Grade 10

Learning Outcome 1 PHY.LO1 (FET)

Scientific Inquiry and Problem-solving Skills

The learner is able to use process skills, critical thinking, scientific reasoning and strategies to investigate and solve problems in a variety of scientific, technological, environmental and everyday contexts.

Progression will be reflected in the differentiation of the problem situation, as it moves from routine problem-solving skills to high order problem-solving skills. The Assessment Standards build on and link with the Assessment Standards for Grades 7-9 as provided in the Revised National Curriculum Statement Grades R-9 (Schools) to reflect on-going progression. The examples provided illustrate this increasing complexity of problem-solving skills but do not necessarily show increasing complexity of concepts used.

Assessment Standards

CONDUCTING AN INVESTIGATION

We know this when the learner is able to:

10.1.1 Plan and conduct a scientific investigation to collect data systematically with regard to accuracy, reliability and the need to control one variable.

Attainment is evident when the learner, for example,

- plans and conducts an experiment to determine the speed of waves in a medium;
- plans and conducts an experiment to measure property of some materials.

INTERPRETING DATA TO DRAW CONCLUSIONS

10.1.2 Seek patterns and trends in the information collected and link it to existing scientific knowledge to help draw conclusions.

Attainment is evident when the learner, for example,

- analyses and interprets the properties of waves during their transmission in a medium, and from one medium to another, to draw conclusions;
- compares the properties of some materials and interprets .

Grade 11

Assessment Standards

CONDUCTING AN INVESTIGATION

We know this when the learner is able to:

11.1.1 Plan and conduct a scientific investigation to collect data systematically with regard to accuracy, reliability and the need to control variables.

Attainment is evident when the learner, for example,

- determines through experiments, properties of solutions;
- investigates the qualitative effect of changing resistance on the current in a circuit and the quantitative relationship between power, voltage and current with reference to all variables.

INTERPRETING DATA TO DRAW CONCLUSIONS

11.1.2 Seek patterns and trends, represent them in different forms to draw conclusions, and formulate simple generalisations.

Attainment is evident when the learner , for example,

- uses graphical methods to indicate the relationship between resistance and the factors affecting resistance;
- establishes the relative strength of acids by measuring conductivity.

Grade 12

Assessment Standards

CONDUCTING AN INVESTIGATION

We know this when the learner is able to:

12.1.1 Design, plan and conduct a scientific inquiry to collect data systematically with regard to accuracy, reliability and the need to control variables.

Attainment is evident when the learner, for example,

- designs and carries out an experiment to identify specific variables that affect motion (e.g. an experiment to verify Newton's second law of motion);
- uses experimentation to determine some of the properties of organic compounds;
- synthesises a common organic compound such as soap.

INTERPRETING DATA TO DRAW CONCLUSIONS

12.1.2 Seek patterns and trends, represent them in different forms, explain the trends, use scientific reasoning to draw and evaluate conclusions, and formulate generalisations.

Attainment is evident when the learner, for example,

- interprets patterns and trends in data in order to analyse and explain the motion of objects;
- interprets the information gathered on the use of electrical energy, to identify patterns and trends of power usage during all seasons, day and night, and formulates strategies to conserve energy.

Grade 10

Learning Outcome 1 Continued

Scientific Inquiry and Problem-solving Skills

The learner is able to use process skills, critical thinking, scientific reasoning and strategies to investigate and solve problems in a variety of scientific, technological, environmental and everyday contexts.

Progression will be reflected in the differentiation of the problem situation, as it moves from routine problem-solving skills to high order problem-solving skills. The Assessment Standards build on and link with the Assessment Standards for Grades 7-9 as provided in the Revised National Curriculum Statement Grades R-9 (Schools) to reflect on-going progression. The examples provided illustrate this increasing complexity of problem-solving skills but do not necessarily show increasing complexity of concepts used.

Assessment Standards

SOLVING PROBLEMS

We know this when the learner is able to:

■ 10.1.3 Apply given steps in a problem-solving strategy to solve standard exercises.

Attainment is evident when the learner, for example,

- draws a diagram, identifies what is known, selects a suitable equation, solves the equation and checks that the answer makes sense for a standard kinematics exercise. Apply known problem-solving strategies to solve multi-step problems.

Grade 11

Assessment Standards

SOLVING PROBLEMS

We know this when the learner is able to:

11.1.3 ■ Apply known problem-solving strategies to solve multi-step problems.

Attainment is evident when the learner, for example,

- uses kinematics to calculate the acceleration of an object being pulled up a slope and then uses the calculated value of acceleration to determine the force with which the object is being pulled. Select and use appropriate problem-solving strategies to solve novel (unseen) problems.

Grade 12

Assessment Standards

SOLVING PROBLEMS

We know this when the learner is able to:

12.1.3 ■ Select and use appropriate problem-solving strategies to solve (unseen) problems.

Attainment is evident when the learner, for example,

- decides what information is needed and what steps must be followed to determine how far away a satellite is, using a laser.

Grade 10

Learning Outcome 1 Continued

Scientific Inquiry and Problem-solving Skills

The learner is able to use process skills, critical thinking, scientific reasoning and strategies to investigate and solve problems in a variety of scientific, technological, environmental and everyday contexts.

Progression will be reflected in the differentiation of the problem situation, as it moves from routine problem-solving skills to high order problem-solving skills. The Assessment Standards build on and link with the Assessment Standards for Grades 7-9 as provided in the Revised National Curriculum Statement Grades R-9 (Schools) to reflect on-going progression. The examples provided illustrate this increasing complexity of problem-solving skills but do not necessarily show increasing complexity of concepts used.

Assessment Standards

COMMUNICATING AND PRESENTING INFORMATION AND SCIENTIFIC ARGUMENTS

We know this when the learner is able to:

■ 10.1.4 Communicate information and conclusions with clarity and precision.

Attainment is evident when the learner, for example,

- selects and uses appropriate vocabulary, SI units, and numeric and linguistic modes of representation to communicate scientific ideas and plans related to experimental procedures;
- reports that the length of a pendulum is the only factor affecting the frequency.

Grade 11

Assessment Standards

COMMUNICATING AND PRESENTING INFORMATION AND SCIENTIFIC ARGUMENTS

We know this when the learner is able to:

11.1.4 ■ Communicate information and present scientific arguments with clarity and precision.

Attainment is evident when the learner, for example,

- discusses the development of modern electronic devices and presents arguments to explain advantages of using them;
- argues which motor will produce the greatest turning effect by referring to appropriate factors;
- presents a scientific argument on the use of nuclear reactors for the generation of electricity.

Grade 12

Assessment Standards

COMMUNICATING AND PRESENTING INFORMATION AND SCIENTIFIC ARGUMENTS

We know this when the learner is able to:

12.1.4 ■ Communicate and defend scientific arguments with clarity and precision.

Attainment is evident when the learner, for example,

- formulates and defends scientific arguments for wearing safety belts;
- formulates and defends scientific arguments around the compulsory installation of air-bags in all means of transport;
- presents scientific arguments on the risks and benefits of the combustion of organic products and the manufacturing of synthetic products on human development, society and the environment;
- explains the dangers associated with the use of organic solvents and other organic products like combustibility and toxicity, and presents scientific arguments against the use of synthetic organic solvents.

Grade 10

Learning Outcome 2 PHY.LO2 (FET)

Constructing and Applying Scientific Knowledge

The learner is able to state, explain, interpret and evaluate scientific and technological knowledge and can apply it in everyday contexts.

Progression in this outcome is reflected by the increase in the quantity and depth of understanding of concepts used, together with an increasing understanding of the connections between different concepts in order to develop a well-organised knowledge base.

Assessment Standards

RECALLING, STATING AND DISCUSSING PRESCRIBED CONCEPTS

We know this when the learner is able to:

10.2.1 Recall and state basic prescribed scientific knowledge.

Attainment is evident when the learner, for example,

- states components of the atom (protons, electrons, neutrons, sub-atomic particles) and their characteristics;
- lists sources, uses and quantities of elements obtained from mining in South Africa;
- states and recognises that there are weak forces between and strong forces within molecules.

Grade 11

Assessment Standards

RECALLING, STATING AND DISCUSSING PRESCRIBED CONCEPTS

We know this when the learner is able to:

11.2.1 ■ Define and discuss basic prescribed scientific knowledge.

Attainment is evident when the learner, for example,

- defines the concepts of atomic number, mass number, atomic mass, isotope and radio-isotope;
- describes concepts and units related to electricity (e.g. electrical charge, electrical current and electron flow);
- states and explains the motor principle;
- describes oxidation and reduction in terms of the loss and the gain of electrons or the change in oxidation number.

Grade 12

Assessment Standards

RECALLING, STATING AND DISCUSSING PRESCRIBED CONCEPTS

We know this when the learner is able to:

12.2.1 ■ Define, discuss and explain prescribed scientific knowledge.

Attainment will be evident when the learner, for example,

- recalls and explains the concepts of distance, speed, time, acceleration, force and momentum;
- defines energy and explains the differences between different types of energy;
- discusses the characteristics of the carbon atom (referring to bonding and chain formation) and identifies the functional groups of common families (e.g. alkanes, alkenes, alcohols, acids, esters);
- describes electrochemical processes.

Grade 10

Learning Outcome 2 Continued

Constructing and Applying Scientific Knowledge

The learner is able to state, explain, interpret and evaluate scientific and technological knowledge and can apply it in everyday contexts.

Progression in this outcome is reflected by the increase in the quantity and depth of understanding of concepts used, together with an increasing understanding of the connections between different concepts in order to develop a well-organised knowledge base.

Assessment Standards

EXPLAINING RELATIONSHIPS

We know this when the learner is able to:

■ 10.2.2 Express and explain prescribed scientific theories and models by indicating some of the relationships of different facts and concepts with each other.

Attainment is evident when the learner, for example,

- uses the atomic model of matter to explain howmelting and boiling temperature can be used to differentiate between substances having molecular and giant structures;
- explains the differences between elements, molecules and compounds.

APPLYING SCIENTIFIC KNOWLEDGE

■ 10.2.3 Apply scientific knowledge in familiar, simple contexts.

Attainment is evident when the learner, for example,

- identifies LEDs in circuits and knows the type and approximate voltage required for them to work.

Grade 11

Assessment Standards

EXPLAINING RELATIONSHIPS

We know this when the learner is able to:

■ 11.2.2 Express and explain prescribed scientific theories, models and laws by indicating the relationship between different facts and concepts in own words.

Attainment is evident when the learner, for example,

- describes the relationship between atomic number, mass number, atomic mass, isotope and radio-isotope;
- compares direct current and alternating current in qualitative terms, and explains the importance of alternating current in the transmission of electrical energy.

APPLYING SCIENTIFIC KNOWLEDGE

■ 11.2.3 Apply scientific knowledge in everyday life contexts.

Attainment is evident when the learner, for example,

- applies knowledge about electricity and magnetism to explain the working of transformers and builds a transformer;
- applies knowledge about radioactivity to explain the use of radio-carbon dating to determine the age of an artefact.

Grade 12

Assessment Standards

EXPLAINING RELATIONSHIPS

We know this when the learner is able to:

■ 12.2.2 Express and explain prescribed scientific principles, theories, models and laws by indicating the relationship between different facts and concepts in own words.

Attainment is evident when the learner, for example,

- indicates and explains the relationships between distance, time, mass, speed, force, acceleration, and balanced and unbalanced forces, and represents these relationships in more than one form;
- explains the principles underlying the use of distillation to separate organic compounds;
- describes, using basic knowledge about chemical reaction and structural formulae, typical organic reactions such as addition, combustion and polymerisation;

APPLYING SCIENTIFIC KNOWLEDGE

■ 12.2.3 Apply scientific knowledge in everyday life contexts.

Attainment is evident when the learner, for example,

- applies scientific knowledge to identify precautions that can be taken to avoid accidents;
- shows how energy transformation technologies are applied in everyday life;
- applies understanding of electrolysis to the production of chlorine in swimming pool chlorinators;
- uses available materials to construct an electrochemical cell.

Grade 10

Learning Outcome 3 PHY.LO3 (FET)

The Nature of Science and its Relationships to Technology, Society and the Environment

The learner is able to identify and critically evaluate scientific knowledge claims and the impact of this knowledge on the quality of socio-economic, environmental and human development.

Progression in this Learning Outcome entails the relationship between knowledge systems and claims, and the increasing ability to analyse and evaluate their impact on socio-economic development in the wider world.

Assessment Standards

EVALUATING KNOWLEDGE CLAIMS

We know this when the learner is able to:

10.3.1 Discuss knowledge claims by indicating the link between indigenous knowledge systems and scientific knowledge.

Attainment is evident when the learner, for example,

- uses scientific knowledge to explain why certain traditional practices are important;
- compares the changing interpretations of the nature and properties of matter.

Grade 11

Assessment Standards

EVALUATING KNOWLEDGE CLAIMS

We know this when the learner is able to:

11.3.1 ■ Recognise, discuss and compare the scientific value of knowledge claims in indigenous knowledge systems and explain the acceptance of different claims.

Attainment is evident when the learner, for example,

- traces and compares the historical development of different electronic technologies;
- compares the ways of explaining lightning by different communities;
- states controversies around the use of radioactivity.

Grade 12

Assessment Standards

EVALUATING KNOWLEDGE CLAIMS

We know this when the learner is able to:

12.3.1 ■ Research, discuss, compare and evaluate scientific and indigenous knowledge system knowledge claims by indicating the correlation among them, and explain the acceptance of different claims.

Attainment is evident when the learner, for example,

- compares and evaluates various explanations from different historical perspectives on the concept of force;
- researches and evaluates the suitability of alternative energy sources such as ethanol as a fuel, wind, solar and nuclear power, and discusses the acceptance of different viewpoints based on scientific knowledge.

Grade 10

Learning Outcome 3 Continued

The Nature of Science and its Relationships to Technology, Society and the Environment

The learner is able to identify and critically evaluate scientific knowledge claims and the impact of this knowledge on the quality of socio-economic, environmental and human development.

Progression in this Learning Outcome entails the relationship between knowledge systems and claims, and the increasing ability to analyse and evaluate their impact on socio-economic development in the wider world.

Assessment Standards

EVALUATING THE IMPACT OF SCIENCE ON HUMAN DEVELOPMENT

We know this when the learner is able to:

10.3.2 Describe the interrelationship and impact of science and technology on socio-economic and human development.

Attainment is evident when the learner, for example,

- provides names, formulae and uses of elements and compounds in everyday life and describes their impact on the environment;
- states the impact of human demands on the resources and products in the earth's system;
- using scientific principles, summarises the dangers of ultra-violet radiation and the role of sunscreens.

Grade 11

Assessment Standards

EVALUATING THE IMPACT OF SCIENCE ON HUMAN DEVELOPMENT

We know this when the learner is able to:

11.3.2 Identify ethical and moral issues related to the development of science and technology and evaluate the impact (pros and cons) of the relationship from a personal viewpoint.

Attainment is evident when the learner, for example,

- identifies and discusses moral and economic issues related to the use of electronic devices to protect cellular phone users against radiation;
- discusses strategies and ethical issues related to using chemical substances in sport;
- identifies and discusses ethical and moral issues related to global warming.

Grade 12

Assessment Standards

EVALUATING THE IMPACT OF SCIENCE ON HUMAN DEVELOPMENT

We know this when the learner is able to:

12.3.2 Research case studies and present ethical and moral arguments from different perspectives to indicate the impact (pros and cons) of different scientific and technological applications.

Attainment is evident when the learner, for example,

- explains the impact on human beings of collisions during road accidents;
- explores the precautions that can be taken to avoid accidents and discusses the technologies used to minimise the effects of collisions;
- analyses and explains the relationship between force and motion with political, economic, environmental and safety issues in the development and use of transportation technologies;
- researches and presents arguments on the impact of organic reactions on the quality of human life and the environment;
- researches and presents arguments on the economic, social and environmental impact of various energy sources;
- identifies typical organic reactions that add value to life (e.g. combustion and addition polymerisation) and researches their impact on socio-economic development;
- explains the dangers and impact associated with the use of organic solvents and other organic products (e.g. combustibility, toxicity) and suggests intervention strategies;
- discusses ethical issues related to the use of newly-synthesised drugs without proper testing.

Grade 10

Learning Outcome 3 Continued

The Nature of Science and its Relationships to Technology, Society and the Environment

The learner is able to identify and critically evaluate scientific knowledge claims and the impact of this knowledge on the quality of socio-economic, environmental and human development.

Progression in this Learning Outcome entails the relationship between knowledge systems and claims, and the increasing ability to analyse and evaluate their impact on socio-economic development in the wider world.

Assessment Standards

EVALUATING THE IMPACT OF SCIENCE ON THE ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

We know this when the learner is able to:

■ 10.3.3 Discuss the impact of scientific and technological knowledge on sustainable local development of resources and on the immediate environment.

Attainment is evident when the learner, for example,

- discusses the environmental challenges to proper management of elements and compounds as well as their safe use and disposal in everyday life.

Grade 11

Assessment Standards

EVALUATING THE IMPACT OF SCIENCE ON THE ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

We know this when the learner is able to:

11.3.3 Evaluate the impact of scientific and technological knowledge on sustainable development of resources and suggest long-term and short-term strategies to improve the management of resources in the environment.

Attainment will be evident when the learner, for example,

- discusses scientific factors that influence the different type of reactions and how these are applied in industry and everyday life;
- explains the impact of electronic devices on society and the environment;
- describes the effects of acid rain on the process of corrosion of metals;
- mentions the applications of radioactivity and its impact on our lives and the environment.

Grade 12

Assessment Standards

EVALUATING THE IMPACT OF SCIENCE ON THE ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

We know this when the learner is able to:

12.3.3 Evaluate the impact of scientific and technological research and indicate the contribution to the management, utilisation and development of resources to ensure sustainability continentally and globally.

Attainment is evident when the learner, for example,

- analyses and explains the relationship between force and motion with political, economic, environmental and safety issues in the development and use of transportation technologies;
- evaluates strategies used to determine the influence and impact of motion on the quality of life and the environment;
- analyses the sustainable use of energy;
- presents scientific arguments on the risks and benefits of combustion of organic products and manufacturing of synthetic products on human development, society and the environment;
- explains the impact on the environment of combustion of fossil fuels (organic compounds);
- presents a report on the social, environmental and economic consequences of the use and discarding of organic products.