around the earth by gravity. • As the moon rotates around the Earth in its orbit, the different parts of the moon are illuminated by the sun in a regular pattern. These are called the phases of the moon: first quarter, full moon, last quarter, new moon. • Brief history of scientific discoveries related to finding out that the Earth orbits around the sun (and not the sun around the Earth). • Explanations from indigenous cultures, about the causes of day and night.	the metal sheets and measuring the time it takes for the wax to melt). • Demonstrate the pull of gravity by swinging a soccer ball attached to rope or string in a circular motion.	Rope/string Soccer ball
3 weeks (9 hours)	Planet Earth	Earth is a sphere on which life exists on the surface. • Gravity (force) pulls everything on the surface towards the centre of the Earth. ("Down" is the same for everyone on the surface of the planet). • The planet Earth is not hollow (like a ball). It consists of layers. • The planet Earth has three main layers: – geosphere: rocks and soil. – hydrosphere: water – atmosphere: air, gases. (Links with Geography Grade 7. No details required) • Geosphere: the land and seabed are part of a very thin rocky "shell" or crust called the lithosphere (litho means "rock"), below the lithosphere is a much thicker layer called the mantle,	• Observe the phases of the moon every night for one month (30 days). – Record observations every evening (as simple "shadow diagrams") – After one month identify the "pattern" in which the phases of the moon are repeated. (How long does it take for the moon to rotate around the Earth, based on these observations?) • Construct a model of the Earth using paper mache or	Newspaper Wall paper glue

2 weeks (6 hours)	The Biosphere	at the centre is the core which consists mainly of iron. The core is almost as hot as the sun (details will be dealt with in Geography). – hydrosphere: oceans, lakes, rivers, underground water – atmosphere: nitrogen, oxygen, carbon dioxide, water vapour and other gases such as ozone. • Careers in astronomy, geography, geology • The lithosphere (soil and rocks), hydrosphere (water) and atmosphere (gases) support life and are called biosphere. • Requirements for sustaining life: – Energy: the biosphere receives energy from the sun and it is the energy that enables the Earth to support life: flow of heat and light energy from the sun to the earth, light absorbed by plants, plants eaten by animals, fossil fuels formed by dead plants and animals. – Gases: Plants need carbon dioxide in order to photosynthesise and produce food, plants and animals require oxygen in order release energy from food. Plants and animals require nitrogen to make proteins. – Water: Plants and animals require water in order for chemical reactions to take place, reactions release the energy from food for plants and animals to grow and for animals to move and find food. – Soil: Plants require the nutrients in the soil in order to be able to grow and to produce food which is eaten by animals. – Favourable temperature range: The temperature range on Earth ranges from about -50°C (very cold) to about +50°C to (very hot). This means that water, which is critical for sustaining life, occurs in all three phases: ice	playdough or • Construct a “cut away” model of the Earth using paper mache or play dough. Colour/paint the different layers. • Design a flow diagram which shows the flow of energy from the sun to the formation of fossil fuels like oil, gas. Show how the energy is used at different stages in the energy flow.	or flour mixed with water Poster paint
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1 week (3 hours)	Habitats in an Ecosystem	(solid), water (liquid) and water vapour (gas). Some water is permanently frozen and some water is only temporarily frozen. If the Earth was hotter, all the water would evaporate and if the Earth was colder all the water would be frozen. There would be no liquid water to sustain life. • Non living things (abiotic) in a mini-ecosystem. Features of the study area: – sunlight or shade – water – air/wind – temperature (hot or cool) – soil, stones and rocks – steep or gentle slope. • Living things (biotic) in the mini-ecosystem. – plants: trees, shrubs, annuals, grass, alien species (weeds). – insects that live on the plants, pollinators – birds, lizards or small mammals that live on insects. • All animals eat something in the mini-ecosystem and, in turn, can be eaten by something else: concept of a food chain. • Remains of dead plants and animals decay and the nutrients are released back into the system. • Careers in Zoology, Botany, Entomology, Environmental Studies, Nature Conservation.	• Briefly describe the non-living (abiotic) aspects of the ecosystem with regard to sunlight (or shade), water (or dry), air/wind, temperature (hot or cold), soil type, slope (steep or gentle). Describe how these aspects of the ecosystem affect the habitats for plants and animals • Study the soil using hand lens and sieve: separate the remains of dead plants and animals from the soil. Infer the populations of living things in the ecosystem from evidence in the study area (mini-ecosystem), for example – spider egg cases – wasp nests – fly maggots – butterfly/moth eggs on the underside of leaves. – exoskeletons of insects in the soil – parts of skeletons of vertebrates – empty seed pods, – dried fruit or seeds – small shoots from	Sieve handlens identification guide
Total				

7 weeks (21 hours)			germinating seeds Identify living organisms in the ecosystems. Record (list) the evidence that is found.	
ASSESSMENT		One formal recorded class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework, worksheets, reports, summaries, essays, etc. Refer to the range of skills specified under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	One practical task. Refer to the range of skills specified under Specific Aim 2.	

TERM 4				
STRAND 4: LIFE AND LIVING				
Time	Topic	Content	Investigations	Resources
2½weeks (7½ hours)	Biodiversity	Concept of a classification system Diversity of animals • Classification of animals as vertebrates (animals with backbones) or invertebrates (animals without backbones) • Classification of some vertebrates: – Fish – Amphibians – Reptiles – Birds – Mammals Distinguishing characteristics of these groups (classes) of vertebrates. • Classification of some invertebrates – Insects – Arachnids (spiders) – Crustaceans (crabs) (Note: Classification of all of the invertebrates is not required) Visible distinguishing characteristics of each of these three groups of invertebrates. Diversity of plants – Plants are classified as seed plants or plants without seeds (e.g. algae, mosses and ferns reproduce through spores) – Seed plants are angiosperms (they have covered seeds which are produced in flowers) and gymnosperms (naked seeds which are not produced in flowers). • Angiosperms consists of two major groups – dicotyledons	• Group a selection of everyday objects according to observable features for instance shape, colour, size, and use. Construct a simple classification diagram. • Use a dichotomous key to identify examples of each of the five classes of vertebrates. • Use a dichotomous key to differentiate between examples of each of these three groups of invertebrates. • Observe a variety of examples of plants from the immediate vicinity of the school. Classify these examples according to the observable characteristics.	Text book. Selection of everyday objects Selection of photographs or drawings of vertebrates Dichotomous key. Selection of photographs or drawings or preserved specimens of three invertebrate groups. Dichotomous key Selection of plants collected in and around the school property. • Dichotomous

2 weeks (6 hours)	Sexual Reproduction in Angiosperms	– monocotyledons Distinguishing features of these two groups according to one key difference in respect of each of the following: – roots – stems – leaves – flowers or fruits Angiosperm plants reproduce by flowers which produce seeds. • Seeds can only form if flowers have been pollinated. • Pollination can be carried out by – Wind – Insects – Birds • Adaptation of flowers for specific types of pollination. • Importance of pollinators for food production: consequences for farming of overuse of insecticides. • Fertilisation: fruits and seeds • Dispersal of fruits and seeds	• Collect a variety of 10 plant specimens from the school playground or immediate surroundings. • Groups plants as monocotyledons or dicotyledons according to visible features of the roots, stems, leaves and flowers. • Record the key visible characteristics of each group in a table. • Hypothesise about requirements for the growth of seedlings (light, water) Test the hypothesis • Propagate plants from bean or maize seeds. • Record observations of germination of seeds and growth of young seedlings for 2 weeks. (If obtainable, use radish seeds which germinate very quickly)	key
1 ½ weeks (4½ hours)	Sexual reproduction in Humans	Sexual reproduction in humans: • Reproductive organs. • Puberty: physical, psychological and emotional changes. • Menstruation in women, fertile stages. • Intercourse (sex) and conception • Pregnancy • Sexually transmitted diseases: STDs including HIV/AIDS • Contraception and responsible behaviour. • Myths about contraception and sex. (Note: As many learners exit the formal schooling system at the end of primary school (Grade 7), it is important to deal with this sensitive		

1 week (3 hours) Total:	Variation in human populations	topic in sufficient detail for learners to understand the consequences of sex. Whilst learners are too young to cope with all of the detail, they need to know enough about this topic to be able to make informed decisions and lifestyle choices). Inherited characteristics among family members: variation regarding height, inherited tongue rolling.	• Measure and collect information (data) about the height of learners in the class. – Show the results as a bar graph. • Collect information (data) about the height of adults in the immediate family of the learners. – Correlate the height of their family members with the height of learners in the class. • Record information about the prevalence (or not) of tongue rolling among learners in the class. – Calculate the percentage of learners in the class who are able to roll their tongues. • Record information about tongue rolling amongst members of the families of the learners. – Calculate the percentage of family members in a family who are able to roll their tongues...or not. • Draw conclusions and make inferences about whether or not tongue rolling is likely to be an inherited	Ruler or measuring tape.
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7 weeks (21 hours)			trait/characteristic.	
ASSESSMENT		One formal recorded class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, worksheets, homework, reports, essays, summaries, etc. End of year examination (1½ or 2 hours) on the work done in four (4) terms. Refer to the range of skills specified under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework, exercises, tests and exams. The cognitive skills listed under specific Aim 1 and 3 will also apply to knowledge skills and understanding of the investigations and practical work.	One practical task. Refer to the range of skills specified under Specific Aim 2.	

NATURAL SCIENCES: GRADE 8

The first section in Grade 8, called “Subject Orientation”, is included to prepare learners for Science teaching at a Secondary/ high school where they may work in laboratories and where different rules would apply.

- familiarise learners with the way the teacher will organise learning activities.
- familiarise learners with the behaviour that will be required and rules for safety.
- connect what learners have learned in the Primary School with what they will learn, and the skills that they must develop, at High School.
- describe how knowledge is constructed in Science and to introduce a scientific approach that both teachers and learners are required to use when teaching and learning Natural Sciences.
- introduce learners to some basic principles related to science.
- familiarise learners with the skills that they must acquire.

This is not part of the assessable curriculum, although the principles and skills will be assessed in the context of specific knowledge, where applicable

TERM 1	
Time	Introduction to Natural Sciences: subject orientation
1 week 3 hours	• Establish links between Natural Sciences and Life Sciences, Physical Sciences and Geography in the FET phase. • Nature of Science: contested knowledge, non-dogmatic, inferences based on evidence, peer review. • How science works: All of the following should be explained in simple terms: – Fundamental knowledge built on scientific evidence and verifying findings. – Observing.

	– Investigating. – Collecting and presenting data/information. – Identifying patterns and relationships in data. – Communicating findings. – Understanding the limitations of scientific evidence. – Beginning to understand variables. • Scientific skills: – Biological drawings and science diagrams. – Interpreting two-dimensional drawings as three-dimensional objects: transverse and longitudinal sections. – Understanding symmetries. – Drawing and interpreting graphs. – Calculating – Overview of the skills listed in the Specific Aims. • Class organisation and rules – Using equipment and other resources. – Safety procedures. – Working in groups. – Assessment requirements. Note:: This introduction must not be assessed. The topics covered in the introduction will be assessed in the context of the specific content where they apply.
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TERM 1				
STRAND 1: EARTH AND BEYOND				
Time	Topic	Content	Investigations	Resources
4 weeks (12 hours)	Earth in Space	• The solar system: The sun (medium sized star), eight planets, outer dwarf planet, asteroids, comets, man-made satellites. Inner four planets are rocky, outer four planets are mostly gas and liquid. • The Earth's moon moves in an orbit around the Earth every 29½ days. From Earth, only one side of the moon is visible. The Earth and moon together move in an orbit around the sun. The eight other planets all move around the sun in their own orbits. Gravity is the force that keeps all of these objects in stable, predictable orbits. • Exploring the solar system (sun and planets) using satellites and robotic craft controlled from Earth using radio signals: pictures and data are sent back to earth. • Conditions on Earth that support life (temperature range, water, oxygen, sunlight): conditions on other planets (links to Grade 7). • Eclipses – Solar eclipses (eclipses of the sun): moon passes between Earth and Sun, shadow of moon falls on the sun. – Lunar eclipses (eclipses of the moon): Earth passes between moon and sun, shadow of earth falls in the moon, • Earth's atmosphere: The atmosphere of the Earth is a very thin layer of gases held in place by Earth's gravity. Importance of the atmosphere for creating conditions that sustain life: protection against radiation (ultraviolet light). Gases: nitrogen, oxygen, carbon dioxide, water vapour, ozone • Importance and uses of gases in the atmosphere: photosynthesis, respiration, protein synthesis • Impact of human activity on the composition of gases in the	• Construct a model of the solar system: relative distances of the planets from the earth and relative sizes of planets. Note: It is not possible to construct an accurate scale model with the exact proportions. Approximations (for practical reasons) are accepted. - and/or • Model the solar system to scale on the school grounds. • Observe man-made satellites (visible on most evenings about 1hr to 1½ hrs after sunset) • Construct a model to show solar and lunar eclipses (use circular cardboard disks).	Textbook Wall charts Scissors Card board. Light source

2 weeks (6 hours)		atmosphere: Increase in carbon dioxide, pollutants, ozone depletion: causes and consequences. - Greenhouse effect, enhanced greenhouse effect, global warming, climate change -acid rain		Star maps (Southern Sky)
Total 7weeks (21 hours)		• Beyond the solar system: Objects in the night sky: galaxies, stars, solar systems, planets, moons, meteors, asteroids, comets: relative distances of these objects from Earth, relative sizes of these objects, concept of light years. • Exploring space with telescopes: brief history of discoveries in space: optical telescopes, radio telescopes, Hubble telescope, SALT (Southern Africa Large Telescope), SKA (Square Kilometre Array radio telescope): “Looking back in time”... • South Africa’s importance for exploring space: the Southern sky, conditions necessary for using telescopes (cloudless, limited light and other pollution). • Visible constellations: cultures that have identified and have named constellations, significance of constellations. • Stories about the stars from different cultures in South Africa. • Careers in astronomy, cosmology.	• Use star maps of the Southern Sky to identify a few easily recognisable features such as Southern Cross, Venus. • Observe the movement of the Southern Cross across the night sky over a period of about four hours after sunset.	
ASSESSMENT		One formal recorded class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework, worksheets, reports, summaries, essays, etc. Refer to the range of skills specified under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	One practical task Refer to range of skills listed under Specific Aim 2.	

TERM 2				
STRAND 2: LIFE AND LIVING				
Time	Topic	Content	Investigations	Resources
2 ½ weeks (7½ hours)	Interactions and Interdependence within the environment.	Light and heat energy from the sun provide the initial energy in the environment to sustain life (links to Grade 7 and Grade 8). Interactions and interdependence in an ecosystem are driven by the need for energy to sustain life (links with Grade 7).		Textbook.
	Producers	• Green plants use energy from the sun in a series of chemical reactions to produce sugar from water and carbon dioxide. This is called photosynthesis. $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{sugar} + \text{O}_2 \uparrow$ (No further details are required) • Plants transform sugar into starch, cellulose and a variety of other chemical compounds that are needed to sustain life and which enable growth and reproduction.	• Carry out an investigation which proves that green leaves produce starch when they are exposed to sunlight. – Identify the variables that need to be controlled in order to give conclusive evidence. – Carry out a food test to prove that starch is present in the leaves. (Build concept of a chemical test)	Green Plants Heat source Glass containers or test tubes Alcohol iodine Tinfoil or Cardboard
	Consumers	• Plants produce food for other organisms (animals). Animals are the consumers of food produced by plants. Energy is “packaged” into food (potential energy) and can be released from the food by a series of chemical reactions. • Respiration (in plants and animals) is the process by which energy is released from food. $\text{Sugar} + \text{O}_2 \uparrow \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ (No further details are required) – Herbivores: eat only plants (any part of plants that are living or dead), e.g. cows. – Carnivores: eat only other animals (living or dead). There are two main kinds of carnivores: those that hunt other animals are predators (and the animals they eat are the prey) , e.g. leopards and those that eat dead animals are scavenger , e.g. hyenas. – Omnivores; eat plants and animals, e.g. humans. (Note: Insectivores are predators that eat insects, e.g. aardwolf.	• Demonstrate that living animals produce carbon dioxide CO_2 – Devise ways of collecting CO_2. – Test for the presence of CO_2. – Evaluate this demonstration as providing conclusive	Small animals such as snails, locusts, cockroaches, silkworms. Glass or plastic containers. Lime water. Rubber or cork stoppers or plasticine or Prestik

1 week (3 hours)	Food chains and food webs: Energy flow	Detritivores are scavengers that eat plant and animal detritus , e.g. oysters, crayfish. Decomposers are micro-organisms that decompose the remains of dead plants and animals). • Energy fixed in food by photosynthesising green plants (producers) is passed along a food chain to consumers; herbivores and carnivores or omnivores and scavengers and eventually decomposers (Links to energy transfer in systems Grade 7). Energy flows traced along a food chain: food passes up a chain from the producers to variety of consumers herbivores, carnivores, omnivores and scavengers and detritivores and decomposers. • Herbivores, carnivores, omnivores and scavengers eat a variety of different foods: food chains become interlinked to form food webs. • At the end (top) of every food chain or food web are the decomposers: they recycle the nutrients in dead plants or animals into the soil (keeping it fertile). • Plants and animals that die in circumstances in which they cannot decompose can form oil, coal or gas (processes are not required). Energy stored in these organisms becomes available in fossil fuels. • Population: all the organisms of a particular type that live in an ecosystem. Ecosystems have many populations of different kinds that are interdependent on one another because of food chains and food webs.	evidence that respiration has taken place and that CO₂ was produced during respiration (Note: Release the animals unharmed after the demonstration). • Identify a simple food chain in an ecosystem in or near the school grounds. Record the observations. • Relate the simple food chain that has been identified to at least one other food chain in the ecosystem to identify a very simple food web.	Local area for study in or near the school. Key for identifying plants and animals.
4½ weeks (13½ hours)	Disruptions in an ecosystem	• Survival of individual organisms and populations depends on the ability to cope with changes in an ecosystem or habitat. Disruptions that affect populations include, for example	• Predict the effects of change in an ecosystem on a particular population.	

		– lack of food – disease – pollution – predation – drought or floods – destruction of habitat – climate change • Short term disruptions: lack of food, predation, diseases, drought or floods; populations are likely to survive short term disruptions. • Long term disruptions: destruction of habitat, pollution, climate change; populations may not survive: extinctions (local and/or global). • Human beings are dependent on ecosystems: large numbers of humans (± 6 billion worldwide) have a huge impact on the environment. Humans take resources from the environment in order to survive or maintain a life style. Understanding of interdependencies is essential in order to use resources wisely: consumer society. • Disruptions caused by humans , e.g. – pollution of water, soil and air. – carbon emissions and climate change – habitat destruction Causes and consequences of disruptions. • Wise and sensitive use of limited resources: behaviour change. • Need for conservation of food, water and habitat, biodiversity. • Other reasons why environments are important: – cultural practices (sacred places) – recreation – spiritual reasons (wilderness areas) – tourism • Careers in conservation, wildlife management, breeding of near extinct species, environmental impacts, environmental journalism.	Consider, for example – lack of food due to drought – habitat destruction due to farming. In order to make predictions learners should research case studies. Write a report on the findings. • Investigate the carbon footprint of any consumer item (e.g. a box of Smarties). Research all the resources and materials that go into producing and distributing the box of Smarties, e.g. – sugar (habitat destruction) – chocolate – titanium dioxide (dune mining, habitat destruction) – colour pigments in coating – electricity from coal fired power stations (pollution) to run the factory. – cardboard box made from wood pulp – process of making cardboard (habitat destruction)	
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Total 8 weeks (24 hours)			– inks for printing on the box. Where do the ingredients and other resources come from? How they are obtained? How they are transported to the factory? – waste products and pollutants from the factory as well as paper mills. • Transporting raw products; sugar, wood and the final product (Smarties) to shops in trucks. – use of fuel: carbon dioxide emissions. The main concept is that consumers demand products that, whilst they appear small and insignificant, may have a huge carbon footprint. Note: Not all learners will be able to access all the information in great detail. Learners should access as much as they can (and think about the rest) in order to be able to come to a conclusion about the environmental impact of producing a single consumer item, (like a box of Smarties).	
	ASSESSMENT	One formal recorded class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in homework, worksheets, reports, summaries, essay, etc. Mid-year examination on work done in terms 1 and 2 (1½	One selected practical task.	

	hours). Refer to the range of the skills specified under specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises, tests and exams. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	Refer to the skills specified under Specific Aim 2 as well as, for the research topic, Specific Aims 1 and 3.	
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TERM 3				
STRAND 3: ENERGY AND CHANGE				
Time	Topic	Content	Investigations	Resources
5 weeks (15 hours)	Energy transfers	Electrical energy Charges - All matter is made up of atoms. Atoms are made up of smaller particles. - The smaller particles are: - Neutrons: in the nucleus, no electrical charge (neutral) - Protons: in the nucleus, positive charge - Electrons: in the outer “shell” of the atom, negative charge. - Electrons are very fast moving particles: have lots of energy, are held around the nucleus by the positive charges of the protons (opposite charges attract) - Different kinds of matter (elements) have different, unique numbers of neutrons, protons and electrons. This gives each element its unique characteristics. Refer to the periodic table as a way of organising atoms/elements according to their unique structure and properties. Static electricity - Friction (rubbing) of certain materials (e.g. nylon, plastic, Perspex, silk) transfers energy to the electrons in the atoms of the material: the electrons move from one material to the other causing a negative charge on one surface and leaving a positive charge on the other. - Charges are responsible for the shocks or sparks of static electricity, especially when the air is dry. - The danger of static when filling plastic containers with petrol. Safety precautions. Current electricity A complete circuit is needed to make a bulb light up. - Circuit is a conducting path:	- Rub a plastic or perspex ruler with a piece of silk fabric. Bring the ruler close to small pieces of paper. Observe and explain what happens. - Interpret an electrical circuit diagram and the symbols used in it.	Text book Cell/battery Circuit board Torch bulbs Switch Resistors Copper wires Steel wires Copper (II) chloride Magnetic compass other (available) input and output devices.

		– from one terminal of a cell/battery – along wires (conductors) – through the filaments of incandescent bulbs – back to the other terminal of cell/battery. • Switches provide a convenient way controlling electrical energy systems safely when high voltages are used. • Cells/batteries are chemical systems that are sources of energy: cells store chemical substances (potential energy) that react when the circuit is completed (connected across the terminals). The energy source, the cell/battery, creates a voltage by providing electric charges (electrons) with potential energy: charges flow along conductors (kinetic energy). • Voltage causes current.	• Draw circuit diagram of at least two of the electrical circuits, with components, used in the following investigations: Investigate the flow of current (electrical energy) using a simple circuit board: – Complete a series circuit to observe the effects of current flowing through it. – Insert a switch into the circuit. – Increase the number of cells (battery) in the circuit. Observe and record the effect on the brightness of the light bulb(s). – Insert a resistor in series into the circuit. – Insert two resistors in series into the circuit. Observe and record the difference that the number of resistors make to brightness of the light bulbs. – Insert two resistors in parallel into the circuit. Observe and record the difference in the brightness of the light bulbs. – Compare the effects of resistors in series and in parallel by comparing the brightness of light bulbs. – Insert different conductors (wires) into a series circuit. (Different metals conduct	
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		• Effects of a current: A current – heats a conductor (bulb filament): electrical current increases energy transfer to the particles in a bulb filament, increases intensity of light that the filament emits. – causes a magnetic field (electromagnet). – decomposes certain compounds (electrolysis) • Series and parallel circuits: – Series circuit provides only one pathway for the current passing through it, the current is the same everywhere in the circuit. Current decreases when one and then two resistors are added. – Parallel circuit provides two or more pathways for the current passing through it. Current increases when two	electricity differently; all conductors have some resistance). Note:: The effects of resistance are treated qualitatively by observing the brightness of a bulb in the circuit. • Investigate the heating effect of a current by using a resistance wire. Observe and record the effect in written form (qualitative). Predict or interpret information about possible applications. • Investigate the magnetic effect of a current in wires bent into various shapes using a magnetic compass. Predict or interpret information about possible applications. • Investigate electrolysis of Copper II Chloride. Predict or interpret information about possible applications. • Design and draw a circuit to solve a specific problem (Links with Technology: Systems and Control)	
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3weeks (12 hours)	Light energy and the visible spectrum	resistors are added in parallel. – Resistors can be put into a circuit to control the current: , e.g. bulbs, heating wires, elements in kettles, heaters, geysers and stoves are resistors. Resistors cause resistance in a circuit, the higher the resistance the smaller the current. – Short circuit: low resistance parallel path. – Practical applications: Fuses and circuit-breakers reduce danger of high currents that can overheat wires. Other output and input devices – At least one other output device: beeper, buzzer, LED, motor or electromagnetic relay. – At least one other input device: NC switch, pressure pad or photocell. • The history of the discovery of electricity and the first town in South Africa to get electricity • Careers in electrical engineering, electrician, electronics, electricity supply maintenance. Light energy is radiated from luminous objects, reflected off the surfaces of objects, absorbed by some kinds of surfaces and refracted by transparent substances. • Dispersion of light and colours of the visible spectrum: prisms refract white light into the colours observed in a rainbow. This is called dispersion. • White light consists of light with different frequencies (and wavelengths): violet, indigo, blue, green, yellow, orange, red. The light at the violet, indigo, blue range of the spectrum has the highest frequency (shortest wavelength) and most energy and orange and red light has the lowest frequency (longest wavelength) and least energy. • Rainbow: Light from behind the observer falls on water	• Shine light through a triangular prism to make the spectrum visible. Observe and record the sequence of colours in the spectrum. Judge which colours have been refracted most.	Textbook Light source Cardboard with narrow slit. Triangular prism
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		droplets in the air and is refracted and dispersed. • Radiation: Light energy is emitted from luminous objects and is transferred by radiation. Light can travel through empty space at 300 000 kilometres per second: 150 million kilometres from the sun to Earth. (links with radiation of heat). • Reflection: Light is reflected off most surfaces. The angle of incidence and reflection are equal. Smooth surfaces: all light reflected on the same direction. Rough surfaces: reflected light is scattered. • Absorption: Light energy is absorbed differently by different materials. Some of the colours in the spectrum (some of the frequencies) will be absorbed and some colours (some of the frequencies) will be reflected. – A black object (e.g. a black pot) absorbs all of the frequencies/colours and therefore looks black. (links to absorption of heat by matt black surface: Grade 7) – A white object (e.g. white paper) reflects all of the frequencies/colours and therefore looks white. (links to reflection of heat by shiny silver or white surface Grade 7). – A red object (e.g. a wall painted red) absorbs violet, indigo, blue, green, yellow and orange light and reflects red light and therefore looks red. The frequencies that are absorbed do not reach the eye.	• Draw a ray diagram to show the change in direction of light rays at a smooth reflector (e.g. mirror). • Draw a ray diagram to show the changes in direction of light rays reflected off a rough surface: reflected light is scattered. • Explain why – a blue car looks blue – a sunflower is yellow – leaves are green. • Green leaves photosynthesise using light energy from the sun. Explain what frequencies/colours are used for photosynthesis (Links to energy flow in the ecosystem).	Mirror Light source Model of the eye Chart to show section of eye Cardboard box (shoe box) Tissue paper Glue
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Total 8 weeks (24hours)		• Seeing light: The colours/frequencies that are reflected enter the eye. Specialised receptor cells in the retina are stimulated by specific frequencies (colours). Light energy is converted to electrical nerve impulses. Impulses travel to the brain and the brain interprets them. The frequencies of light that are absorbed by the surface of an object do not reach the eye. • Opaque substances: Light is absorbed or reflected by opaque surfaces (it cannot pass through , e.g. metal, clay, bricks, wall paint, cardboard). Shadows are caused by opaque objects and cause areas of a reflecting surface not to be reached by light. • Transparent substances: Light passes through transparent substances (glass, clear plastic, cellophane, clean water). Some of the energy is absorbed but most passes through. • Refraction: Light entering a transparent medium (e.g. glass, water, perspex) at an angle changes direction towards the normal in that medium. Light travelling out of the medium (back into the air) changes direction away from the normal. • Light striking a surface can be absorbed and/or reflected and/or refracted. • Discovery of fire in prehistoric times: light and heat. Importance of this discovery for the development of modern humans. First evidence of the use of fire in caves (France, South Africa). • Careers in optics, physics, optical transmission of information (fibre optics).	• Construct a pinhole camera. Draw a ray diagram to explain the image formed in the tissue paper at the back of the pinhole camera. • Draw ray diagrams to show sizes of shadows caused by cardboard shape. Predict effects of moving the cardboard shape closer to, or further away from, the light source. • Demonstrate the change in the direction of a light ray (beam) through a parallel sided prism. Draw a ray diagram to show the change or Place a pencil or ruler in a glass of clean water. Observe the change in direction of light reflected from the pencil or ruler above the water (in air) and below the surface of the water.	Pin Light source Cut-out cardboard shapes Parallel sided prism. Light source Cardboard with a narrow slit or Glass Pencil or ruler Water
ASSESSMENT		One formal recorded class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of	One practical task.	

	assessment in homework, tests, worksheets, reports, summaries, essay etc. Refer to the range of skills specified under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	Refer to the range of skills specified under Specific Aim 2.	
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3weeks (9 hours)		• Three states of matter – Solids – Liquids – Gases • Physical changes in matter Changes of the state of matter are caused by adding or removing heat. – Adding heat: melting (solid to liquid), evaporation (liquid to gas). – Removing heat: condensation (gas to liquid), solidification (liquid to solid) PKM (Particle Kinetic Model) explains why adding or removing heat causes physical changes in matter. • Models in science A model can be – a physical object – a set of ideas (words or pictures) – mathematical equations which explain a complicated phenomenon in a simple way. • Using the Particle Kinetic Model explain – compressibility of gases – dissolving – diffusion – conduction of heat – convection heat • Compounds and elements – Difference between mixtures and pure substances (links to Grade 7).	becomes more difficult. Explain why it becomes more difficult. • Investigate phase changes by heating solid candle wax in a metal container: • Hot, liquid wax will solidify if the heat source is removed and it is allowed to cool down. Note: The wax has to be heated to high temperatures in order for it to evaporate and if an open flame is used, the vapour can ignite. If ice is available, it is safer to use. This can be heated to melt the ice and to make the water boil and evaporate. • Investigate conduction of heat by placing a drop of wax at one end of a metal rod or metal ruler and heating the other end. Measure the time it takes for the wax to melt. Identify the variables that could affect the result. • Separate (break down) pure copper chloride compound into copper and chlorine	Heat source Metal container Wax or Water (ice) Metal rod or ruler. Heat source Wax Copper II chloride Cell/ battery Wires
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Total 7 weeks (21 hours)		– Pure substances: compounds, such as pure water H_2O, pure carbon dioxide CO_2, pure salt NaCl and elements, such as hydrogen H, oxygen O, carbon C, Sodium Na and Chlorine Cl. – Elements are made of just one kind of atom: compounds are made of two or more kinds of atoms (elements). Compounds can be broken down into elements (which are also pure substances) by heating or electrolysis. – Known elements are limited in number: (about 100): building blocks of millions of pure compounds. – Elements and compounds exist in all three states: solids, liquids and gases. • Chemical reactions – Elements react to form compounds: chemical reaction results in a different substance (compound) being formed. Reactants: substances that react with one another. Products: substances that are produced in the reaction. – Bonds between atoms: force holding atoms together forms bonds in a compound. Bonds are broken when compounds decompose and new bonds between other atoms (elements) can be formed to form new compounds. These changes are called chemical reactions because a chemical change has occurred. (In physical changes such as evaporation or melting and solidification or condensation no bonds are formed or broken. The molecules stay the same). • Useful reactions in indigenous knowledge systems: brewing • Careers in inorganic and organic chemistry, mining,	elements by electrolysis. Record observation or Demonstration: Separate (decompose) any of the following compounds: – Potassium permanganate KMnO_4 to get oxygen O_2 – Mercury oxide HgO by heating to get oxygen O_2 and mercury Hg. Test for O_2 – Water O_2 by electrolysis. Test for H_2 and O_2. • React iron sulphide FeS with hydrochloric acid HCl to produce hydrogen sulphide H_2S (stink bomb gas) • Use plastic “poppet” beads to model reactions or use modelling clay or playdough to model reactions Show reactants (before) and products (after) the reaction has taken place. • Write word equations for the reactions.	Metal plate Test tubes or Small glass containers Potassium permanganate Mercury oxide Iron sulphide Hydrochloric acid. Plastic Beads or modelling clay or playdough
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		engineering, materials development.		
ASSESSMENTS		One formal recorded class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, worksheets, homework, reports, summaries, essays, etc. End of year examination (1½ or 2 hours) on the work done in the four (4) terms. Refer to the range of skills specified under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework, exercises, tests and exams. The cognitive skills listed under specific Aims 1 and 3 will also apply to knowledge skills and understanding of the investigations and practical work.	One practical task. Refer to the range of skills specified under Specific Aim 2.	

NATURAL SCIENCES: GRADE 9				
TERM 1				
STRAND 1: MATTER AND MATERIALS				
Time	Topic	Content	Investigations	Resources
1 week (3 hours)	Particle Kinetic Model of Matter (PKM) in reactions	INTRODUCTION: - Review and revision of PKM which was introduced in Grade 8. - Reactions can be represented in macroscopic (e.g. models) and symbolic ways (e.g. equations). Simple reactions such as $C + O_2 \rightarrow CO_2$ $H_2 + O \rightarrow H_2O$ Names of compounds using names of elements from which they derive , e.g. carbon dioxide, common names for compounds , e.g. water, salt.	- Use beads, beans, plasticine or playdough to make models of several elements and compounds in gas, liquid or solid states. - Draw pictures to show particles in gas, liquids and solids. For example: H_2O, O_2, CO_2, HgO, $NaCl$. In gases the molecules should be far apart, in liquids the molecules should be closer together and, solids, even closer.	Textbook. Plastic beads or beans or plasticine or playdough
3weeks (9 hours)	Metals and Non-metals	Important chemical reactions: Metals and non-metals with oxygen: Introduction: properties of metals and non-metals, main differences between the two. - Some metals react with oxygen to form metal oxides - Non-metals react with oxygen to form non-metal oxides.	- Provide a selection of samples of different materials. What do all metals have in common? Identify the metals. - Investigate the properties of two different metals (e.g. iron, brass or lead):	Samples of wood clay cardboard iron copper brass

2weeks (6 hours)	Acids and	Both kinds of reactions are the reaction of two different elements to form a compound. Metals When metals such as Iron or Magnesium are burnt in air which contains Oxygen, Iron oxide or Magnesium oxide are formed: – Equations in words – Equations as balanced chemical equations. (equal numbers of reactant atoms and product atoms). • Rusting of metal: metals such as iron slowly react with oxygen in the air to form metal oxides such as iron oxide (rust). Non-metals: When non-metal elements such as Sulphur or Carbon burn in air, Sulphur dioxide and Carbon dioxide are formed. – Reactions as word equations – Reactions as balanced chemical equations. Important chemical reactions: Acids and Bases Concept of pH as a measurement of acidity and alkalinity: Universal indicator (UI)	– thermal conductivity – electrical conductivity – malleability and ductility Construct a table to show results. • Burn at least two metals (Iron and Magnesium) in air. Observe the visible changes. (Note: Keep the products of these two reactions for using later) • Model reactions by using beads, beans, plasticine or playdough. • Draw pictures of the reactions (atoms and molecules). • Burn at least two non-metals (Sulphur and Carbon) in pure Oxygen (if possible). Air contains 21% oxygen and this will work but may take longer. • Collect the gas products in a gas jar or large glass container containing a small amount of water: bubble the gas through the water. • Model reactions by using beads, beans, plasticine or playdough. • Draw pictures of the reactions (atoms and molecules). • Test a number of household products , e.g. vinegar, tomato sauce, lemon juice, orange juice,	sugar cubes plastic glass Perspex 9v battery wire leads vaseline or wax hot water • Heat source , e.g. Bunsen burner or spirit lamp. Iron Magnesium Pliers Hammer Heat source Sulphur Carbon (pure oxygen if possible) Gas jar or glass container Plastic tubing. Glass jars or test tubes Universal Indicator
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	Bases – Acids change colour of UI towards the red end of the colour scale. – Bases change the colour of UI towards the blue end of the colour scale. – pH scale represents a range from strongly acidic (low pH) to strongly basic substances (high pH).	• Neutralisation: Reactions of acids and bases A base reacts with an acid and reduces acidity. Use an indicator to show when an acid is neutralised. – A base neutralises an acid and forms a salt and water. – Energy is given off in a neutralisation reaction: the solution gets warm. – A salt is the substance that forms when a metal atom replaces the hydrogen atoms in an acid. – Represent the reaction by writing a word equation and a balanced chemical equation. – Examples of salts: NaCl (table salt) and Magnesium chloride MgCl₂.	dish washing liquid, water, fizzy (carbonated) cold drink, cordial, bleach, shampoo, soaps, toilet cleaner or tea using UI. Record the colour changes for all the products tested and arrange them according to the UI colour changes from darkest red (acidic) to darkest blue (alkaline). • Create a display with the (tested) UI strips. • Make at least two pH indicators from black tea, red cabbage juice or beetroot juice. Test one acidic and one basic household product. Record the colour changes in each indicator for each of the household products. • Use one of the indicators to sort household products into three groups (acidic, neutral, basic) • Neutralise vinegar using an antacid (obtained at a pharmacy or supermarket) or household bleach. • Neutralise Sodium hydroxide (NaOH) with Hydrochloric acid (HCl). Use an indicator to find the point at which the acid neutralises the base, collect the table salt (Sodium chloride NaCl). Note the temperature change. • Make a model to show the	Small samples of a range of household products. Tea bags Red cabbage or Beetroot Household product ., e.g. Vinegar Bleach Range of household products. Sodium hydroxide Hydrochloric Acid UI
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1 week (3 hours)		– Metal oxides and Non-metal oxides Metal oxides: metals react with Oxygen and form oxides that are basic (alkaline) (high pH). Non-metal oxides: non-metals burn in Oxygen and form non metal-oxides that are acidic when they dissolve in water (low pH) – Lime (CaO: Calcium oxide) is used in agriculture to make soil less acidic. – Summary and review of the reactions dealt with in Term 1 Pattern Metal oxide + acid → salt + water Other acids used in the laboratory: formulas of, e.g. Sulphuric acid, H₂SO₄, Nitric acid HNO₃. • Acid rain: natural acid rain and acid rain as a result of the burning of wood and fossil fuels.	neutralisation reaction and make a drawing of the equation. • Test the pH of the solutions that were formed when Carbon and Sulphur were burned in oxygen to form CO₂ and SO₂. The gases dissolved in water and then reacted with water to form Carbonic acid H₂CO₃ and Sulphurous acid H₂SO₃ respectively. Record the acidity using UI. • Test soil from different places in the area around the school. Use UI to find out whether the soil is acidic or basic. Record the results • Research acid rain: the causes and consequences. • Write a report on the problems related to acid rain. Include recommendations for reducing acid rain.	Soil UI Newspapers Magazines Internet Reference books.
Total 7 weeks (21 hours)				
ASSESSMENT		One formal recorded class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework, worksheets, reports, summaries, essays etc. Refer to the range of skills specified under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	One practical task Refer to range of skills listed under Specific Aim 2. Note: In Term 1, learners are expected to spend a significant amount of time on doing practical work.	

TERM 2				
STRAND 1: MATTER AND MATERIALS (cont) AND STRAND 2: EARTH AND BEYOND				
Time	Topic	Content	Investigations	Resources
2 weeks (6 hours)	Acids: reactions with metal hydroxides, metal carbonates.	- Metals also form metal hydroxides and metal carbonates; these metal compounds neutralise acids. Pattern: hydroxide + acid → salt + water Pattern: carbonate + acid → salt + water + carbon dioxide Examples - Potassium hydroxide and Hydrochloric acid: $\text{KOH} + \text{HCl} \rightarrow \text{KCl} + \text{H}_2\text{O}$ - Calcium carbonate and Hydrochloric acid: $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ - Reactions as word equations. - Reactions as balanced chemical equations. Mind mapping to organise the information about chemical reactions so far: - metals and non-metals with oxygen - acids and bases, neutralisation. - metal oxides and non-metal oxides - metal hydroxides and acids. - metal carbonates and acids. (Many metals react with acids to form a salt and hydrogen.)	- Use UI to test solution that forms when Magnesium oxide (MgO) dissolves in water. Record the pH (MgO dissolves in water to form $\text{Mg}(\text{OH})_2$ (Magnesium hydroxide). This is an ingredient of the antacid “Milk of Magnesia” - Investigate the reaction of Potassium hydroxide with Hydrochloric acid. Record results. - Investigate the reaction of Calcium carbonate with Hydrochloric acid. Exercise - Use this pattern to predict reaction of, for example: $\text{CaCO}_3 + \text{H}_2\text{SO}_4$ (Calcium carbonate and Sulphuric acid). - Make model of the reactants and products of the reaction. - One other example of a metal carbonate reacting with an acid.	Textbook. Potassium hydroxide Hydrochloric acid Calcium carbonate Test tubes or small glass containers. Sulphuric acid. Beads or beans or plasticine or playdough
2 weeks (6 hours)	Acids: reactions with metals	Pattern: metal + acid → salt + hydrogen gas	SAFETY NOTE: LEARNERS SHOULD NOT TRY TO DILUTE	Magnesium Hydrochloric acid

2 weeks (6 hours)	Reactivity of metals	Examples: • Magnesium and dilute Hydrochloric acid: $\text{Mg} + 2 \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2 \uparrow$ • Zinc and dilute Hydrochloric acid. $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2 \uparrow$ • Write reaction in words • Write reaction as a chemical equation • Each metal is different because the atoms in the metals are different: Some metals react easily, some metals don't. (The reactivity of metals is a useful pattern in chemistry). More reactive metals will replace less reactive metals in a solution. • Reactivity is used in industrial processes to extract a less reactive metals from solutions. • Rusting is the reaction of iron with oxygen that dissolves in water. Iron and steel are essential materials in modern constructions. Equipment or structures can rust, weakening them. This is corrosion. Iron rusting is a special case of corrosion. Rust prevention: protect iron from water and moist air or connect a more	HYDROCHLORIC ACID THEMSELVES as acids react strongly with water. An acid must be slowly added to water and not water to an acid to dilute it. • Investigate the reaction between Magnesium and dilute Hydrochloric acid. Collect the gas that is formed. • Investigate the reaction between Zinc and dilute Hydrochloric acid. Collect the gas that is formed. • Use a flame to identify the gases. • Compare the reaction times of Magnesium and Zinc with dilute hydrochloric acid. • Construct a model of the reactants and products. • Fill a balloon with hydrogen gas, let it rise and explode. • Compare the reactivity of Magnesium Mg, Zinc Zn, Iron Fe and Copper Cu with dilute Hydrochloric acid. Record observations and rank these metals in order of how quickly they react. Write these reactions as chemical equations: – Magnesium and Hydrochloric acid – Zinc with Hydrochloric acid. – Copper with Hydrochloric	Test tubes or small glass containers Candle Beads, beans Plasticine or Playdough
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2weeks (6 hours)	Extracting metals from ores.	reactive metal (Magnesium or Zinc) to the Iron: the more reactive metal reacts and corrodes instead of the Iron. Kidney stones - Some kidney stones are Calcium oxalate, an insoluble compound. They are more common in areas in South Africa where the water does not contain sufficient Magnesium. By taking a small amount of Magnesium daily, the formation of Calcium oxalate is prevented because Magnesium is more reactive than Calcium and displaces the Calcium to form a soluble compound which can be excreted. - Introduction to the periodic table, vertical and horizontal patterns in the periodic table. Mendeleev - Careers in chemical industries, agriculture, pharmacy or the food industry, chemical engineering, mining etc. - Review chemical reactions done in Grade 9: many of them have to do with metals. Focus on reactions involving Iron and the reactivity of different metals. - Minerals are extracted from ore (ore is rocks in which minerals are concentrated.) - Indigenous technology of iron smelting and modern methods of mass producing iron. Knowledge of iron extraction is thousands of years old: iron and copper extracted on the Highveld, KZN and Limpopo. - Environmental impacts of opencast and underground mining: waste products and pollution of water resources. - Laws that aim to control environmental impacts of mining. - Decisions about using land for tourism, agriculture or mining. Impacts of mining on high value tourist areas, cultural heritage sites (even world heritage sites), wild life and farming.	acid. - Investigate the reactions of Iron with Magnesium sulphate solution and Magnesium with Iron sulphate solution. Record observations. Write these reactions as chemical equations. - Hypothesise about the best way to prevent rust. - Research indigenous iron smelting which used the reaction: Iron oxide and carbon reacts to form iron and carbon dioxide $2 \text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 4\text{Fe} + 3\text{CO}_2$ - Analyse and interpret information about a mining related issue in South Africa. Debate the issue in terms of - sustainability - value of environments for tourism - heritage environments - farming - short term and long term job creation Write a report on the issue and communicate scientific information. About sustain ability.	
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Total 8 weeks (24 hours)		Renewable and non-renewable resources • Mining removes resources from the ground: these resources are not renewable. Non-renewable mined resources include platinum, gold, diamonds, oil, gas, asbestos: once resources have been mined they cannot be replaced. • Renewable resources include power generation through wind and/or water. Biofuels made from plants (for powering motor vehicles) are sometimes listed as renewable because they are made from plants. Environmental impact of producing biofuels: habitat destruction, loss of topsoil, use of water for irrigation, pesticides and fertiliser pollutants in soil and water. Renewable, but not without environmental damage (Links to Grade 7, 8 and 10).		
ASSESSMENT		One formal class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, homework, worksheets, reports, summaries and essays. Mid-year examination on work done in Terms 1 and 2 (1½ hours). Refer to the range of the skills specified under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises, tests and exams. The cognitive skills listed under Specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	One selected practical task. Refer to the range of skills listed under specific Aim 2	

TERM 3				
STRAND 3: ENERGY AND CHANGE				
Time	Topic	Content	Investigations	Resources
2 weeks (6 hours)	Forces	- Push and pull forces: two objects (bodies) exert forces on each other: forces always act in pairs. - Different kinds of forces: Contact forces: two bodies must be in contact (touch) with each other: Mechanical: physical forces , e.g. using a lever to move a heavy object. Mechanical: Push and Pull. Newton’s Laws apply. (Mention only) Field forces (non-contact forces): forces act at a distance: gravity, magnetic and electrical forces: Gravity: Objects with mass attract one another , e.g. sun and planets, Earth and moon, Earth and objects on the surface (people and things). Force is greater the more massive the objects (greater mass). Force decreases if distance between the objects increases. Force of gravity is measured in Newtown (N). Weight of an object (determined by its mass) will be different when weighed in different places. Mass of an object stays the same no matter where it is determined. Gravity: pull force Magnetism: Magnets attract magnetic substances , e.g. Iron, Nickel. Magnetic poles of a bar magnet: opposite poles attract and like poles repel each other. Earth’s magnetic field. Magnetism: push or pull forces.	- Investigate physical (mechanical) push and pull forces. Learners stand on planks on rollers (pencils or dowel sticks) and push and pull each other. Observe and record what happens when one person pulls, when both people pull, when one person pushes when two people push. - Demonstrate gravity by falling objects: direction always “down” towards the centre of the Earth. The object (small mass) and the Earth (large mass) attract one another. - Investigate the magnetic field of a bar magnet using iron filings. Draw the magnetic field. - Investigate the magnetic field of two bar magnets with opposite poles towards each other (pull force). Draw	Text book 2 planks dowel sticks or pencils or pieces of broom stick (2 pieces per plank) . . Bar magnets Iron fillings Paper Wood Plastic Iron Brass

3 weeks (12 hours)	Cells as chemical systems and sources of energy	• Electrical: Like charges repel each other (+ and + or - and -) and unlike charges attract each other (+ and -): push or pull forces. Two charged objects in an electrostatic system store energy as potential energy. The energy comes from the work done to cause the friction. • Lightning: clouds separate huge quantities of electrostatic charge, charges accumulate potential energy which is released in a lightning strike. Various cultural beliefs about the causes of lightning. Safety during thunder and lightning storms. • Dynamos and cells separate charge and give them potential energy. • Cells store substances that can react if an external circuit is connected across the terminals. • Chemical reactions in a cell separate positive and negative charges (potential energy) which can then flow through an external circuit (kinetic energy). • Battery: cells that are connected together.	the magnetic field. • Investigate the magnetic field of two bar magnets with like poles towards each other (Push force). Draw the magnetic field. • Investigate substances (non-metals and metals) attracted by a bar magnet: , e.g. paper, wood, plastic, iron, brass, magnesium. Record the observations in table form. • Investigate different materials through which a magnetic force can act , e.g. wood, paper, foil, hand, steel. • Investigate the attraction and repulsion of electrostatically charged objects: simple electrostatic system that causes movement. (links with static electricity in Grade 8). Note: This activity does not work well in rainy weather or humid conditions as water droplets in the air allow electric charge to “leak” away from charged objects. • Explore various beliefs about the causes of lightning. • Make a cell using laboratory chemicals or acidic fruit (e.g. lemons). Connect several cells until a LED (light emitting diode) is able to light up.	Magnesium Aluminium foil Perspex rod or Plastic ruler Silk cloth
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	Relationships in series and parallel circuits.	- Cells connected in series: voltages (potential differences) add up. - Cells connected in parallel: voltage the same as for one cell but larger current can be drawn from them. Voltage and current - Series circuit: resistors split the voltage of a battery, higher resistances have higher voltages. - Parallel circuit: all parallel resistors have the same voltage across them. - Series circuit: total current from a battery decreases with each resistor added to the current. - Parallel circuit: total current from a battery increases with each parallel resistor added Resistance and resistors Conductors (even good conductors) heat up when current passes through them: some energy is lost as heat. Conductors have some resistance. Resistor: conductor selected to control the current or to provide useful energy transfer , e.g. bulbs, rheostats, motors, light sensitive diodes. Resistors are manufactured to have accurate resistances to control current. - Current through a resistor is directly proportional to the current across it (except when resistor gets very hot). - Resistance of the resistor is the ratio of the voltage to the current $R = V/I$ (R=resistance, V=Voltage, I = current) Note:: Cells do not produce a constant current. Current can be very small in some circuits, irrespective of the cells/battery. Cells produce a constant voltage, not current. Current will be bigger with low resistance and smaller with higher resistance. Factors that affect resistance in a circuit: - Type of material - Diameter or conductor - Length of resistor - Temperature of conductor	- Measure voltages across series resistors, add up voltages and measure the current at different points in a series circuit. Record measurements in a table. - Measure voltages across parallel resistors and the currents through them and add up the currents. Record measurements. - Investigate at least one of the factors that affect resistance of a resistive conductor in a circuit. Identify the range of variables. Control variables. Measure current to infer resistance.	Circuit board Cells/battery Conductor (wire) Resistors Light bulbs or LEDs Voltmeter Ammeter
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2 weeks (6 hours)	Safety with electricity	Wiring in homes, cars and toys. • Identify series and parallel circuits, fuses, circuit breakers, earthing and earth leakage systems. • Safety practices – Parallel connections causing overload of mains circuits: circuit breakers and fuses. – Illegal connections to ESKOM main supply: energy theft, dangers.	• Draw the plan for wiring a House: – Each room has light with a switch. – house has a main switch and a fuse to prevent short circuit overload. Different ways to wire rooms. (Do not construct a model house). or Make a switch, a dimmer switch, alarm, main switch or trip switches.	
	National electricity grid	• Power stations burn coal to heat water to create steam to drive turbines which drive dynamos (generators). • Power stations feed energy into the national grid at high voltages, powerlines carry energy at high voltages. Transformers step down the voltage for local distributors and consumers: 15% of energy is wasted due to heating of transmission lines and transformers (No details are required of alternating current or step- down transformers). • National grid is a network of interacting parts: change in one part of the grid affects other parts of the grid: power surges. • Consequences of grid overload. • Alternative sources of energy, besides coal, that can be used to drive dynamos: wind, waves in the sea, falling water, sun heated steam, nuclear fission.	• Demonstrate a dynamo on a bicycle. Connect extra bulbs in parallel. Record the effect of this on the rate at which a learner must pedal. • Research alternative sources of energy that can be used to drive dynamos for the national grid. Evaluate these in terms of sustainability and environmental impact.	
1 week (3 hours)	Costs of energy from electrical systems	• Power is the rate of supplying energy to a system: Joules, seconds and watts. • Power to electrical systems: voltage x current: volts, amperes and watts. $P=V \times I$	• Collect bulbs or other output devices. Record the voltage rating and power output printed on the devices. Which ones use most energy and which ones use least.	

Total 8 weeks (24 hours)		• Consumers pay for energy (not power or current) costed in kWh (kilowatt hours). Quantity of energy paid for by consumer depends on kW rating of the appliance multiplied by the number of hours that the appliance is used. • Energy consumption of different appliances , e.g. incandescent and compact fluorescent lamps. • Alternatives such as solar heating panels for heating water. • Careers: electrician, electrical engineer, artisans for maintaining the power grid, IT specialists.	• Calculate the energy consumption of different appliances , e.g. iron, stove, TV, radio, refrigerator. (Different learners should calculate the consumption of different appliances). Tabulate the energy consumption of the different appliances calculated by different learners. Calculate how long a prepaid card will last in an “average” household , e.g. Fridge is switched on for 24 hours a day, stove is used for two hours a day, TV is switched on for four hours a day.	
ASSESSMENT		One formal recorded class test. Assessment for learning (informal) using a variety of strategies and forms of assessment in tests, homework, worksheets, reports, summaries, essays etc. Refer to the range of skills specified under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework exercises and tests. The cognitive skills listed under specific Aims 1 and 3 will also apply to knowledge and understanding of investigations.	One practical task. Refer to the range of skills specified under Specific Aim 2.	

TERM 4

STRAND 4: LIFE AND LIVING

Time	Topic	Content	Investigations	Resources
1½ weeks (4½ hours)	Healthy living	Micro-organisms and diseases • Micro- organisms: living things too small to see with the naked eye • Microscopes: the hidden world of micro-organisms: history of the discovery of microscopes. • Great variety of different micro-organisms. • Roles of micro-organisms in ecosystems: – decomposers: maintaining fertility of the soil – water purification. – digestion of food in human alimentary canal • Harmful micro-organisms cause diseases: TB, HIV, E Coli, meningitis, malaria. • Disease causing organisms occur most everywhere (ATMs, handrails of staircases, lift buttons, door handles, toilets, bathrooms and kitchens). Invisible micro-organisms are picked up on the hands. Washing hands is an effective method of preventing the spread of diseases. • Water borne diseases caused by micro-organisms account for more child deaths than any other cause. Boiling water, even if it looks clean, is essential to prevent infections and disease if the water is untreated or not properly treated. • Cultural and historical beliefs about the causes of diseases. • The role of modern scientists in identifying and developing cures for some diseases , e.g. Fleming, Salk and Pasteur • Careers in microbiology, primary health care and medicine.	• Use hand lenses or micro viewers to examine small objects (e.g. animals) to understand the concept of magnification. • Examine photographs and/or micrographs of micro-organisms. Use scales to calculate the real size of the organisms. • Culture micro- organisms from soil water on gelatine or agar plates. Count varieties and record growth of cultures over a period of 10 days. Make deductions about the rate of reproduction. or	Textbook Hand lenses or bioviewers Petri dishes or glass bowls Gelatine or sugar Yeast Sugar Glass container
1½ weeks (4½ hours)	Cells as the basic units of life	• All living things have a metabolism (sum of all the chemical reactions that sustain life). All organisms (including micro-organisms) have the same,	• Make a culture of yeast cells. Record observations over a period of 6 days.	

		essential, metabolic processes , e.g.: – take in oxygen – take in and digest food (nutrients). – respire – grow – reproduce – repair damage – excrete waste products. • Microscopic organisms consist of a single cell (e.g. bacteria). Macroscopic organisms consist of large numbers of cells made of different molecules and atoms. Cells are specialised to form different tissues with specialised functions and different tissues make up organs. Organs make up systems. Generalised cell structure • All cells are enclosed by a membrane which allows specific substances to pass into and out of the cell. • All cells have a cytoplasm which provides a liquid medium for all the chemical reactions (metabolism) that take place inside the cell. • All cells contain DNA which carries the genetic code according to which organisms reproduce. In most organisms the DNA is enclosed within a membrane to form the nucleus. • All cells contains small structures (organelles) such as mitochondria which are responsible for respiration to release energy from food. • Plant cells differ from animal cells: some plant cells contain chlorophyll which absorbs light energy to photosynthesise and make energy-rich food: sugar and starch (links to Grade 7 and 8). Plant cells have cellulose cell walls to provide support for the cells in tissues.	Make deductions about the rate of reproduction. • Make 3 dimensional (3D) model of a cell	Plasticine Playdough
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4weeks (12 hours)	The human body and healthy living	• Whilst most cells carry out their own life processes (metabolism): nutrition, respiration, gas exchange, growth, excretion, repair and reproduction, different cells specialise in different functions. • In the human body cells are specialised to carry out specific functions, , e.g. – muscle cells are specialised to contract and to cause movement. – nerve cells are specialised to conduct electrical nerve impulses. – red blood cells are specialised to transport oxygen and carbon dioxide. Cells with the same function look the same and form tissues which specialise in the same functions. • Stem cell research: stem cells can be made to specialise into a range of different cells. (No detail required). Ethical issues related to stem cell research. Note: The structure and functioning of organs and systems in the human body should be taught only as far as they are required to understand their main functions and health issues related to these organs or systems. The intention is to provide learners with an overview of the functioning of the human body in order for them to make decisions about healthy living. The emphasis is on health education. • Human body is complex: depends on all of the parts (systems, organs, tissues, cells) working together effectively.	• Examine micrographs of different tissues such as nerve tissue, muscle tissue, red blood cells, bone, cartilage, skin. Draw and label cells from two at least different tissues. • Build a 2D (2 dimensional) model of the human systems. Draw each system on paper or cardboard and add each system to an outline of the human body when the system is dealt with in the	. Models or charts: – torso – heart – kidney – digestive system – lungs Paper Scissors Prestik Pens If photocopying facilities exist teachers can consider printing one outline of the
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		• Alimentary canal and Nutrition: ingestion, digestion absorption and egestion. Essential nutrients: carbohydrates, proteins, fats, vitamins, micro nutrients. Balanced and unbalanced diets. Consequences of poor nutrition. Causes of obesity and ulcers. Diarrhoea and dehydration. • Heart, blood vessels and Circulation: Transport of substances such as oxygen, carbon dioxide, digested food, waste products for excretion, hormones. Relate the transporting of substances around the body to the circulatory system and the function of the heart (no details required) Diseases related to the circulatory system: hypertension (high blood pressure) narrowing of arteries, heart attacks, strokes. Dangers of smoking and high cholesterol levels (links to nutrition). • Skeleton, Muscles and movement: Skeleton, muscles and nerves work together to enable coordinated movement. Food is needed to provide energy (links to alimentary canal and nutrition) and respiration releases energy for muscle contraction. Exercise requires more energy in the muscles and this requires more oxygen (breathing rate increases) Diseases which affect the skeleton: rickets, osteoporosis (links to nutrition) • Lungs and breathing: Lungs and gas exchange system. Inhalation to obtain oxygen for respiration to release energy for movement and metabolic processes. Exhalation to rid the body of carbon dioxide (excrete a waste product). Relate the gas exchange system to the circulatory system. Benefits of exercise for the cardio vascular system. Diseases of the lungs: emphysema, cancer. Effects of smoking, pollution or asbestosis.	curriculum. • Compare balanced diets from different cultural traditions. • Measure and compare heart rates before and after exercise. Collect information/data on at least 10 learners. Draw a bar graph of the results. Make deductions about the fitness of the learners based on heart rate. • Dissect a pig or sheep heart obtained from butchery to examine the structure of the heart. • Measure and compare lung capacity of different learners (by exhaling air through a tube to displace water in a container). Draw a bar graph of the lung capacity of learners in the class. Analyse and interpret results. Link lung capacity to the	human body for each learner as well as a set of systems and organs which they can cut out and stick onto the outline. Stop watch or cell phone clock Sheep's or pig's heart (from butchery) Glass jar or plastic bottle water plastic tube. • Lung pluck from the butchery hand lens • Kidneys obtained from
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Total: 7 weeks (21 hours)		more oxygen and exhale more carbon dioxide. A balanced diet is needed for growth and muscle development as well as providing energy. The kidneys need to function efficiently to remove metabolic waste products. The brain would have to coordinate movement. Efficient thermoregulation is essential to prevent overheating during exercise. • Recognising ill health: Importance of recognising the implications of a fever and dehydration in young children. • Life style choices. • Indigenous knowledge systems: use of indigenous plants to support and improve health and to fight disease. • Modern medicines from natural products , e.g. aspirin, progesterone, oestrogen, chloroquine. • Occupational health and safety. Preventing damage to hearing, lungs, skeleton /spine. • Careers in medicine, health care, nutrition, fitness training.	• Produce a poster advocating healthy life style choices.	Paper/card Coloured pens
ASSESSMENT		One formal recorded class test. Assessment for learning (informal) using a variety of strategies and appropriate forms of assessment in tests, worksheets, homework, reports, summaries and essays. A variety or focus of informal assessment for learning. End of year examination on work done in terms 1 to 4 (2 hours). Refer to the range of skills specified under Specific Aims 1 and 3. Note that knowledge and understanding of investigations and practical work should also be assessed in written worksheets, reports, homework, exercises, tests and exams. The cognitive skills listed under specific Aim 1 and 3 will also apply to knowledge skills and understanding of the investigations and practical work.	One practical task. Refer to the range of skills specified under Specific Aim 2.	

SECTION 4

ASSESSMENT

4.1 INTRODUCTION

Assessment is a continuous planned process of identifying, gathering and interpreting information about the performance of learners, using various forms of assessment. It involves four steps: generating and collecting evidence of achievement; evaluating this evidence; recording the findings and using this information to understand and thereby assist the learner's development in order to improve the process of learning and teaching.

Assessment should be both informal (Assessment for Learning) and formal (Assessment of Learning). In both cases regular feedback should be provided to learners to enhance the learning experience.

Assessment is a process that measures individual learners' attainment of knowledge (content, concepts and skills) in a subject by collecting, analysing and interpreting the data and information obtained from this process to:

- enable the teacher to judge a learner's progress in a reliable way.
- inform learners of their strengths, weaknesses and progress.
- assist teachers, parents and other stakeholders in making decisions about the learning process and the progress of learners.

Assessment should be mapped against the content and intended aims specified for Natural Sciences and in both informal and formal assessments it is important to ensure that in the course of a school year:

- all of the subject content is covered.
- the full range of skills is included.
- a variety of different forms of assessment are used.

Barriers to learning and assessing

- Although there are many barriers to learning, teachers need to identify and build on strengths of learners in order to affirm their uniqueness. **All learners need to experience success.**
- Alternative strategies must be applied: more time, enlarged text, use of information communication technology, amanuensis or scribes in cases of learners with special educational needs.

- The use of alternative assessment relates to the change in the form of assessment used to accommodate all learners. It is important to vary the assessment strategy appropriately.
- Learners' personal involvement with tasks often improves their attention span, patience, persistence and commitment.
- Designing and making real products that can be used can give learners a sense of achievement and improve their self-esteem.
- The following strategies, depending on the physical barriers of LSEN learners, could apply when supporting:
 - Using the support of others to help pupils take part safely in practical work, for example, the assistance of adults or other learners to help them to hold or manipulate tools, or to carry out activities according to instructions. It is important that the learners should retain control of the making process and be the decision makers.
 - Learners can describe their design ideas for others to record or to translate into a drawing, whilst retaining control of the design idea and the modifications.
 - Work on shorter, more focused tasks, rather than longer, open tasks. Doing so can provide learners with incremental elements of success, and regular motivation and reward.
 - Use ICT applications, such as specialist software, to help sequencing and following instructions during practical work.
 - Use modelling, role play, tape recorders, video and photographs to communicate, develop and record their ideas.
 - Communicate using a range of methods avoiding over-reliance on the written word.

4.2 INFORMAL ASSESSMENT OR DAILY ASSESSMENT

Assessment for learning has the purpose of continuously collecting information on a learner's achievement that can be used to improve their learning.

Informal assessment is a daily monitoring of learners' progress. This is done through observations, discussions, practical demonstrations, learner-teacher conferences, informal classroom interactions, etc. Informal assessment may be as simple as stopping during the lesson to observe learners or to discuss with learners how learning is progressing. Informal assessment should be used to provide feedback to the learners and to inform planning for teaching, but need not be recorded. It should not be seen as separate from learning activities taking place in the classroom. Learners or teachers can mark these assessment tasks.

Self assessment and peer assessment actively involves learners in assessment. This is important as it allows learners to learn from and reflect on their own performance. The results of the informal daily assessment tasks are not formally recorded unless the teacher wishes to do so. The results of daily assessment tasks are not taken into account for promotion and certification purposes.

Informal, ongoing assessments should be used to scaffold the acquisition of knowledge and skills and should be the stepping stones leading up to the formal tasks in the Programmes of Assessment.

4.3 FORMAL ASSESSMENT

All assessment tasks that make up a formal programme of assessment for the year are regarded as Formal Assessment. Formal assessment tasks are marked and formally recorded by the teacher for progression and certification purposes. All Formal Assessment tasks are subject to moderation for the purpose of quality assurance and to ensure that appropriate standards are maintained.

Formal assessment provides teachers with a systematic way of evaluating how well learners are progressing in a grade and in a particular subject. Examples of formal assessments include tests, examinations, practical tasks, projects, oral presentations, demonstrations, performances, etc. Formal assessment tasks form part of a year-long formal Programme of Assessment in each grade and subject.

Grades	Formal School-based Assessments	End-of-year Examinations
R – 3	100%	n/a
4 – 6	75%	25%
7 – 9	40%	60%
10 and 11	25%	75%
12	25% including school based mid-year examinations and “trial” examinations	External examination: 75%

The cognitive demands of assessment used should be appropriate to the age and developmental level of the learners in the grade. Assessments in Natural Sciences must cater for a range of cognitive levels and abilities of learners within this context. The assessment tasks should be carefully designed to cover the content of the subject as well as the range of skills that have been specified under the Specific Aims. The design of these tasks should therefore ensure that the full range of content and skills are assessed within the each year of the Senior Phase. The Specific Aims, the topics and content and the range of skills must be used to inform the planning and development of assessment tasks.

WEIGHTING OF COGNITIVE LEVELS FOR THE ASSESSMENT OF CONTENT IN GRADE 7, 8 and 9

	Knowing Science	Understanding Science	Applying Scientific Knowledge	Evaluating, Analysing Synthesising Scientific Knowledge
%	40%	25%	20%	15%
Useful verbs	State Name Label List Define Describe and others	Explain Compare Rearrange Give an example of Illustrate Calculate Make a generalisation and others	Predict Apply Use knowledge Demonstrate Solve Implement Judge and others	Select Differentiate Analyse Infer Suggest a reason Discuss Categorise and others

Note: These cognitive skills apply to all three Specific Aims: Knowing and doing science and science and society.

Note: A single formal class test in a term will not necessarily provide the most accurate and reliable evidence of every learner's performance. As far as possible, teachers should try to let learners write more than one class test per term in order to get a better picture of the abilities of the learners in the class. One formal class test per term is the minimum number that must be recorded.

4.4. ASSESSMENT REQUIREMENTS FOR NATURAL SCIENCES

4.4.1 GRADE 7

The Programme of Assessment is designed to spread formal assessment tasks in all subjects in a school throughout the term.

PROGRAMME OF FORMAL ASSESSMENT					
Formal, recorded school-based assessments 40%				End-of-year internal school-based examination 60%	
Content		Investigations		Written examination (1½ hours) (90 marks)	
- Four formal class tests (40 marks each) - One mid-year examination (60 marks) One project (can be done in any term but marks be recorded in term 4) (50 marks) The skills are specified in Specific Aims 1,2 and 3.		A selection of eight (prescribed) representative practical tasks, which cover the range of skills described in Specific Aim 2, of which four must be recorded.		Content, concepts and skills across all topics, including knowledge of investigations and some of the skills associated with practical work, must be assessed in the written exam.	
		Practical tasks differ with regard to the skills that can be assessed. The marks allocated per activity will therefore vary but should not be less than 20. (20 to 30 marks)			
SCHOOL-BASED ASSESSMENT (During the year)					
TERM 1	TERM 2	TERM 3	TERM 4		
- One formal class test. - One selected practical task	- One formal class test. - One selected practical task - One mid-year examination (1 hour)	- One formal class test - One selected practical task	- One formal class test - One selected practical task - One project		
25%	25%	25%	25%		
Convert to 40% (YEAR MARK)				60% (EXAM MARK)	

4.4.2. GRADE 8

The Programme of Assessment is designed to spread formal assessment tasks in all subjects in a school throughout the term.

PROGRAMME OF FORMAL ASSESSMENT				
Formal, recorded school-based assessments 40%				End-of-year internal school-based examination 60%
Content		Investigations		Written examination (1 ³ / ₄ hours) 100 marks
- Four formal class tests (45 marks each) - One mid-year examination (90 marks) One project (can be done in any term but marks must be recorded in term 4) (50 marks) The skills are specified in Specific Aims 1,2 and 3.		A selection of eight (prescribed) representative practical tasks, which cover the range of skills described in Specific Aim 2, of which four must be recorded. Practical tasks differ with regard to the skills that can be assessed. The marks allocated per activity will therefore vary but should not be less than 20. (20 to 40 marks)		Content, concepts and skills across all topics, including knowledge of investigations and some of the skills associated with practical work, must be assessed in the written exam.
SCHOOL-BASED ASSESSMENT (During the year)				
TERM 1	TERM 2	TERM 3	TERM 4	
- One formal class test. - One selected practical task	- One formal class test. - One selected practical task - One mid-year examination (1½ hours)	- One formal class test - One selected practical task	- One formal class test - One selected practical task - One project	
25%	25%	25%	25%	
Convert to 40% (YEAR MARK)				60% (EXAM MARK)

4.4.3 GRADE: 9

The Programme of Assessment is designed to spread formal assessment tasks in all subjects in a school throughout the term.

PROGRAMME OF FORMAL ASSESSMENT				
Formal, recorded school-based assessments 40%				End-of-year internal school based examination 60%
Content		Investigations		Written examination (2hrs) 120 marks
- Four formal class tests (50 marks each) - One mid-year examination (90 marks) One project (can be done in any term but marks must be recorded in term 4) (50 marks) The skills are specified in Specific Aims 1,2 and 3.		A selection of eight (prescribed) representative practical tasks, which cover the range of skills described in Specific Aim 2, of which four must be recorded. Practical tasks differ with regard to the skills that can be assessed. The marks allocated per activity will therefore vary but should not be less than 20. (20 to 40 marks)		Content, concepts and skills across all topics, including knowledge of investigations and some of the skills associated with practical work, must be assessed in the written exam.
SCHOOL-BASED ASSESSMENT (During the year)				
TERM 1	TERM 2	TERM 3	TERM 4	
- One formal class test. - One selected practical task	- One formal class test. - One selected practical task - One mid-year examination on the work terms 1 and 2 (1½ hours)	- One formal class test - One selected practical task	- One formal class test - One selected practical task - One project	
25%	25%	25%	25%	
Convert to 40% (YEAR MARK)				60% (EXAM MARK)

4.5 EXAMINATIONS:

4.5.1 GRADE 7

The end-of-year examination for grade 7 will consist of one examination paper for 90 marks to be written in 1½ hours. The examination will be set on the whole year's work and the topics are weighted as follows:

TOPIC	TIME	WEIGHTING	
		%	MARKS
T 1 • Properties of Materials	2 weeks	7	6
• Mixtures	5 weeks (7)	17 (24)	15
T2 • Energy systems and transfers: EK and EP	3 weeks	7	6
• Heating: transfer of energy	4 weeks	13	12
• Energy wastage, natural supply	2 weeks (8)	7 (27)	6
T3 • Sun	1 week	3	3
• Solar System	1 week	3	3
• Planet Earth	3 weeks	10	9
• Biosphere	2 weeks	7	6
• Habitats	1 week (8)	3 (26)	3
T4 • Biodiversity	2½ weeks	8	7
• Reproduction in flowering plants	2 weeks	7	6
• Reproduction in humans	1½ weeks	5	5
• Variation in humans	1 week (7)	3 (23)	3
TOTALS	30 weeks	100%	90

4.5.2 GRADE 8

The end-of-year examination for Grade 8 will consist of one examination paper for 100 marks to be written in

1 ¾ hours. The examination will be set on the whole year's work and the topics are weighted as follows:

TOPIC	TIME	WEIGHTING	
		%	MARKS
T 1 • Earth in space • Beyond the Solar System	4 weeks	14	14
	2 weeks	7 (21)	7
T2 • Interactions in the environment • Food chains: Energy flow • Disruptions in the Ecosystem	2 ½ weeks	9	9
	2 week	3	3
	4½ weeks	16 (28)	16
T3 • Energy transfers • Light energy	5 weeks	17	17
	3 weeks	10 (27)	10
T 4 • Particle Kinetic Model of matter • Components and Elements	4 weeks	14	14
	3 weeks	10 (24)	10
TOTALS	29 weeks	100%	100

4.5.3 GRADE 9

The end-of-year examination for grade 9 will consist of one examination paper for 120 marks to be written in 2 hours. The examination will be set on the whole years work and the topics are weighted as follows:

TOPIC	TIME	WEIGHTING	
		%	MARKS
T 1 • Particle kinetic model	1 week	3	4
• Metal and non-metals	2 weeks	7	8
• Acids and Bases	3 weeks	10	12
• Metal and non-metal oxides	1 week	3 (23)	4 (28)
T2 • Acids: Reactions with metal hydroxides and carbonates.	2 weeks	7	8
	3 weeks	7	8
• Acids: Reactions with metals	2 weeks	7	8
• Reactivity of metals	2 weeks	7 (28)	8 (32)
• Metal extraction			
T3 • Forces	2 weeks	7	8
• Cells as chemical systems	3 weeks	10	12
• National electricity grid	2 weeks	7	8
• Costs of energy	1 week	3 (27)	4
T4 • Healthy living	1½ weeks	5	6
• Cells as basic units of Life	1½ weeks	5	6
• Human body and healthy living	4 weeks	13 (23)	16
TOTALS	30 weeks	100 %	120

4.6 RECORDING AND REPORTING

Recording is a process in which the teacher documents the level of a learner's performance in a specific assessment task. It indicates learner progress towards the achievement of the knowledge as prescribed in the Curriculum and Assessment Policy Statements. Records of learner performance should provide evidence of the learner's conceptual progression within a grade and her / his readiness to progress or being promoted to the next grade. Records of learner performance should also be used to verify the progress made by teachers and learners in the teaching and learning process.

Reporting is a process of communicating learner performance to learners, parents, schools, and other stakeholders. Learner performance can be reported in a number of ways. These include report cards, parents' meetings, school visitation days, parent-teacher conferences, phone calls, letters, class or school newsletters, etc. Teachers in all grades report in percentages against the subject. The various achievement levels and their corresponding percentage bands are as shown in the Table below.

Recording is a process in which the teacher documents the level of a learner's performance. Teachers record the actual raw marks against the task using a record sheet.

Records of learner performance should also be used to verify the progress made by teachers and learners in the teaching and learning process. Records should be used to monitor learning and to plan ahead.

Note: The seven point scale should have clear descriptions that give detailed information for each level. Teachers will record actual marks against the task by using a record sheet; and report percentages against the subject on the learners' report cards.

Codes and percentages for reporting in Grades R – 12

Rating code	Description of competence	Percentage
7	Outstanding achievement	80 – 100
6	Meritorious achievement	70 – 79
5	Substantial achievement	60 – 69
4	Adequate achievement	50 – 59
3	Moderate achievement	40 – 49
2	Elementary achievement	30 – 39
1	Not achieved	0 – 29

Schools are required to provide quarterly feedback to parents on the Programme of Assessment, using a formal reporting tool, such as a report card. The schedule and the report card should indicate the overall level of performance of a learner.

4.7 MODERATION OF ASSESSMENT

Moderation refers to the process that ensures that the assessment tasks are fair, valid and reliable. Moderation should be implemented at school, district, and provincial levels if necessary. Comprehensive and appropriate moderation practices must be in place for the quality assurance of all subject assessments.

In Grade 7, 8 and 9, of the Formal School Based Assessment and the practical assessment tasks should be moderated by the relevant subject specialists at the district and, if necessary, provincial levels in consultation with the moderators at school. Moderation serves five purposes:

1. It must ascertain whether subject content and skills have been sufficiently covered.
2. The moderator must ensure that the correct balance of cognitive demands are reflected in the assessments.
3. The assessments and marking are of an acceptable standard and consistency.
4. The moderator must make judgements about the comparability of learner performance across schools; whilst recognising that teachers teach in different ways.
5. The subject specialist/moderator must identify areas in which a teacher may need development and support and must ensure that this support is provided.

Moderation is therefore an ongoing process and not a once-off end-of-year event. There is no national moderation in the Senior Phase.

4.8 GENERAL

This document should be read in conjunction with:

- 4.8.1 *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R – 12; and*
- 4.8.2 *The policy document, National Protocol for Assessment Grades R – 12.*

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