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NATIONAL CURRICULUM STATEMENT GRADES 10-12 (GENERAL)

LEARNING PROGRAMME GUIDELINES

PHYSICAL SCIENCES

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SECTION 1

INTRODUCTION

1.1 INTRODUCING THE NATIONAL CURRICULUM STATEMENT

1.1.1 BACKGROUND

In 1995 the South African government began the process of developing a new curriculum for the school system. There were two imperatives for this. First, the scale of change in the world, the growth and development of knowledge and technology and the demands of the 21st Century required learners to be exposed to different and higher level skills and knowledge than those required by the existing South African curricula. Second, South Africa had changed. The curricula for schools therefore required revision to reflect new values and principles, especially those of the Constitution of South Africa.

The first version of the new curriculum for the General Education Band, known as Curriculum 2005, was introduced into the Foundation Phase in 1997. While there was much to commend the curriculum, the concerns of teachers led to a review of the Curriculum in 1999. The review of Curriculum 2005 provides the basis for the development of the National Curriculum Statement for General Education and Training (Grades R-9) and the National Curriculum Statement for Grades 10-12.

1.1.2 THE NATIONAL CURRICULUM STATEMENT

The National Curriculum Statement consists of 29 subjects. Subject specialists developed the Subject Statements which make up the National Curriculum Statement. The draft versions of the Subject Statements were published for comment in 2001 and then re-worked to take account of the comments received. In 2002 twenty-four subject statements and an overview document were declared policy through Government Gazette. In 2004 five subjects were added to the National Curriculum Statement. The National Curriculum Statement now consists of the Subject Statements for the following subjects:

- Languages – 11 official languages (each counted as three subjects to cater for the three levels Home Language, First Additional Language and Second Additional Language); 13 non-official languages

- Mathematics; Mathematical Literacy; Physical Sciences; Life Sciences; Computer Applications Technology; Information Technology

- Accounting; Business Studies; Economics

- Geography; History; Life Orientation; Religion Studies

- Consumer Studies; Hospitality Studies; Tourism

- Dramatic Arts; Dance Studies; Design; Music; Visual Arts

- Agricultural Sciences, Agricultural Management Practices, Agricultural Technology

- Civil Technology; Mechanical Technology; Electrical Technology; Engineering Graphics and Design

1.1.3 NATIONAL SENIOR CERTIFICATE

The *National Senior Certificate: A Qualification on Level 4 of the National Qualifications Framework (NQF)* provides the requirements for promotion at the end of Grades 10 and 11 and the awarding of the National Senior Certificate at the end of Grade 12. This document replaces two of the original National Curriculum Statement documents: the *Overview* and the *Qualifications and Assessment Policy Framework.*

1.1.4 SUBJECT ASSESSMENT GUIDELINES

The Subject Assessment Guidelines set out the internal or school-based assessment requirements for each subject and the external assessment requirements. In addition, the *National Protocol for Recording and Reporting (Grades R-12)* (an addendum to the policy, *The National Senior Certificate*) has been developed to standardise the recording and reporting procedures for Grades R to 12. This protocol came into effect on 1 January 2007.

1.2 INTRODUCING THE LEARNING PROGRAMME GUIDELINES

1.2.1 PURPOSE AND CONTENT OF THE LEARNING PROGRAMME GUIDELINES

The Learning Programme Guidelines aim to assist teachers and schools in their planning for the introduction of the National Curriculum Statement. The Learning Programme Guidelines should be read in conjunction with the National Senior Certificate policy and the National Curriculum Statement Subject Statements.

Section 2 of the Learning Programme Guidelines suggests how teaching the particular subject may be informed by the principles which underpin the National Curriculum Statement.

Section 3 suggests how schools and teachers might plan for the introduction of the National Curriculum Statement. The Department of Education encourages careful planning to ensure that the high skills, high knowledge goals of the National Curriculum Statement are attained.

The Learning Programme Guidelines do not include sections on assessment. The assessment requirements for each subject are provided in the Subject Assessment Guidelines which come into effect on 1 January 2008.

1.2.2 WHAT IS A LEARNING PROGRAMME

INTRODUCTION

A Learning Programme assists teachers to plan for sequenced learning, teaching and assessment in Grades 10 to 12 so that all Learning Outcomes in a subject are achieved in a progressive manner. The following three phases of planning are recommended:

- Phase 1 – develop a *Subject Framework* for grades 10 to 12

- Phase 2 – develop a *Work Schedule* for each grade

- Phase 3 – develop *Lesson Plans*

It is recommended that the teachers of a subject at a school or cluster of schools first put together a broad subject outline (Subject Framework) for the three grades to arrive at an understanding of the content of the subject and the progression which needs to take place across the grades (see Section 3.3.1). This will assist with the demarcation of content for each grade. Thereafter, teachers of the subject teaching the same grade need to work together to develop a year long Work Schedule. The Work Schedule should indicate the sequence in which the content and context will be presented for the subject in that particular grade (see Section 3.3.2). Finally, individual teachers should design Lesson Plans using the grade-specific Work Schedule as the starting point. The Lesson Plans should include learning, teaching and assessment activities that reflect the Learning Outcomes and Assessment Standards set out in the Subject Statements (see Section 3.3.3). Learning Programmes should accommodate diversity in schools and classrooms but reflect the core content of the national curriculum.

An outline of the process involved in the design of a Learning Programme is provided on page 6.

DESIGNING A LEARNING PROGRAMME

A detailed description of the process involved in the design of a Learning Programme is provided in Sections 3.3.1 – 3.3.3 of the Learning Programme Guidelines. The first stage, the development of a Subject Framework does not require a written document but teachers are strongly advised to spend time with subject experts in developing a deep understanding of the skills, knowledge and values set out in the Subject Statements. The quality and rigour of this engagement will determine the quality of teaching and learning in the classroom.

Once the Subject Framework has been completed, teachers should develop Work Schedules and Lesson Plans. Examples of Work Schedules and Lesson Plans are provided in the Learning Programme Guidelines. Teachers are encouraged to critically engage with these formats and develop their own.

Developing a Subject Framework (Grades 10-12)

Planning for the teaching of subjects in Grades 10 to 12 should begin with a detailed examination of the scope of the subject as set out in the Subject Statement. No particular format or template is recommended for this first phase of planning but the steps recommended should be used as a checklist.

Although no prescribed document is required for this stage of planning, school-wide planning (timetables, requisitioning, teacher development, classroom allocation) as well as the development of grade-specific work schedules would benefit from short documents which spell out:

- The scope of the subject – the knowledge, skills and values; the content; the contexts or themes; electives etc. to be covered in the three grades for each subject
- A three-year assessment plan for the subject
- The list of LTSM required for the subject

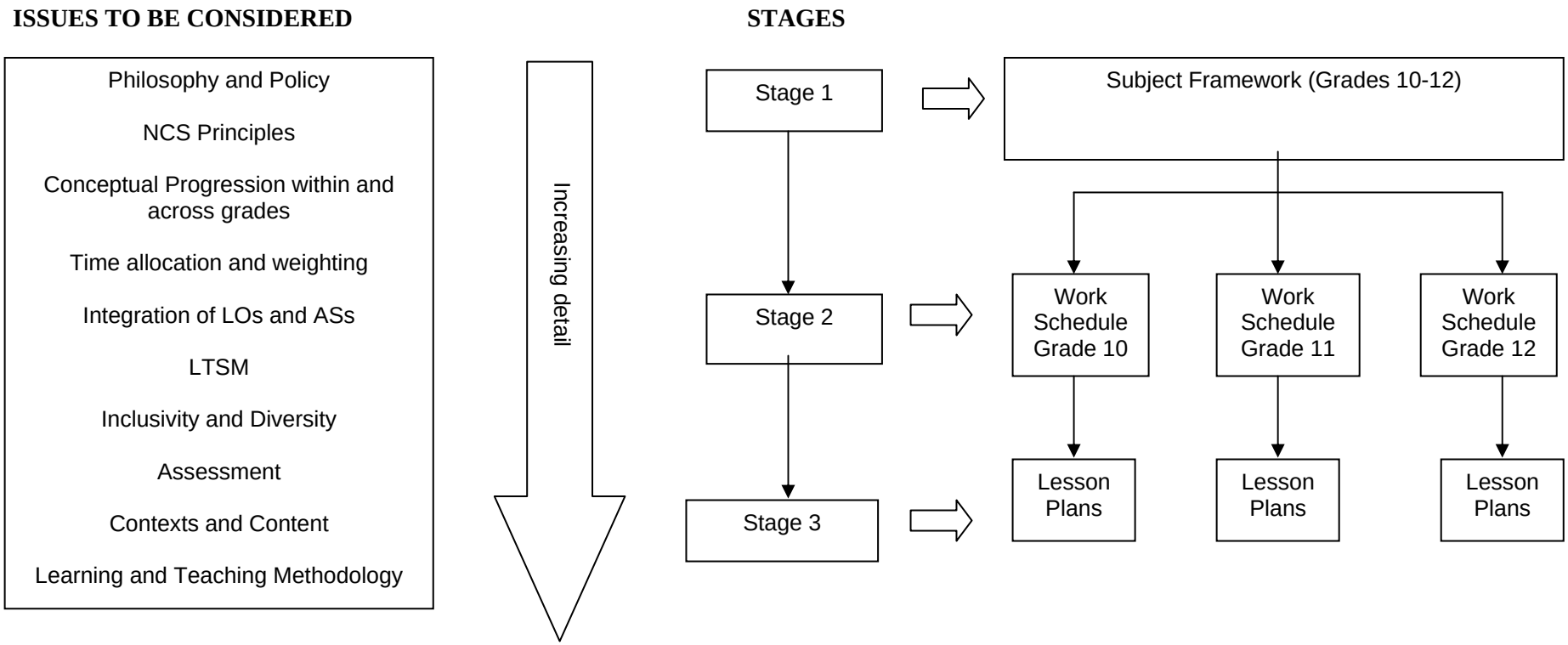
Designing Work Schedules

This is the second phase in the design of a Learning Programme. In this phase teachers develop Work Schedules for each grade. The Work Schedules are informed by the planning undertaken for the Subject Framework. The Work Schedules should be carefully prepared documents that reflect what teaching and assessment will take place in the 36-40 weeks of the school year.

Designing Lesson Plans

Each grade-specific Work Schedule must be divided into units of deliverable learning experiences, that is, Lesson Plans. Lesson Plans are not equivalent to periods in the school timetable. Each Lesson Plan should contain a coherent series of teaching, learning and assessment activities. A Lesson Plan adds to the level of detail for each issue addressed in the Work Schedule. It also indicates other relevant issues to be considered when teaching and assessing a subject.

FIGURE 1: RELATIONSHIP BETWEEN THE 3 STAGES OF PLANNING WHEN DEVELOPING A LEARNING PROGRAMME



SECTION 2

INTRODUCING PHYSICAL SCIENCES

This section should be read in conjunction with the Physical Sciences Subject Statement from the *National Curriculum Statement Grades 10-12 (Schools).*

2.1 WHAT IS PHYSICAL SCIENCES?

Physical Sciences investigates physical and chemical phenomena. This is done through scientific inquiry, application of scientific models, theories and laws in order to explain and predict events in the physical environment.

This subject also deals with society's need to understand how the physical environment works in order to benefit from it and responsibly care for it. All scientific and technological knowledge, including Indigenous Knowledge Systems (IKS), is used to address challenges facing society. In the subject Physical Sciences challenges such as the safe disposal of chemical waste, responsible utilisation of resources and the environment, alternative energy sources are addressed.

2.2 WHAT IS THE PURPOSE OF PHYSICAL SCIENCES?

The purpose of Physical Sciences is to equip learners with investigating skills relating to physical and chemical phenomena, for example, lightning and solubility. Examples of some of the skills that are relevant for the study of Physical Sciences are classifying, communicating, measuring, designing an investigation, drawing and evaluating conclusions, formulating models, hypothesising, identifying and controlling variables, inferring, observing and comparing, interpreting, predicting, problem solving and reflective skills.

Physical Sciences promotes knowledge and skills in scientific inquiry and problem solving; the construction and application of scientific and technological knowledge; an understanding of the nature of science and its relationships to technology, society and the environment. See details in the Physical Sciences Subject Statement from the *National Curriculum Statement Grades 10-12 (Schools).*

Physical Sciences prepares learners for future learning, specialist learning, employment, citizenship, holistic development, socio-economic development, and environmental management. Learners choosing Physical Sciences as a subject in Grades 10-12, including those with barriers to learning, can have improved access to: academic courses in Higher Education; professional career paths related to applied science courses and vocational career paths.

The Physical Sciences plays an increasingly important role in the lives of all South Africans owing to their influence on scientific and technological development, which are necessary for the country's economic growth and the social well being of its people.

Six main knowledge areas inform the subject Physical Sciences. These are:

- Matter and Materials
- Chemical Systems
- Chemical Change
- Mechanics
- Waves, Sound and Light
- Electricity and Magnetism

2.3 WHAT IS THE RELATIONSHIP BETWEEN PHYSICAL SCIENCES AND THE NATIONAL CURRICULUM STATEMENT PRINCIPLES?

The Constitution of the Republic of South Africa (Act 108 of 1996) provided the basis for curriculum transformation and development in South Africa. The National Curriculum Statement Grades 10-12 (General) lays a foundation for the achievement of these goals by stipulating Learning Outcomes and Assessment Standards, and by spelling out the key principles and values that underpin the curriculum. The Physical Sciences curriculum supports the application of the nine NCS principles as follows:

2.3.1 Social transformation

Physical Sciences contributes to social transformation by ensuring the development of scientifically literate citizens who are responsible and can critically debate scientific issues and participate in an informed way in democratic decision-making processes. The curriculum in Physical Sciences addresses the historical limitations of poor quality or lack of education in certain sectors by ensuring increased access to scientific knowledge and literacy for learners.

2.3.2 Outcomes-Based Education

Physical Sciences makes use of Learning Outcomes to describe what the learner should achieve and Assessment Standards describe what a learner should know and be able to demonstrate (i.e. the skills, knowledge, values and attitudes) by the end of each grade. Emphasis is placed on the application and construction of knowledge, and the understanding of the relationships between scientific and technological knowledge and socio-economic development. The activity-based approach to teaching, learning and assessment in Physical Science encourages learners to develop inquiry and problem solving skills which support the practical application of knowledge in new situations.

2.3.3 High knowledge and high skills

The subject Physical Sciences aims to develop high-level knowledge and skills for all learners. The Physical Sciences curriculum fulfils this aim by developing scientific inquiry and problem solving skills, conceptual knowledge and a broadened understanding of the impact Physical Sciences has on the quality of sustainable socio-economic and human development. This is achieved by critically evaluating the interrelationships between Physical Sciences and technology, society, ethics and the environment.

Through the Learning Outcomes (LOs) and Assessment Standards (ASs) of Physical Sciences, teaching and learning aims at intellectual accomplishment with acquisition of a broad range of skills, gains in knowledge and understanding, recognition of changes in values and attitudes as well as the ability to apply these competencies to promote sustainable development. In addition, Physical Sciences places particular emphasis on creating opportunities for all learners to realise their full potential as thinking and doing beings who will contribute to an improved quality of life for themselves and others in society.

2.3.4 Integration and applied competence

Integration is achieved within and across subjects. Integration within Physical Sciences is achieved by the close relationship between the Learning Outcomes, Assessment Standards and the content. It is therefore important to note that no single outcome can be addressed on its own. The planning of learning units must reflect the integration of different Learning Outcomes. However, some of the Learning Outcomes can be dealt with better in one specific context than in another, but all Learning Outcomes must be covered and addressed in an integrated manner. Applied competence aims at integrating practical (LO 1), foundational (LO 2) and reflective (LO 3) competencies. Integration is also achieved across subjects. For example, the subject is closely linked, amongst others, with Mathematics, Agricultural and Life Sciences. This integration is illustrated in the Work Schedule (Annexure 1).

2.3.5 Progression

The Assessment Standards for each Learning Outcome in the *National Curriculum Statement Grades 10-12 (General)* are designed at various levels of complexity and depth to provide for progression as learners move from the beginning to the end of a grade and from grade to grade. Within Physical Sciences examples of progression can be seen when looking at the first Assessment Standard of Learning Outcome 1 for Grades 10-12 where the Assessment Standard increases in complexity by moving from focusing on *identifying and questioning phenomena to finding reasons for the occurrence of certain phenomena through surveys which involve more than one variable.* The development and integration of high levels of knowledge, values and skills within and across different grades in the band is important in the study of the Physical Sciences. The increasing levels of complexity and depth required as learners progress through the band are reflected in the Assessment Standards.

2.3.6 Articulation and portability

The Physical Sciences Learning Outcomes are closely related to the Natural Sciences Learning Outcomes of the National Curriculum Statements (NCS) Grades R-9. This ensures continuity and further development of the skills, knowledge, values and attitudes acquired in Grades R-9.

In Physical Sciences the Learning Outcomes, Assessment Standards and content framework will allow mobility and portability across and within Grades 10-12 as well as access to the Higher Education and Training Band.

2.3.7 Human rights, Inclusivity, Environment and Socio-Economic Justice

The Physical Sciences should contribute to promoting a culture of human rights, inclusivity and socio-economic justice. In studying the Physical Sciences learners should be aware of, and sensitive to issues such as environmental management, inequality, disability, gender, barriers to learning, indigenous knowledge and the impact of Science and Technology on socio-economic development of communities.

2.3.8 Valuing Indigenous Knowledge systems

In Physical Sciences learners are required to research, discuss, compare and evaluate claims made by scientific and Indigenous Knowledge Systems by indicating the relationship between them (Scientific concepts and IKS claims) - LO 3. Indigenous knowledge systems in the South African context refer to the body of knowledge embedded in African philosophical thinking and social practices that have evolved over thousands of years, e.g. the making of African beer as compared to the traditional western methods of manufacturing beer.

Nowadays people recognise the wide diversity of knowledge systems through which people make sense, and attach meaning to, the world in which they live. Physical Sciences recognises the richness of indigenous knowledge systems and their contribution to the learner and society.

2.3.9 Credibility, Quality and Efficiency

The *National Curriculum Statement Grades 10-12 (General)* aims to achieve credibility through pursuing a transformational agenda and through providing an education that is comparable in quality, breadth and depth to that of other countries. The credibility and quality of the Physical Science curriculum is evident in that its focus areas (matter and materials; chemical systems; chemical change; mechanics; waves, sound and light; electricity and magnetism) are internationally recognised as relevant areas for the learning, teaching and assessment of Physical Sciences.

2.4 PROFILE OF A PHYSICAL SCIENCES LEARNER

Physical Sciences builds on the foundation laid by the Natural Sciences Learning Area in the General Education and Training band. In the Natural Sciences Learning Area, achievement of Learning Outcomes is mediated through the following four knowledge areas: (a) life and living; (b) energy and change; (c) earth and beyond; (d) matter and materials.

In addition, learners in the Physical Sciences are expected to develop the following competences:

- scientific inquiry and problem-solving skills;
- construction and application of Physical Sciences knowledge; and
- understanding the interrelationship of Physical Sciences, technology, the environment and society, and of different attitudes and values.

The envisaged Physical Sciences learner will be imbued and empowered with skills and knowledge for lifelong learning; and encouraged to pursue careers at tertiary level such as medicine, bioengineering, psychology, nursing, education, marine biology, environmental science, physics and chemistry.

2.5 RELATIONSHIPS BETWEEN PHYSICAL SCIENCES LEARNING OUTCOMES AND CRITICAL AND DEVELOPMENTAL OUTCOMES

Education and Training in South Africa has 7 Critical Outcomes and 5 Developmental Outcomes, which derive from the Constitution. Each of them describes an essential characteristic of the type of South African citizen the education sector hopes to produce. These Critical Outcomes should therefore be reflected in the teaching approaches and methodologies that Physical Sciences teachers use. Both teachers and learners should be aware of and focus on these Critical and Developmental outcomes, which will be addressed through Physical Sciences teaching and learning.

Table 2 shows links between the Critical and Developmental Outcomes and Physical Sciences Learning Outcomes

Table 2: Links between Critical, Developmental and Learning Outcomes

LO for Physical Sciences	*Critical Outcomes*	*Developmental Outcomes*
LO 1	***CO 1,2,3,4,5***	***DO 1***
LO 1 in Grades 10-12 most clearly represents COs 1-5 by focussing on process skills, scientific reasoning, critical thinking and problem solving, by working effectively with others and individually. The activities to build LO 1 also reflect DO 1.		
LO 2	***CO 4,5***	***DO 1,4***
LO 2 in Grades 10-12 most clearly represents COs 4 and 5 by focussing on constructing, understanding and applying scientific knowledge .The activities to build LO2 also reflect DO 1and 4.		
LO 3	***CO 1,3,4,6,7***	***DO 2,3***
LO 3 in Grades 10-12 most clearly represents CO 1,3,4,6 and 7 where learners are expected to see the world as a set of related systems and by focussing learners' understanding on the interrelationship between science, technology, society, ethics and the environment. Activities required to build LO 4 also reflect DO 2 and 3.		

2.6 WAYS TO ACHIEVE PHYSICAL SCIENCES LEARNING OUTCOMES

Ways of achieving the Physical Sciences Learning Outcomes are spelt out through the Assessment Standards. This, however, cannot be attained in a vacuum but through content and context. Core knowledge areas have been selected as appropriate content for the achievement of the Learning Outcomes.

The Physical Sciences Content document (Department of Education, 2006) gives guidance of the level and depth of the content to be used in achieving the Learning Outcomes of the subject Physical Sciences. It is essential that the content be read in conjunction with the Assessment Standards.

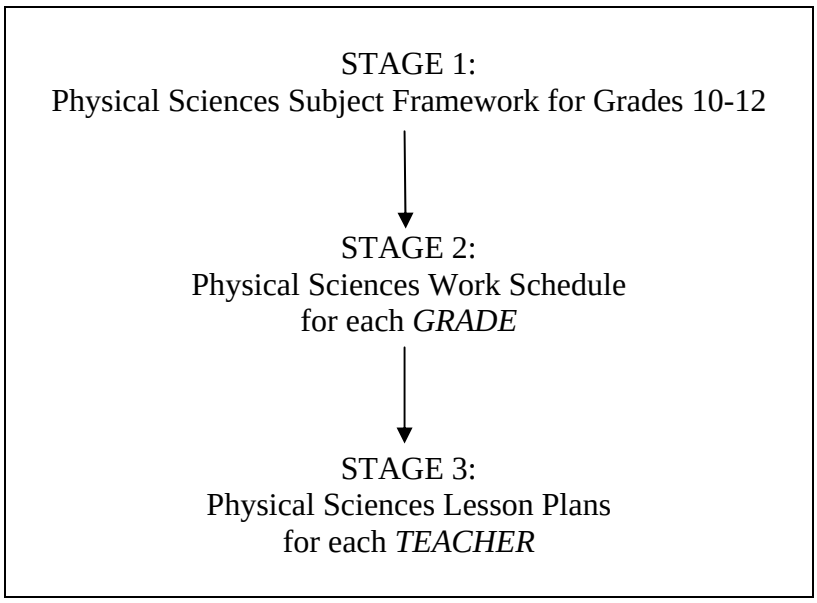
SECTION 3

DESIGNING A LEARNING PROGRAMME FOR PHYSICAL SCIENCES

3.1 INTRODUCTION

A Learning Programme is a tool to plan for sequenced learning, teaching and assessment across Grades 10-12 so that all three Learning Outcomes in Physical Sciences are achieved in a progressive manner. It is recommended that the Physical Sciences teachers at a school first put together a broad subject outline (i.e. Subject Framework) for Grades 10-12 to arrive at an understanding of the progression which needs to take place across the grades (see Section 3.3.1). This will assist with the demarcation of content for each grade. Thereafter, Physical Sciences teachers teaching the same grade need to work together and draw from the content and context identified for their grade in the Subject Framework, to develop a Work Schedule in which they indicate the sequence in which the content and context will be presented for Physical Sciences in that particular grade (see Section 3.3.2). Finally, the individual Physical Sciences teacher should design Lesson Plans using the grade-specific Work Schedule as the starting point. The Lesson Plans should include learning, teaching and assessment activities (see Section 3.3.3).

An outline of the process involved in the design of a Learning Programme for Physical Sciences is provided in the diagram below:



The process to be followed in the development of a Learning Programme is not a neatly packaged sequence of numbered steps that follow one another in a particular order. Teachers may find themselves moving back and forth in the process as they plan and critically reflect on decisions taken before moving on to the next decision in the process. The process is therefore not strictly linear and is reflective in nature. For this reason the steps provided in this Section are a guide and should be used as a checklist in the planning process.

3.2 ISSUES TO ADDRESS WHEN DESIGNING A LEARNING PROGRAMME

The issues to be addressed in the development of a Physical Sciences Learning Programme are presented in a tabular format to indicate the implications of each issue at each of the three stages of the development of a Learning Programme:

- Stage 1 – Subject Framework
- Stage 2 – Work Schedule
- Stage 3 – Lesson Plan

3.2.1 Policies and Principles

STAGE 1 **Subject Framework** **STAGE 2** **Work Schedule** **STAGE 3** **Lesson Plan**	The various Policies that impact on curriculum implementation should be considered throughout the planning process. *NCS*: • Principles: Refer to Section 2.3 to see how Physical Sciences supports the application of the nine principles of the NCS • Critical and Developmental Outcomes: Refer to Section 2.5 to see how Physical Sciences supports the application of the Critical and Developmental Outcomes *Other Policies and Legislation*: • White Paper 6, Language in Education Policy, Religion and Education Policy, HIV/AIDS Policy– all have implications for LTSM and teaching methods in Physical Sciences • White Paper 7 – gives an indication on the use of computers in the classroom and therefore has implications for LTSM and teaching methods in Physical Sciences

3.2.2 Content

In the NCS Grades 10-12 content means the combination of knowledge, skills and values.

STAGE 1 **Subject Framework**	The Physical Sciences Content document (Department of Education, 2006) sets out the content for the three years (i.e. Grades 10, 11 and 12). The ASs give an indication of the knowledge, skills and values (KSVs) to be covered in each of the three grades.
STAGE 2 **Work Schedule**	The Work Schedule sets out the content for one year. Here the focus falls on the grade-specific KSVs required by the NCS.
STAGE 3 **Lesson Plan**	The Lesson Plans set out the content to be covered in each coherent series of learning, teaching and assessment activities. Each Lesson Plan can be one or more weeks in duration.

3.2.3 Integration

Integration involves the grouping of Assessment Standards according to natural and authentic links.

STAGE 1 **Subject Framework**	Integration within the subject should be considered in broad terms during discussions at this stage. All Grade 10-12 teachers should consider integration of ASs within and across the grades.
STAGE 2 **Work Schedule**	The integration and sequencing of the ASs is undertaken in the Work Schedule to ensure that all ASs for a particular grade are covered in the 40-week contact period.
STAGE 3 **Lesson Plan**	The same groupings of LOs and ASs as arrived at in the Work Schedule should be used to develop a coherent series of learning, teaching and assessment activities for each Lesson Plan.

3.2.4 Conceptual Progression

STAGE 1 **Subject Framework**	The Physical Sciences Content document indicates the increasing depth across Grades 10-12. Progression across the three grades is shown in the ASs per Learning Outcome.
STAGE 2 **Work Schedule**	Progression in a grade is evident in the increasing depth in that particular grade. Grade-specific progression is achieved by appropriately sequencing the groupings of integrated LOs and AS in the Work Schedule.
STAGE 3 **Lesson Plan**	In the individual Physical Sciences classroom increasing depth is shown in the activities and Lesson Plans. Progression is achieved by appropriately sequencing the activities contained within each Lesson Plan and in the series of Lesson Plans.

3.2.5 Time Allocation and Weighting

STAGE 1 **Subject Framework**	4 hours per week is allocated to Physical Sciences in the NCS. This is approximately 160 hours per year. The teachers of the subject should plan how this time will be used for the teaching of Physical Sciences in the three grades.
STAGE 2 **Work Schedule**	The groupings of ASs as arrived at in the integration process should be paced across the 40 weeks of the school year to ensure coverage of the curriculum.
STAGE 3 **Lesson Plan**	The amount of time to be spent on activities should be indicated in the Lesson Plans.

3.2.6 LTSM

LTSM refers to any materials that facilitate learning and teaching. LTSM need to be chosen judiciously because they have cost implications for the school and the learner. The NCS provides scope for the use of a variety of resources. All teachers and learners must have a textbook. However, teachers are required to go beyond the textbook. They do not necessarily need exotic, specialised materials. Rather common and readily available items can be used.

STAGE 1 **Subject Framework**	Compile a list of general LTSM (text books and other resources) that will be necessary and useful in the teaching, learning and assessment of the content. This assists with the requisition and availability of LTSM at a school.
STAGE 2 **Work Schedule**	List grade-specific LTSM (resources) required in the learning, teaching and assessment process for the grade.
STAGE 3 **Lesson Plan**	Identify specific resources related to the individual activities contained within a Lesson Plan.

3.2.7 Assessment

All Grade 10, 11 and 12 learners are expected to complete seven internal tasks for Physical Sciences. Of the seven tasks, two must be tests, two must be examinations and the remaining three tasks can take any form suitable to the teaching and assessment of Physical Sciences. In addition, Grade 12 learners are expected to complete an external examination. See Section 3 of the Subject Assessment Guidelines for Physical Sciences.

In order to administer effective assessment one must have a clearly defined purpose. It is important that all the tasks are well covered as spelt out in the Subject Assessment Guideline document. By answering the following questions the teacher can decide what assessment activity is most appropriate:

- What concept, skill or knowledge needs to be assessed?
- What should the learners know?
- At what level should the learners be performing?
- What type of knowledge is being assessed: reasoning, memory or process?

STAGE 1 **Subject Framework**	Develop a three-year assessment plan using the Subject Assessment Guidelines for Physical Sciences. This should ensure the use of a variety of assessment forms relevant to the subject and progression across the three grades.
STAGE 2 **Work Schedule**	Use the Subject Assessment Guidelines for Physical Sciences to develop a grade-specific assessment plan. The forms of assessment listed must facilitate the achievement of the particular LOs and ASs in each grouping.
STAGE 3 **Lesson Plan**	Indicate more classroom-specific assessment strategies, by mentioning the methods, forms and tools that will be used to assess learner performance in each activity. HINT: Not all activities need to be assessed – some may just be introductory in nature or for enrichment. The choice of an assessment strategy is determined by the LOs and ASs that have been grouped together for a particular Lesson Plan. The assessment strategy chosen must facilitate the achievement of these particular LOs and ASs in the classroom.

3.2.8 Inclusivity and Diversity

The following steps can be taken to effectively address diversity in the classroom when planning Physical Sciences teaching activities:

- consider individual past experiences, learning styles and preferences;
- develop questions and activities that are aimed at different levels of ability;
- provide opportunity for a variety of participation levels such as individual, pairs and small group activities;
- consider the value of individual methods ; and
- assess learners based on individual progress.

STAGE 1 **Subject Framework**	Teachers should be sensitive to inclusivity and diversity when identifying content, teaching styles and methods, forms of assessment and LTSM (Resources). Diversity should be accommodated in the following areas: • Learning styles: provide optional activities / different ways of doing same activity • Pace of learning: provide for both slower and faster learners by providing optional extra activities, reading or research, as well as multiple assessment opportunities • Differences in levels of achievement: provide optional extra activities, challenges and materials that cater for these differences between learners. • Gender diversity: ensure that teachers do not inadvertently allow or contribute towards discrimination against boys or girls in the classroom on the basis of gender. • Cultural diversity: recognise, celebrate and be sensitive to the differences in people.
STAGE 2 **Work Schedule**	
STAGE 3 **Lesson Plan**	This is catered for as EXPANDED OPPORTUNITIES in the Lesson Plan. Enrichment is provided for high achievers and remediation or other relevant opportunities for learners requiring additional support. It is not necessary to develop an activity to cater for each type of diversity which arises in the classroom. Teachers may find it possible to cater for different diversities within one activity with effective planning.

3.2.9 Learning and Teaching Methodology

STAGE 1 **Subject Framework**	It is not necessary to record Teaching Methods for either of these stages.
STAGE 2 **Work Schedule**	
STAGE 3 **Lesson Plan**	This is catered for as TEACHING METHOD in the Lesson Plan. It provides an indication of how teaching and learning will take place, that is, how each activity will be presented in the classroom.

3.3 DESIGNING A LEARNING PROGRAMME

A detailed description of the process involved in the design of a Learning Programme for Physical Sciences is provided in this section (see Sections 3.3.1 – 3.3.3). The process presented here is a suggestion of how to go about designing a Learning Programme.

3.3.1 Subject Framework (Grades 10-12) for Physical Sciences

Planning for the teaching of Physical Sciences in Grades 10 to 12 should begin with a detailed examination of the scope of the subject as set out in the Physical Sciences Content document (Department of Education, 2006). No particular format or template is recommended for this first phase of planning but the five steps below should be used as a checklist.

Although no prescribed document is required for this stage of planning, school-wide planning (timetables, ordering, teacher development, classroom allocation) as well as the development of grade-specific work schedules would benefit from short documents which spell out:

- The scope of the subject – the knowledge, skills and values; the content; the contexts or themes; electives etc. to be covered in the three grades (Physical Sciences Content document: Department of Education, 2006)
- A three-year assessment plan
- The list of LTSM required

❶ Clarify the Learning Outcomes and Assessment Standards.

The essential question for Physical Sciences is: What Learning Outcomes do learners have to master by the end of Grade 12 and what Assessment Standards should they achieve to show that they are on their way to mastering these outcomes?

All learning, teaching and assessment opportunities must be designed down from what learners should know, do and produce by the end of Grade 12. The Learning Outcomes and Assessment Standards that learners should master by the end of Grade 12 are specified in the Physical Sciences Subject Statement.

❷ Study the conceptual progression across the three grades.

Study the Assessment Standards for Physical Sciences across the three grades. Progression should be clearly evident across the grades.

❸ **Identify the content to be taught.**

Study the Assessment Standards and the content for Physical Sciences (Physical Sciences Content document: Department of Education, 2006) to identify the skills, knowledge, attitudes and values to be addressed in each grade. Also consider the content and context in which they will be taught.

❹ **Identify three-year plan of assessment.**

Use the Subject Assessment Guidelines to guide the three-year assessment plan. Consider what forms of assessment will be best suited to each of the Learning Outcomes and Assessment Standards. This ensures that assessment remains an integral part of the learning and teaching process in Physical Sciences and that learners participate in a range of assessment activities.

❺ **Identify possible LTSM (resources).**

Consider which LTSM will be best suited to the learning, teaching and assessment of each Learning Outcome in the three grades using the Assessment Standards as guidance.

3.3.2 Designing Work Schedules for Physical Sciences

This is the second phase in the design of a Learning Programme. In this phase teachers develop Work Schedules for each grade. The Work Schedules are informed by the planning undertaken for the Subject Framework. The Work Schedules should be carefully prepared documents that reflect what teaching and assessment will take place in the 40 weeks of the school year. See Annexure 1 for examples of Work Schedules for Physical Sciences.

The following steps provide guidelines on how to approach the design of a Work Schedule per grade for Physical Sciences:

❶ **Package the content.**

Study the Learning Outcomes and Assessment Standards prescribed for the particular grade in Physical Sciences and group these according to natural and authentic links.

❷ **Sequence the content.**

Determine the order in which the groupings of Learning Outcomes and Assessment Standards will be presented in the particular grade in Physical Sciences. Besides the conceptual progression in the Assessment Standards for Physical Sciences, *context* can also be used to sequence groupings in Physical Sciences.

❸ **Pace the content.**

Determine how much time in the school year will be spent on each grouping of Learning Outcomes and Assessment Standards in the particular grade.

❹ **Review forms of assessment.**

Revisit the forms of assessment listed for the particular grade in the Subject Assessment Guidelines, and refine them to address each grouping of Learning Outcomes and Assessment Standards as developed in Step 1.

❺ Review LTSM.

Revisit the LTSM (resources) listed for the particular grade in the Subject Framework, and refine them to address each grouping of Learning Outcomes and Assessment Standards as developed in Step 1.

3.3.3 Designing Lesson Plans for Physical Sciences

Each grade-specific Work Schedule for PHYSICAL SCIENCES must be divided into units of deliverable learning experiences, that is, Lesson Plans. A Lesson Plan adds to the level of detail in the Work Schedule. It also indicates other relevant issues to be considered when teaching and assessing Physical Sciences.

A Lesson Plan is not equivalent to a subject period in the school timetable. Its duration is dictated by how long it takes to complete the coherent series of activities contained in it.

❶ Indicate the content, context, Learning Outcomes and Assessment Standards.

Copy this information from the Work Schedule for the particular grade.

❷ Develop activities and select teaching method.

Decide how to teach the Learning Outcomes and Assessment Standards (context) indicated in Step 1 and develop the activity or activities that will facilitate the development of the skills, knowledge, attitudes and values in the particular grouping. Thereafter, determine the most suitable teaching method(s) for the activities and provide a description of how the learners will engage in each activity.

❸ Consider diversity.

Explore the various options available within each activity that will allow expanded opportunities to those learners that require individual support. The support provided must ultimately guide learners to develop the skills, knowledge, attitudes and values indicated in the grouping of Learning Outcomes and Assessment Standards.

❹ Review assessment and LTSM.

Indicate the details of the assessment strategy and LTSM to be used in each activity.

❺ Allocate time.

Give an indication of how much time will be spent on each activity in the Lesson Plan.

3.3.4 Reflection and review of the Physical Sciences Learning Programme

After the Learning Programme has been delivered by means of Lesson Plans in the classroom, the teacher should reflect on what worked, how well it worked and what could be improved. Teachers need to note these while the experience is still fresh in their minds, so that if necessary, they can adapt and change the affected part of the Physical Sciences Learning Programme for future implementation. It is advisable to record this reflection on the Lesson Plan planning sheets.

ANNEXURE 1: EXAMPLES OF WORK SCHEDULES FOR PHYSICAL SCIENCES

Example of a Grade 10 Work Schedule

Time: 35 weeks of 40 weeks. 5 weeks could be allocated to formal assessment.
Depth of content is provided in the Physical Sciences Content document (Department of Education, 2006)

MATTER AND MATERIALS: 6 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
3 weeks	<u>Observing, describing, classifying and using materials - a macroscopic view</u> • The material(s) of which an object is composed. • Mixtures: heterogeneous and homogeneous. • Pure substances: elements and compounds. • Names and formulae of substances. • Metals, semimetals and non-metals. • Electrical conductors, semiconductors and insulators. • Thermal conductors and insulators. • Magnetic and nonmagnetic materials.		Chemistry in the home. Compounds in the home e.g. milk, medicine. Appliances in the home.	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1 weeks	<u>Particles substances are made of</u> • Atoms and molecules (simple and giant) • Linking macroscopic properties of materials to micro (particle) structure. • Intermolecular and intramolecular forces (chemical bonds). Physical state and density explained in terms of these forces. Particle kinetic energy and temperature.		Human nutrition Ice cubes	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	<u>The Atom: basic building block of all matter</u> • Models of the atom. • Atomic mass and diameter. • Structure of the atom: protons, neutrons, electrons. • Isotopes • Energy quantization and electron configuration. • Periodicity of ionization energy to support the arrangement of the atoms in the Periodic Table. • Successive ionization energies to provide evidence for the arrangement of electrons into core and valence electrons.		Hydrogen bomb	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

MECHANICS: 7 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
4 weeks	<u>Motion in one dimension:</u> • position, displacement, distance; • speed, average velocity, instantaneous velocity; • acceleration; • description of motion in words, diagrams, graphs and equations; • frames of reference.		Sports	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
3 weeks	<u>Gravity and mechanical energy:</u> • weight (force exerted by the earth on an object); • acceleration due to gravity (acceleration resulting from the force exerted by the earth); • gravitational potential energy; • kinetic energy; • mechanical energy (sum of gravitational potential energy and kinetic energy); • conservation of mechanical energy (in the absence of dissipative forces).		SumbandilaSat	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

WAVES, SOUND AND LIGHT: 8 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
3 weeks	<u>Transverse pulses on a string or spring:</u> • pulse length, amplitude, speed; • graphs of particle position, displacement, velocity, acceleration; • transmission and reflection at a boundary between two springs (or strings); • relation of pulse speed to medium; • reflection from a fixed end and a free end; • superposition.		Earth quakes	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
3 weeks	<u>Transverse waves:</u> • wavelength, frequency, amplitude, period, wave speed; • particle position, displacement, velocity, acceleration; • standing waves with rent boundary conditions (free and fixed end) as a kind of superposition.			Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	<u>Geometrical optics:</u> • light rays;		Photography	Any form of assessment as outlined in the Subject	Science equipment; any relevant equipment from the home

	• reflection; • refraction (change of wave speed in different media); • mirrors; • total internal reflection, fibre optics in endoscopes and telecommunications			Assessment Guidelines including practical work	Textbook Library Books, newspaper articles, any other resource materials including the internet.

ELECTRICITY AND MAGNETISM: 5 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
1,5 weeks	<u>Magnetism:</u> • magnetic field of permanent magnets; • poles of permanent magnets, attraction and repulsion; • Earth's magnetic field, compass.		Sea Travel	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1,5 weeks	<u>Electrostatics:</u> • two kinds of charge; • force between charges (descriptive); • attraction between charged and uncharged objects (polarisation); • conductors and insulators.		Electrical appliances around the home	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	<u>Electric circuits:</u> • need for a closed circuit for charges to flow; • electrical potential difference (voltage); • current; • resistance; • principles and instruments of measurement of voltage (P.D.), current and resistance.		Electrical appliances in the home	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

CHEMICAL CHANGE: 5 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
2,5 weeks	<u>Physical and Chemical Change</u> • Microscopic interpretation of macroscopic changes (for example changes in conductivity and temperature) • Separation of particles in decomposition and synthesis reactions • Conservation of atoms and mass. • Law of constant composition		Pressure in car tyres	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

	• Conservation of energy • Volume relationships in gaseous reactions.				
2,5 weeks	Representing chemical change • Balanced chemical equations			Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

CHEMICAL SYSTEMS: 3 WEEKS					
Time Frame	Content	Date Completed	Context	Assessment	LTSM
1,5 weeks	Global cycles: The water cycle: Physical changes and energy transfers: • The movement of water from the ocean and land surfaces as controlled by energy in sunlight. Reservoirs for water on Earth. • Macroscopic properties of the three phases of water related to their microscopic structure. The nitrogen cycle: Chemical changes and energy transfers. The movement of nitrogen between interrelated biological and geological systems. • Industrial fixation of nitrogen			Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1,5 weeks	The hydrosphere • Its composition and interaction with other global systems. • Ions in aqueous solution: their interaction and effects. • Electrolytes and extent of ionization as measured by conductivity • Precipitation reactions.			Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

Example of a Grade 11 Work Schedule

Time: 35 weeks of 40 weeks. 5 weeks could be allocated to formal assessment.
Depth of concepts is provided in the Physical Sciences Content document (Department of Education, 2006)

MATTER AND MATERIALS: 10 WEEKS					
Time Frame	Content	Date Completed	Context	Assessment	LTSM
2 weeks	Electronic properties of matter: • Conduction in semiconductors, metals, ionic liquids; • Intrinsic properties and doping – properties by design; • Principles of the p-n junction and the junction diode; • Insulators, breakdown		Chemistry in the home e.g. pot handles Microchips	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
3 weeks	Atomic combinations: molecular structure: • A chemical bond as the net electrostatic force between two atoms sharing electrons. • Chemical bonds as explained by Lewis theory and represented using Lewis diagrams. • Electronegativity of atoms to explain the polarity of bonds. • Oxidation number of atoms in molecules to explain their relative "richness" in electrons. • Bond energy and length. • Multiple bonds. • Molecular shape as predicted using the Valence Shell Electron Pair Repulsion (VSEPR) theory.		Strength of materials Chemistry in the home e.g. cleaning agents Rusting of compounds	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	Atomic nuclei: • nuclear structure and stability; • radioactivity; • ionising radiation; • fission and fusion and their consequences; • nucleo-synthesis – the Sun and stars; • age determination in geology and archaeology.		Nuclear energy in South Africa; Uses of nuclear technology; Nuclear medicine Archeology	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

3 weeks	Ideal gases and thermal properties: • motion of particles; • kinetic theory of gases; • temperature and heating, pressure; • ideal gas law.		Explosions	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

MECHANICS: 4 WEEKS					
Time Frame	Content	Date Completed	Context	Assessment	LTSM
4 weeks	Force, momentum and impulse: • pairs of interacting objects exert equal forces on each other (Newton's Third Law); • momentum; • a net force on an object causes a change in momentum – if there is no net force on an object/system its momentum will not change(momentum will be conserved); • impulse (product of net force and time for which it acts on an object, momentum change); • a net force causes an object to accelerate (Newton's Second Law); • objects in contact exert forces on each other(e.g. normal force, frictional force); • masses can exert forces on each other (gravitational attraction) without being in contact (fields); • force between two masses (Newton's Law of Universal Gravitation); • moment of force, mechanical advantage.		Transportation; Movement; Astronomy; cosmology; Road Accidents; Structures Fork lifts	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

WAVES, SOUND AND LIGHT: 6 WEEKS					
Time Frame	Content	Date Completed	Context	Assessment	LTSM
2 weeks	Geometrical optics: • lenses, image formation, gravitational lenses, spectacles, the eye; • telescopes, SALT; • microscopes.		Medical Technologies; Astronomical Instruments; Eyes – human and animal	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	Longitudinal waves: • on a spring; • wavelength, frequency, amplitude, period, wave speed; • particle position, displacement, velocity, acceleration; • sound waves.		Communications; Echoes; Sonar; Musical instruments	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1 week	Sound: • pitch, loudness, quality (tone); • physics of the ear and hearing; • ultrasound.		Medical Technologies; Earthquakes	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1 week	Physics of music: • standing waves in different kinds of instruments.		Music; Culture	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

ELECTRICITY AND MAGNETISM: 5 WEEKS					
Time Frame	Content	Date Completed	Context	Assessment	LTSM
2 weeks	Electrostatics: • force between charges (Coulomb's Law); • electric field around single charges and groups of charges; • electrical potential energy and potential; • capacitance, physics of the parallel plate capacitor, relation between charge, potential difference and capacitance; • capacitor as a circuit device.		Lightning; ESKOM power grid	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1 week	Electromagnetism: • magnetic field associated with current; • current induced by changing magnetic field – transformers; • motion of a charged particle in a magnetic field.		Medical Technologies; Communications; Aurora	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work.	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	Electric circuits: • relation between current, voltage and resistance (Ohm's Law); • resistance, equivalent resistance, internal resistance; • series, parallel networks; • Wheatstone bridge.		ESKOM power grid	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work.	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

CHEMICAL CHANGE: 7 WEEKS					
Time Frame	Content	Date Completed	Context	Assessment	LTSM
4 weeks	Quantitative aspects of chemical change: • atomic weights; • molecular and formula weights; • determining the composition of substances; • amount of substance (mole), molar volume of gases, concentration; • stoichiometric calculations		Alternative fuels; Mining; Mineral processing; Industrial production of chemicals	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1 week	Energy and chemical change: • energy changes in reactions related to bond energy changes; • exothermic and endothermic reactions; • activation energy.		Chemistry in the home e.g. cooking Hair relaxing industry Chemical industry	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	Types of reactions: • acid-base and redox reactions; • substitution, addition and elimination.		Chemical industry; Mineral processing	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

CHEMICAL SYSTEMS: 3 WEEKS					
Time Frame	Content	Date Completed	Context	Assessment	LTSM
2 weeks	Exploiting the lithosphere/Earth's crust: • mining and mineral processing – gold, iron, phosphate, (South Africa's strengths); environmental impact of these activities; • energy resources and their use.		Mining and mineral processing; Alternative energy sources	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1 week	The atmosphere: • atmospheric chemistry; • global warming and the environmental impact of population growth.		The weather The depletion of the ozone layer	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

Example of a Grade 12 Work Schedule

Time: 34 weeks of 40 weeks. 6 weeks could be allocated to formal assessment.
Depth of content is provided in the Physical Sciences Content document (Department of Education, 2006)

MATTER AND MATERIALS: 8 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
2 weeks	*Optical phenomena and properties of materials:* • Transmission and scattering of light • Emission and absorption spectra • Lasers • Photoelectric effect		Astrophysics; Medical and industrial uses of lasers	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	*Organic molecules:* • Organic molecular structures – functional groups, saturated and unsaturated structures, isomers • Systematic naming and formulae, structure physical property relationships • Substitution, addition and elimination reactions		Fuel industry; Manufacture of organic chemicals; Manufacture of polymers	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	*Mechanical properties:* • Elasticity, plasticity, fracture, creep (descriptive) • Hooke's Law, stress-strain, ductile and brittle materials • Fracture, strength of materials		Civil engineering Mechanical engineering (strength of materials)	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	*Organic macromolecules:* • Plastics and polymers – thermoplastic and thermoset • Biological macromolecules – structure, properties, function		Chemistry in the home. Plastic ware	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

MECHANICS: 6 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
4 weeks	*Motion in two dimensions:* • Projectile motion represented in words, diagrams, equations and graphs • Conservation of momentum in 2D • Frames of reference		Transportation; Planets and their movement; Astronomy; Cosmology;	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	*Work, power and energy:* • When a force exerted on an object causes it to move, work is done on the object (except if the force and displacement are at right angles to each other) • The work done by an external force on an object or system equals the change in mechanical energy of the object or system • Power (rate at which work is done)		Machines and mechanics; Structures; Architecture;	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

WAVES, SOUND AND LIGHT: 6 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
3 weeks	*Doppler effect (source moves relative to observer):* • With sound and ultrasound • With light – red shifts in the universe (evidence for the expanding universe)		Astronomical instruments; Starlight and sunlight; Astronomical and terrestrial speed determination; Cosmology	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1 week	*Colour:* • Relationship to wavelength and frequency • Pigments, paints • Addition and subtraction of light		Sunlight; Art; Paint; Textiles	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1 week	*2D and 3D wavefronts:* • Diffraction • Interference (special kind of superposition) • Shock waves, sonic boom; diffraction		Microwaves; Starlight and sunlight; Communications; Transport	Any form of assessment as outlined in the Subject Assessment Guidelines including	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the

				practical work	internet.
1 week	*Wave nature of matter:* • de Broglie wavelength • Electron microscope		Cosmology; Medical Technologies	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

ELECTRICITY AND MAGNETISM: 5 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
2 weeks	*Electrodynamics:* Electrical machines (generators, motors) • Alternating current • Capacitance and inductance		Information technologies; Power generation; Power grid; Motors in gadgets used in the home.	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1,5 weeks	*Electronics:* • Capacitive and inductive circuit • Filters and signal tuning • Active circuit elements, diode, LED and field effect transistor, operational amplifier • Principles of digital electronics – logical gates, counting circuits		Digital communications; Information technologies; Cellular communications Sensors	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
1,5 weeks	*Electromagnetic radiation:* • Dual (particle or wave) nature of EM radiation • Nature of an EM-wave as mutual induction of oscillating magnetic or electric fields • EM spectrum • Nature of EM as particle – energy of a photon related to frequency and wavelength • Penetrating ability		Storage and transport of energy; Lightning; Medical technologies X-rays Nuclear Energy	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

CHEMICAL CHANGE: 5 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
3 weeks	*Rate and extent of reaction:* • Rates of reaction and factors affecting rate (nature of reacting substances, concentration [pressure for gases], temperature and presence of a catalyst) • Measuring rates of reaction • Mechanism of reaction and catalysis • Chemical equilibrium and factors affecting equilibrium • Equilibrium constant • Application of equilibrium principles		Mining and mineral processing; Polymers, paints and plastic; Industrial production of chemicals. Chemistry in the home	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.
2 weeks	*Electrochemical reactions:* • Electrolytic and galvanic cells • Relation of current and potential to rate and equilibrium • Understanding of the processes and redox reactions taking place in cells • Standard electrode potentials • Writing of equations representing oxidation and reduction, half reactions and redox reactions		Mining and mineral processing; Electroplating; Rusting of metals Chemical Industry Batteries	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.

CHEMICAL SYSTEMS: 4 WEEKS					
Time Frame	Content	Date completed	Context	Assessment	LTSM
4 weeks	*Chemical industry – resources, needs and the chemical connection:* • SASOL, fuels, monomers and polymers, polymerisation • The chloralkali industry (soap, PVC, etc) • The fertiliser industry (N, P, K) • Batteries, torch, car, etc.		Fuel production; Mining and mineral processing; Cosmology	Any form of assessment as outlined in the Subject Assessment Guidelines including practical work	Science equipment; any relevant equipment from the home Textbook Library Books, newspaper articles, any other resource materials including the internet.