An Roinn Oideachais agus Eolaíochta

Junior Certificate

SCIENCE SYLLABUS

(Ordinary Level and Higher Level)

THE JUNIOR CERTIFICATE

Aims and Principles

1. The general aim of education is to contribute towards the development of all aspects of the individual, including aesthetic, creative, critical, cultural, emotional, intellectual, moral, physical, political, social and spiritual development, for personal and family life, for working life, for living in community and for leisure.

2. The Junior Certificate Programme is designed to meet the needs of all students in second-level education. Arising from this, every subject is offered at two levels, ordinary and higher. In the case of English, Irish and Mathematics a foundation level is also available.

3. The Junior Certificate Programme aims to
   - reinforce and further develop in the young person the knowledge, understanding, skills and competencies acquired at primary level;
   - extend and deepen the range and quality of the young person's educational experiences in terms of knowledge, understanding, skills and competencies;
   - develop the young person's personal and social confidence, initiative and competence through a broad, well-balanced general education;
   - prepare the young person for the requirements of further programmes of study, of employment or of life outside full-time education;
   - contribute to the moral and spiritual development of the young person and to develop a tolerance and respect for the values and beliefs of others;
   - prepare the young person for the responsibilities of citizenship in the national context and in the context of the wider European and global communities.

4. The Junior Certificate Programme is based on the following principles:

   Breadth and balance
   At this stage of their school careers, all students should have a wide range of educational experiences. Particular attention must be given to reinforcing and developing the skills of numeracy, literacy and oracy. Particular emphasis should be given to social and environmental education, science and technology and modern languages.

   Relevance
   Curriculum provision should address the immediate and prospective needs of the young person, in the context of the cultural, economic and social environment.

   Quality
   Every young person should be challenged to achieve the highest possible standards of excellence, with due regard to different aptitudes and abilities and to international comparisons.

5. Each Junior Certificate Syllabus is presented for implementation within the general curriculum context outlined above.

Junior Certificate

SCIENCE SYLLABUS

(Ordinary Level and Higher Level)

CONTENTS

1. INTRODUCTION AND RATIONALE

INTRODUCTION

This revised syllabus in Junior Certificate science has been drawn up to cater for the full range of student ability, aptitude and achievement. The syllabus has three major components, biology, chemistry and physics, and is concerned with the development of scientific knowledge, skills, concepts, and attitudes essential for the responsibilities of citizenship in today's world. All students, irrespective of syllabus level, will be required to study these three components.

The course is activity-based in its design and emphasises practical experience of science for each individual student. The importance of the processes of science as well as knowledge and understanding is reflected in the syllabus structure. Through a variety of investigations and experiments, students attain the specified learning outcomes, developing appropriate science process skills and a knowledge of underlying science concepts.

RATIONALE

In the post-primary junior cycle, the study of science contributes to a broad and balanced educational experience for students, extending their experiences at primary level. It is concerned with the development of scientific literacy[1] and associated science process skills, together with an appreciation of the impact that science has on our lives and environment. In an era of rapid scientific and technological change the study of science is fundamental to the development of the confidence required to deal with the opportunities and challenges that such change presents in a wide variety of personal and social contexts.

Arising out of their experience in the junior cycle, it is hoped that many students will be encouraged to study one or more of the science subjects in the senior cycle, thus preparing themselves for further study or work in this area.

[1] Scientific literacy (OECD/PISA definition): The capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity.

2. SYLLABUS AIMS AND OBJECTIVES

SYLLABUS AIMS

Science education at junior cycle should

- encourage the development of manipulative, procedural, cognitive, affective and communication skills through practical activities that foster investigation, imagination, and creativity
- provide opportunities for observing and evaluating phenomena and processes and for drawing valid deductions and conclusions
- enable students to acquire a body of scientific knowledge appropriate to their age, and an understanding of the relevance and applications of science in their personal and social lives
- foster an appreciation of and respect for life and the environment, while at the same time developing awareness of the potential use, misuse and limitations of science, and of health and safety issues relating to science
- provide a balanced understanding of the physical, biological and chemical dimensions of science, thus facilitating the further study of science in the senior cycle.
- develop a sense of enjoyment in the learning of science.

SYLLABUS OBJECTIVES

Knowledge and understanding

The student will develop a knowledge and understanding of

- the various forms of matter and the reactions and interactions which enable matter to be transformed
- the ways in which the composition of materials around us affects our quality of life
- energy in its various forms, the application of energy conversions, and the need for economical use of energy sources
- the composition of the atmosphere and the importance of air and water to life
- the nutritional needs of plants and animals and their interdependence
- important principles, theories and facts relating to science and their applications in everyday living
- the scientific method and the concept of a valid experiment
- the underlying scientific principles applied to industry at local, national and international level
- the ways in which a code of safety can be applied in scientific and technological investigations and activities.

Skills

The student will develop skills associated with

- manipulation of equipment and manual dexterity, with due regard to issues of health and safety
- procedural plans and the use of the scientific method in problem solving
- observation, measurement and the accurate recording of data
- obtaining and using information from a variety of sources
- numeracy, and the manipulation and interpretation of data in a variety of forms, including the use of symbols, charts and graphs

- logical thinking, inductive and deductive reasoning, and the formation of opinions and judgments based on evidence and experiment
- the preparation and presentation of reports on scientific topics, experiments, etc.
- independent study and co-operative learning
- the application of scientific knowledge to everyday life experiences.

Attitudes

The student will develop

- a sense of safety in the laboratory, at home, in the workplace, and in the environment
- a sense of accuracy and attention to detail
- an appreciation of the role of science in the everyday world
- a scientific interest in the local community and environment
- an awareness of health issues.

3. SYLLABUS STRUCTURE

SYLLABUS SECTIONS

The syllabus is presented in three main sections, which focus on the specific areas of biology, chemistry and physics. Within each syllabus section, topics and sub-topics are described, together with associated learning outcomes. In general, these are presented in an increasing order of difficulty—later investigations and experiments build upon and extend the knowledge and skills developed earlier.

LENGTH OF SYLLABUS

The course outcomes are presented in considerable detail in order to indicate the depth of treatment required. 240-270 hours class contact time (normally equivalent to four class periods per week) are recommended for science over the three years of the junior cycle in order to achieve the aims, objectives and learning outcomes of the syllabus. It is recommended that two class periods each week be timetabled together to facilitate the completion of required student laboratory work and assignments.

DIFFERENTIATION BETWEEN ORDINARY AND HIGHER LEVELS

Much of the syllabus material is common to both levels. At Higher level a deeper and more analytical treatment is required, as is indicated in the syllabus objectives and learning outcomes. Additional syllabus material designated for Higher level only is underlined. As many students as possible should be encouraged to study science at Higher level.

REQUIRED COURSEWORK

Some of the learning outcomes in the syllabus are highlighted in bold. Students are required to keep a record in their laboratory notebooks of these practical activities, which form one element of the coursework assessment (see page 32).

4. PRACTICAL ACTIVITIES IN SCIENCE

The revised syllabus emphasises a practical experience of science for the student. The syllabus presentation does not imply any particular method or sequence of teaching science, although it should follow a logical and coherent approach. In the teaching and learning, appropriate links should be made between the three syllabus sections. A wide range of teaching approaches may be used, including the use of datalogging where appropriate. Particular emphasis should be laid on the everyday applications of science in the student's life and environment, and appropriate reference should be made to the work of prominent scientists and to modern scientific developments. These represent the points of transference from school-based learning to general experience.

Teaching strategies should promote the aims, objectives and learning outcomes described in the syllabus, and they should encourage investigative work as well as experimental work. Practical activities are, therefore, an essential element of the course. They serve to

- encourage accurate observation and careful recording
- promote logical patterns of thought
- develop manipulative skills
- give training in problem solving
- elucidate the theoretical work so as to aid comprehension
- arouse and maintain interest in the subject
- make biological, chemical and physical phenomena more real through actual experience.

Activities include

- measuring (various quantities)
- recording (information/data)
- calculating (using recorded or supplied data)
- graphing or tabulating (using recorded or supplied data)
- presenting information, findings or conclusions in a variety of forms
- identifying (animal or plant species, patterns of behaviour)
- classifying (information, animals, plants)
- analysing (recorded or supplied data)
- investigating (properties, relationships)
- observing (behaviour, patterns, reactions)
- examining (materials, samples, illustrations, functions)
- describing (by means of words, illustrations, etc.)
- testing (materials, products of reactions)
- preparing (solutions, gases).

These activities can be grouped under the headings of investigations and experiments.

Investigation

The term *investigation* is used to represent an experience in which the student seeks information about a particular object, process or event in a manner that is not pre-determined in either procedure or outcome. Such experiences can enable the student to observe phenomena, select and follow a line of enquiry, or conduct simple practical tests that may stimulate thought or discussion, thus

leading to a clearer understanding of the facts or underlying principles. It should involve the student in following a logical pattern of questioning and decision-making that enables evidence to be gathered in a similar way to that used by scientists. Investigations can be used to develop skills of logical thinking and problem solving, and can give the student an insight into the scientific process. Thus, the student can appreciate the importance of using a fair test in order to arrive at valid deductions and conclusions, and the significance of making and recording measurements and observations accurately.

Experiment

In conducting an *experiment,* the student follows a prescribed procedure in order to test a theory, to confirm a hypothesis or to discover something that is unknown. Experiments can help to make scientific phenomena more real to students and provide them with opportunities to develop manipulative skills and safe work practices in a school laboratory.

5. SYLLABUS TOPICS AND LEARNING OUTCOMES

In the pages that follow, the syllabus is set out in three sections. In each section, the main topics and sub-topics are described, and the associated learning outcomes are presented. The topics described in the syllabus are designed to be delivered in a way that will involve the student in consistent experimental and investigative work, which will be reflected in the structure and format of the assessment.

Certain activities are basic to all science: observing, measuring, recording, calculating, classifying, investigating and communicating. Through their study of this syllabus and the associated activities, students should become familiar with standard apparatus and its safe use in school science. They should develop an understanding of what constitutes a fair test or valid experiment and an awareness of the importance of accuracy.

The set of outcomes highlighted in bold in the following syllabus sections represents a minimum of practical work. As part of their coursework (which forms one element of their assessment) students will be required to keep a record of this practical work in their laboratory notebooks, which must be available for inspection. *Other experiments and investigations within the syllabus can and will be examined.*

Having completed the investigations and experiments contained within the syllabus, students will be expected to know the associated outcomes and results. They should also be able to manipulate recorded data and to interpret, present and communicate results in an appropriate manner.

5.1 BIOLOGY

Biology is the science of living things and can be categorised broadly into the study of animals and plants. This section of the syllabus deals with aspects of human biology and plant biology. The human body is an integrated organism, with a variety of systems that carry out a range of functions. Each system has a particular structure that enables it to carry out its functions. Understanding how the body functions and how it develops will enable us to appreciate the processes and changes that occur during our lives. Plants and micro-organisms are a vital component of our living world. Plants are the main food producers for all living things.

- Section 1A: Human Biology – food, digestion and associated body systems
- Section 1B: Human Biology – the skeletal/muscular system, the senses and human reproduction
- Section 1C: Animals, plants and micro-organisms

SECTION 1A: HUMAN BIOLOGY – FOOD, DIGESTION AND ASSOCIATED BODY SYSTEMS

Food is one of the basic human needs and the digestive system enables the body to convert it into a form that is more suitable for use. The breathing and circulatory systems enable the transport of oxygen and digested food around the body to provide energy and growth materials where they are required. Waste products are removed from the body by excretion (undigested food is removed by egestion).

Main Topic		Sub-topics
1A1	Food	contents of a variety of food products as described on their labels food as a necessary source of energy and as a growth material for the body constituents of a balanced diet
1A2	Digestion	major parts and functions of the digestive system teeth, types and function
1A3	Enzymes	enzyme action
1A4	Aerobic respiration	respiration as a release of energy from digested food energy conversion from chemical energy to heat energy human breathing rate the breathing system and its role in gaseous exchange, including the effects of smoking
1A5	Circulatory system	composition and function of blood structure and function of the heart passage of blood through the heart and main body organs factors affecting human pulse rate
1A6	Excretion	the functions of the lungs, kidneys and skin in the excretion of waste products made in the body

SECTION 1A: HUMAN BIOLOGY – FOOD, DIGESTION AND ASSOCIATED BODY SYSTEMS

On completion of this section, students should be able to

OB1 recall that a balanced diet has six constituents: carbohydrates (including fibre), fats, proteins, vitamins, minerals and water, each with different functions

OB2 describe a food pyramid and give examples of types of food recommended in a balanced diet

OB3 carry out qualitative food tests for starch, reducing sugar, protein and fat

OB4 read and interpret the energy values indicated on food product labels and compare the energy content per 100 g of a number of foods, and identify the food types on the label that form part of a balanced diet

OB5 investigate the conversion of chemical energy in food to heat energy

OB6 identify and locate the major parts of the digestive system including the mouth, oesophagus, stomach, liver, pancreas, small intestine and large intestine, and know their functions

OB7 identify molars, premolars, canines and incisors, and describe their functions

OB8 investigate the action of amylase on starch; name the substrate, product and enzyme

OB9 describe the process of aerobic respiration by means of a word equation and understand that aerobic respiration requires the presence of oxygen

OB10 demonstrate the products of aerobic respiration

OB11 carry out qualitative tests to compare the carbon dioxide levels of inhaled and exhaled air

OB12 describe how oxygen is taken into the bloodstream from the lungs and how carbon dioxide is taken into the lungs from the bloodstream during gaseous exchange and how these processes are affected by smoking

OB13 describe the function and composition of blood (white blood cells, red blood cells and platelets in a liquid called plasma) and state the function of each component

OB14 state the function of the heart; describe its structure, identifying the four chambers; explain the difference between the left ventricle and the right ventricle

OB15 describe the passage of blood through the heart and lungs via arteries and veins; identify the pulmonary artery and vein, aorta and vena cava; distinguish between arteries, veins and capillaries

OB16 demonstrate the effect of exercise and rest on pulse and breathing rate and appreciate that a balance of each promotes good health

OB17 recall that the average pulse rate for an adult at rest is 70 b.p.m., and explain why exercise results in increased pulse and breathing rates

OB18 recall that the normal temperature of the human body is 37 °C, and that illness may cause a change in body temperature

OB19 associate the circulation of the products of digestion around the body with their absorption into the bloodstream

OB20 state the function of the urinary system; describe its structure, identifying the bladder, renal artery, renal vein, ureter, urethra and kidney

OB21 name the products of excretion: CO_2, water and urea

OB22 describe the function of the skin in the excretion of waste products made in the body

OB23 recall that waste products are removed from the bloodstream by filtration in the kidneys in the form of urine, which contains urea, water and salts; recall that urine is stored in the bladder before being released from the body.

SECTION 1B: HUMAN BIOLOGY – THE SKELETAL/MUSCULAR SYSTEM, THE SENSES AND HUMAN REPRODUCTION

Our basic body shape is formed by our skeleton, which is made up of over two hundred bones. The skeleton provides support and protection for the body and the arrangement of the bones, together with the associated ligaments and muscles, allows for movement. Our senses enable us to be aware of, and respond to, our immediate surroundings.

The human species is continued through the process of sexual reproduction. The reproductive system develops to maturity during adolescence, and males and females have different roles in reproduction. Children inherit many characteristics from their parents.

Main Topic		**Sub-topics**
1B1	Skeletal system	the role of the skeleton in support, movement and protection function of bone
1B2	Muscular system	muscles, tendons, ligaments and joints function of muscle in relation to movement
1B3	Sensory system	awareness of, and response to our surroundings through the sense organs sensory and motor function of nerves communication between the sense organs and the brain structure of the eye and functions of the parts of the eye
1B4	Reproductive system	male and female reproductive systems menstrual cycle fertilisation and pregnancy contraception
1B5	Genetics	inheritable and non-inheritable characteristics chromosomes and genes

SECTION 1B: HUMAN BIOLOGY – THE SKELETAL/MUSCULAR SYSTEM, THE SENSES AND HUMAN REPRODUCTION

On completion of this section, students should be able to

OB24 identify the main parts of the human skeleton and describe its functions as support, movement and protection

OB25 locate the major bones in the human body including the skull, ribs, vertebrae, collarbone, shoulder blade, humerus, radius, ulna, pelvis, femur, tibia and fibula, using a diagram or a model skeleton

OB26 describe the function of joints and muscles (including antagonistic pairs), tendons and ligaments, and the relationship between these and bones

OB27 describe the general structure and action of different types of joints: fused, ball and socket and hinged, and identify examples of each: skull, shoulder, elbow, hip, knee

OB28 recall five sense organs in the human (eyes, ears, nose, skin and tongue) and explain how these enable humans to gather information from their surroundings

OB29 describe the role of the central nervous system and the sensory and motor functions of nerves

OB30 locate the main parts of the eye on a model or diagram and describe the function of the cornea, iris, lens, pupil, retina, optic nerve and ciliary muscle

OB31 use wall charts or other illustrative diagrams to identify and locate the main parts of the male and female reproductive systems

OB32 recall that the menstrual cycle lasts about 28 days, that menstruation occurs at the start of the cycle and that a fertile period occurs during the cycle

OB33 describe the following events which occur in relation to human reproduction:

- sexual intercourse
- fertilisation - the fusion between male and female gametes (sperm and egg) resulting in a zygote
- cell division of the zygote, which develops into a foetus within the womb
- pregnancy
- birth
- growth and puberty

OB34 recall that there are many forms of contraception, some of which prevent fertilisation

OB35 appreciate that humans have inheritable and non-inheritable characteristics, and recall that inheritable characteristics are controlled by genes

OB36 recall that genes are located on chromosomes and that in a human there are 23 pairs of chromosomes, which are located in the nucleus

OB37 recall that chromosomes are made of DNA and protein.

SECTION 1C: ANIMALS, PLANTS AND MICRO-ORGANISMS

Through photosynthesis plants use the sun's energy to make food, which is stored in the form of carbohydrates. At the same time, they replenish the supply of oxygen in the atmosphere and remove carbon dioxide. Plants have systems that enable them to function and survive, and to respond to their environment. Competition and interdependence occur within an ecosystem.

Main Topic		Sub-topics
1C1	Living things	variety of living things; classifying living organisms as plants or animals (vertebrates/invertebrates) identifying common plants and animals; life processes and common characteristics of living organisms relationship between cells, tissues, organs and systems
1C2	The microscope	function and main parts of a microscope: eyepiece lens, objective lens, stage, focus control, light source using a microscope to examine animal and plant cells
1C3	Plant structure	structure and function of the main parts of a typical flowering plant
1C4	Transport in plants	passage of water and minerals through the plant transpiration
1C5	Photosynthesis	word equation for photosynthesis conversion of light energy into chemical energy phototropism and geotropism
1C6	Reproduction and germination in plants	sexual and asexual reproduction pollination and fertilisation seed dispersal conditions necessary for germination
1C7	Ecology	local habitat study simple keys and instruments (quadrat, pooter, pitfall trap, beating tray, line transect) to show variety and distribution of named organisms food chains and food webs, adaptation, competition and interdependence conservation, pollution and waste management
1C8	Microbiology and biotechnology	micro-organisms: bacteria, fungi and viruses biotechnology in industry and medicine

SECTION 1C: ANIMALS, PLANTS AND MICRO-ORGANISMS

On completion of this section, students should be able to

OB38 use a simple key to identify plants and animals, including vertebrates and invertebrates

OB39 investigate the variety of living things by direct observation of animals and plants in their environment; classify living organisms as plants or animals, and animals as vertebrates or invertebrates

OB40 identify the basic life processes and characteristics common to all living organisms: nutrition, respiration, excretion, growth, reproduction, movement and response

OB41 recall that living things are composed of cells, tissues, organs and systems, and that growth results from cell division

OB42 describe the functions of the main parts of a light microscope and use it to examine an animal cell and a plant cell

OB43 draw one example each of an animal cell and a plant cell, identifying the nucleus, cytoplasm and cell wall (plant cell), and indicating the position of the cell membrane

OB44 prepare a slide from plant tissue and sketch the cells under magnification

OB45 identify the main parts of a typical flowering plant and their functions: the root, stem, leaf and flower

OB46 associate the transport of water and minerals in the plant with the xylem and the transport of food in the plant with the phloem

OB47 carry out simple activities to show the path of water through plant tissue, and show that water evaporates from the surface of a leaf by transpiration

OB48 describe, using a word equation, how plants make their own food through photosynthesis

OB49 show that starch is produced by a photosynthesising plant

OB50 investigate the growth response of plants to light (phototropism) and gravity (geotropism)

OB51 distinguish between asexual and sexual reproduction in plants and describe a way in which a named plant can reproduce asexually

OB52 locate and identify the main parts of the flower: sepals, petals, carpel and stamen

OB53 use a suitable flower to identify the stigma, style, ovary, anther and filament

OB54 recall that the stamen/anther produces pollen (which provides the male gamete for fertilisation), that the carpel/ovary produces the egg cell (which provides the female gamete for fertilisation) and describe how pollen is transferred (wind and insect)

OB55 recall that seed formation follows fertilisation, and describe seed dispersal

OB56 describe seed structure (testa, food supply, radicle, plumule)

OB57 recall that seed germination is necessary to produce a new plant

OB58 investigate the conditions necessary for germination

OB59 study a local habitat, using appropriate instruments and simple keys to show the variety and distribution of named organisms

OB60 appreciate that living things are affected by their environment and respond to changes that occur in that environment, and that their numbers depend on the availability of food and the presence or absence of other organisms

OB61 list examples of producers, decomposers and consumers in an ecosystem

OB62 select a food chain and a food web from a named habitat and identify examples of adaptation, competition and interdependence

OB63 appreciate the importance of conservation and of pollution and waste management to the environment, and identify ways in which living things contribute to these, both individually and as a community

OB64 discuss how human activity affects the environment, both positively and negatively (two examples in each case)

OB65 investigate the presence of micro-organisms in air and soil

OB66 state two uses of biotechnology in industry and two uses of biotechnology in medicine

OB67 list three common illnesses caused by viruses and three caused by bacteria.

5.2 CHEMISTRY

The world is made up of a variety of substances. Some of these occur naturally in our environment, others are made through the combination of naturally occurring substances to form new materials. The study of chemistry can lead us to a better understanding of our material world and the processes by which materials can change and be changed.

- Section 2A: Classification of substances
- Section 2B: Air, oxygen, carbon dioxide and water
- Section 2C: Atomic structure, reactions and compounds

SECTION 2A: CLASSIFICATION OF SUBSTANCES

Substances can be classified in three principal categories:

- solids, liquids or gases
- elements (metals and non-metals), compounds and mixtures
- acidic, neutral or basic.

Main Topic		Sub-topics
2A1	Materials	states of matter characteristics of solids, liquids and gases
2A2	Mixtures	separating substances using filtration, evaporation, distillation and paper chromatography
2A3	Classification of substances, elements and compounds	classification and properties of elements, compounds and mixtures the Periodic Table classification of elements into metals and non-metals
2A4	Metals	examples of metallic elements and their symbols: copper, zinc, aluminium, iron, silver and gold properties of metals alloys
2A5	Non-metals	examples of non-metallic elements and their symbols: carbon, oxygen, sulfur, hydrogen and nitrogen
2A6	Mixtures and compounds	difference between a mixture and a compound
2A7	Water and solutions	water as a solvent the effect of temperature on solubility formation of crystals
2A8	Acids and bases	classifying substances as acidic, basic or neutral the pH scale the pH of a variety of common substances

SECTION 2A: CLASSIFICATION OF SUBSTANCES

On completion of this section, students should be able to

OC1 name three states of matter and describe their distinguishing characteristics

OC2 separate mixtures using a variety of techniques: filtration, evaporation, distillation and paper chromatography

OC3 describe, and distinguish between, an element, a compound and a mixture; recall that all known elements are listed in the Periodic Table and that, in a chemical reaction, elements may lose their individual properties

OC4 examine a variety of substances and classify these as

- elements or compounds (using the Periodic Table as a reference)
- metals or non-metals

OC5 list the physical properties (state and colour only) of two examples of metallic and two examples of non-metallic elements

OC6 recall that metals conduct electricity and heat

OC7 identify everyday applications of metals, for example in industry, in the making of jewellery

OC8 recall the symbols of the metallic elements Cu, Zn, Al, Fe, Ag and Au

OC9 recall the symbols of the non-metallic elements C, O, S, H and N

OC10 recall that metals are shiny (lustrous), can be beaten into shape (malleable) and can be stretched (ductile)

OC11 classify an alloy as a mixture and state one use each of the alloys: solder, steel, brass and bronze

OC12 compare the properties of the simple compounds H_2O, CO_2, MgO and FeS to those of their constituent elements

OC13 compare mixtures and compounds made from the same constituents

OC14 use cobalt chloride paper or anhydrous copper sulfate to test for water

OC15 investigate the solubility of a variety of substances in water and the effect of temperature on solubility

OC16 explain the difference between a dilute, a concentrated and a saturated solution

OC17 grow crystals using alum or copper sulfate

OC18 use litmus or a universal indicator to test a variety of solutions, and classify these as acidic, basic or neutral

OC19 investigate the pH of a variety of materials using the pH scale

OC20 give examples of everyday acids and bases.

SECTION 2B: AIR, OXYGEN, CARBON DIOXIDE AND WATER

Air, oxygen, carbon dioxide and water are important chemicals in our everyday lives. Knowledge of their properties helps us to develop an understanding of the role they play. Acids and bases are present in many everyday materials, including common household substances, and salts are produced when acids and bases react.

Main Topic		Sub-topics
2B1	Air and oxygen	air as a mixture of gases preparation and properties of oxygen products of combustion of carbon and magnesium
2B2	Carbon dioxide	preparation and properties of carbon dioxide density of CO_2 (qualitative only) acidity of a solution of CO_2 in water
2B3	Hardness of water Water treatment	dissolved solids in water hardness in water and its effects water treatment
2B4	Electrolysis of water	decomposition of water by electrolysis
2B5	Acids and bases	names of the common strong acids and bases reactions of acids and bases production of a sample of salt

SECTION 2B: AIR, OXYGEN, CARBON DIOXIDE AND WATER

On completion of this section, students should be able to

OC21 recall that air is a mixture of gases, and state the composition of air (approximately 78% N_2 and 21% O_2, with CO_2, water vapour and other gases making up the balance)

OC22 show that approximately one fifth of the air is oxygen; show that there is CO_2 and water vapour in air

OC23 demonstrate and describe what happens when (i) a wooden splint and (ii) a piece of magnesium are burned in air

OC24 prepare a sample of oxygen by decomposing H_2O_2 using MnO_2 as a catalyst (word equation and chemical equation)

OC25 investigate the ability of oxygen to support combustion in a glowing wooden splint and a lighted candle; state two uses of oxygen

OC26 burn carbon and magnesium in oxygen, and test the products using moist litmus paper

OC27 prepare carbon dioxide (word equation and chemical equation), and show that it does not support combustion

OC28 carry out simple tests on carbon dioxide involving its reaction with limewater (word equation and chemical equation), and with moist litmus paper

OC29 investigate the density of carbon dioxide relative to air (qualitative only), and state two uses of carbon dioxide

OC30 conduct a qualitative experiment to detect the presence of dissolved solids in water samples, and test water for hardness (soap test)

OC31 explain that some dissolved compounds, including compounds of calcium, cause hardness in water, and that water hardness can be removed using an ion-exchanger

OC32 carry out a simple distillation, and obtain a sample of water from seawater

OC33 describe the processes involved in the treatment of water supplied to domestic consumers

OC34 investigate the de-composition of water by electrolysis; recall the composition of water

OC35 state the names and formulae of common strong acids and bases: H_2SO_4, HCl, NaOH, $Ca(OH)_2$, and recall that alkalis are soluble bases

OC36 show the neutralisation of an acid with a base using an indicator

OC37 explain that when an acid reacts with a base a salt and water are formed

i. $HCl + NaOH \rightarrow NaCl + H_2O$
(word equation only at Ordinary level)

ii. $2HCl + CaCO_3 \rightarrow CaCl_2 + CO_2 + H_2O$
(word equation only at Ordinary level)

OC38 titrate HCl against NaOH, and prepare a sample of NaCl.

SECTION 2C: ATOMIC STRUCTURE, REACTIONS AND COMPOUNDS

All substances contain atoms. All atoms contain sub-atomic particles and different atoms contain different numbers of these particles. The principal sub-atomic particles are protons, neutrons and electrons. Why and how substances react are related to their atomic structure.

Main Topic		Sub-topics
2C1	Basic atomic structure	structure of the atom location, relative charge, and relative atomic mass of the sub-atomic particles atomic number, mass number
2C2	Bonding	molecules as groups of atoms Bohr model of atom stability associated with noble gas electronic configuration as a guide for simple bonding simple understanding of ionic and covalent bonding examples of covalent compounds (methane and water) examples of ionic compounds (NaCl and MgO) properties of ionic and covalent substances
2C3	Rusting and corrosion	rusting as a chemical process conditions necessary for rusting prevention of rusting
2C4	Metals	properties of Group I metals reaction of Group I metals with air and water (word equation only) relative reactivities of Ca, Mg, Zn and Cu alkaline earth metals
2C5	Hydrocarbons, acid rain	products of combustion of fossil fuels cause and effects of acid rain the effect of acid rain on limestone and on plants crude oil products as raw materials for plastics non-biodegradable plastics and their contribution to pollution

SECTION 2C: ATOMIC STRUCTURE, REACTIONS AND COMPOUNDS

On completion of this section, students should be able to

OC39 describe the structure of the atom; state the location, relative charge and relative atomic mass of the sub-atomic particles; define atomic number and isotope

OC40 draw the Bohr structure of the first 20 elements

OC41 relate the formation of compounds to the combination of atoms

OC42 recall that ionic bonding is an attraction between positive and negative ions; describe the bonding in NaCl and MgO as examples

OC43 state what a molecule is; recall that covalent bonds involve the sharing of pairs of electrons, and describe the bonding in H_2, O_2, H_2O, CH_4 as examples of covalent bonding

OC44 investigate the ability of ionic and covalent substances to conduct electricity

OC45 appreciate that rusting is a chemical process that changes iron into a new substance

OC46 carry out an experiment to demonstrate that oxygen and water are necessary for rusting

OC47 list three examples of methods of rust prevention: paint, oil, galvanising

OC48 describe the general properties of the alkali metals and recall that alkali metals are in Group I of the Periodic Table and have similar properties

OC49 describe the reactions of the alkali metals with air and water; give the word equations for their reaction with water

OC50 recall that Group II elements are the alkaline earth metals

OC51 investigate the reaction between zinc and HCl, and test for hydrogen (word equation and chemical equation)

OC52 investigate the relative reactivities of Ca, Mg, Zn and Cu based on their reactions with water and acid (equations not required)

OC53 recall that fossil fuels are sources of hydrocarbons, and that they produce CO_2 and H_2O when burned

OC54 list two examples of fossil fuels

OC55 describe the role of the combustion of fuels in the production of acid rain, with particular reference to SO_2; describe the effects of acid rain

OC56 describe the effect of acid rain on limestone and on plants

OC57 appreciate that natural gas is mainly methane

OC58 identify everyday applications of plastics, and understand that crude oil products are the raw material for their production

OC59 associate the properties of everyday plastics with their use

OC60 describe and discuss the impact of non-biodegradable plastics on the environment

OC61 appreciate that chemistry has an important role in pharmacy, medicine and the food industry.

5.3 PHYSICS

Physics is involved in most of the everyday applications of science and technology that we meet in our daily lives, in work, medicine, entertainment and in the home. While physics is principally concerned with the laws and relationships that govern our world, it also provides interesting insights into how things work and contributes to the development of problem-solving skills.

- Section 3A: Force and energy
- Section 3B: Heat, light and sound
- Section 3C: Magnetism, electricity and electronics

SECTION 3A: FORCE AND ENERGY

Forces occur throughout nature and affect all aspects of living and working. Energy cannot be created or destroyed. It is converted from one form to another. It is in the process of these conversions that useful work is done. Natural resources need to be conserved.

Main Topic		Sub-topics
3A1	Measurement in science	measuring the temperature of various solids and liquids, the melting point of ice and boiling point of water measuring and recording length, mass, time, volume, temperature; SI units calculations using recorded data; presenting and communicating data derived data: area, volume, density, speed, velocity, acceleration
3A2	Density and flotation	flotation for solids and liquids relating flotation to density
3A3	Force and moments	forces, effects of forces extension of a spring friction, everyday applications of friction, lubrication the force of gravity (weight) and its relationship to mass centre of gravity and its importance in design equilibrium, the law of the lever, everyday applications of levers
3A4	Pressure	factors affecting pressure; pressure in fluids air has mass and occupies space atmospheric pressure and its relationship to weather measuring pressure, everyday applications of pressure
3A5	Work and power	definition and units for work and power
3A6	Energy	definition and units for energy principle of conservation of energy forms of energy, sources of energy, renewable and non-renewable energy sources need for energy conservation, national energy needs
3A7	Energy conversion	energy conversions examples of energy conversion from everyday experience

SECTION 3A: FORCE AND ENERGY

On completion of this section, students should be able to

OP1 measure length, mass, time and temperature (SI units); perform simple calculations based on these to find the derived quantities: area, volume, density, speed, velocity and acceleration

OP2 measure mass and volume of fixed quantities of a variety of solids and liquids and hence determine their densities

OP3 investigate flotation for a variety of solids and liquids in water and other liquids, and relate the results of this investigation to their densities

OP4 appreciate the concept of force; recall that the newton is the unit of force; describe forces and their effects

OP5 investigate examples of friction and the effect of lubrication

OP6 investigate the relationship between the extension of a spring and the applied force

OP7 recall that weight is the force due to gravity and that weight can vary with location; recall that mass in kilograms multiplied by 10 is approximately equal in magnitude to weight in newtons on the surface of the earth

OP8 find the centre of gravity of a thin lamina; investigate the role of centre of gravity in design for stability and equilibrium

OP9 investigate the law of the lever; recall two everyday applications of levers

OP10 state the relationship between pressure, force and area; perform simple calculations using this relationship

OP11 investigate the relationship between pressure and depth for a liquid

OP12 show that air has mass and occupies space

OP13 associate change in the pressure exerted by the atmosphere with change in altitude

OP14 examine weather charts to observe variations in atmospheric pressure and relate these to weather conditions

OP15 define and give the units for work, energy and power; state the relationship between work and power and perform simple calculations based on this relationship

OP16 classify sources of energy as renewable or non-renewable

OP17 state the principle of conservation of energy

OP18 explain why the sun is considered our primary source of energy and how this is important in food production and energy supply

OP19 list the advantages and disadvantages of different energy sources, including nuclear sources of energy, as part of the solution to national energy needs

OP20 identify different forms of energy and carry out simple experiments to show the following energy conversions:

- **a. chemical energy to electrical energy to heat energy**
- **b. electrical energy to magnetic energy to kinetic energy**
- **c. light energy to electrical energy to kinetic energy**

OP21 give examples of energy conversion from everyday experience.

SECTION 3B: HEAT, LIGHT AND SOUND

Heat, light and sound are forms of energy that have many applications in our lives. Students should develop a basic understanding of these forms of energy and their common properties, and be able to identify everyday applications. They should be able to investigate these forms of energy, using appropriate equipment.

Main Topic		Sub-topics
3B1	Heat	expansion of solids, liquids and gases change of state and latent heat
3B2	Heat transfer	conduction, convection and radiation; heat energy and temperature; insulation
3B3	Light	sources and transmission of light; speed of light; shadows; colour and the visible spectrum; dispersion of white light
3B4	Reflection of light Refraction of light	reflection of light at plane surfaces; image in a plane mirror refraction; refraction by lenses applications of reflection and refraction
3B5	Sound	vibrations and sound; transmission of sound; speed of sound
3B6	Reflection of sound Hearing	reflection of sound; echoes sound detection in the ear; sound levels; hearing protection

SECTION 3B: HEAT, LIGHT AND SOUND

On completion of this section, students should be able to

OP22 recall that heat is a form of energy and that it can be converted into other forms of energy

OP23 investigate and describe the expansion of solids, liquids and gases when heated, and contraction when cooled

OP24 demonstrate the expansion of water on freezing

OP25 measure the temperature of various solids and liquids at, above and below room temperature; determine the melting point of ice and the boiling point of water

OP26 investigate the effect of pressure on the boiling point of water

OP27 explain the difference between heat and temperature

OP28 carry out experiments that involve changes of state from

i. solid to liquid and liquid to solid

ii. liquid to gas and gas to liquid

OP29 plot a cooling curve and explain the shape of the curve in terms of latent heat

OP30 appreciate that all hot bodies radiate heat

OP31 carry out simple experiments to show the transfer of heat energy by conduction, convection and radiation; investigate conduction and convection in water

OP32 identify good and bad conductors of heat and compare insulating ability of different materials

OP33 recall that light is a form of energy and that it can be converted into other forms of energy

OP34 show that light travels in straight lines and explain how shadows are formed

OP35 contrast luminous objects, which are themselves a source of light, with non-luminous objects, which are seen because light is reflected from them

OP36 recall that white light is made up of different colours which can be separated by dispersion

OP37 produce a spectrum of white light using appropriate apparatus; list the colours of the spectrum

OP38 investigate the reflection of light by plane mirrors, and illustrate this using ray diagrams; demonstrate and explain the operation of a simple periscope

OP39 show the refraction of light as it passes from: air to glass, air to water, glass to air, water to air; show refraction of light through a lens; demonstrate the operation of a magnifying glass

OP40 show that sound is a form of energy, and explain that sound is produced by vibrations

OP41 show that sound transmission requires a medium and that echoes are reflected sound

OP42 appreciate that the ear detects sound vibrations and that exposure to very loud sounds can cause damage to hearing

OP43 recall that the speed of sound is less than the speed of light

OP44 explain the time lag between seeing and hearing the same event.

SECTION 3C: MAGNETISM, ELECTRICITY AND ELECTRONICS

Magnetism is a natural phenomenon with many useful applications. Electricity is a form of energy. Electricity makes a significant contribution to all aspects of our lives. Students should develop a basic knowledge of the nature of electricity, and of its supply and use in the home. They should understand the operation of simple circuits and be aware of safety issues in the use of electricity. In this section, students are also given a simple introduction to electronics.

Main Topic		Sub-topics
3C1	Magnetism	forces of attraction and repulsion; magnetic field; the Earth's magnetic field; the magnetic compass
3C2	Static electricity	electric charge; effects of static electricity; earthing
3C3	Current electricity Voltage	current as a flow of charge; measuring current measuring potential difference (voltage) and resistance for metallic conductors relationship between voltage, current and resistance direct and alternating current; heating, chemical and magnetic effects of an electric current conductors and insulators
3C4	Electric circuits	simple circuits—series and parallel; function of a switch
3C5	Electricity in the home	mains supply; fuses and circuit breakers and their role in safety; wiring a plug power rating of electric appliances; units used in calculating electricity bills
3C6	Electronics	simple electronic devices; everyday applications

SECTION 3C: MAGNETISM, ELECTRICITY AND ELECTRONICS

On completion of this section, students should be able to

OP45 carry out simple experiments to show attraction and repulsion between magnets, and test a variety of materials for magnetism

OP46 plot the magnetic field of a bar magnet

OP47 demonstrate that the Earth has a magnetic field, and locate north and south

OP48 use simple materials to generate static electricity; demonstrate the force between charged objects and the effect of earthing

OP49 test electrical conduction in a variety of materials, and classify each material as a conductor or insulator

OP50 set up a simple electric circuit, use appropriate instruments to measure current, potential difference (voltage) and resistance, and establish the relationship between them

OP51 demonstrate simple series and parallel circuits containing a switch and two bulbs

OP52 perform simple calculations based on the relationship between current, potential difference (voltage), and resistance

OP53 describe the heating effect, the chemical effect, and the magnetic effect of an electric current, and identify everyday applications of these, including the action of a fuse

OP54 distinguish between direct and alternating current; recall that the voltage of the mains supply is 230 volts a.c.

OP55 recall that the unit of electrical energy used by electricity supply companies is the kilowatt-hour; calculate the cost of using common electrical appliances based on their power rating

OP56 describe how to wire a plug correctly, and explain the safety role of a fuse or circuit breaker in domestic electrical circuits

OP57 describe a diode as a device that allows current to flow in one direction only and recall that a light-emitting diode (LED) requires less current than a bulb

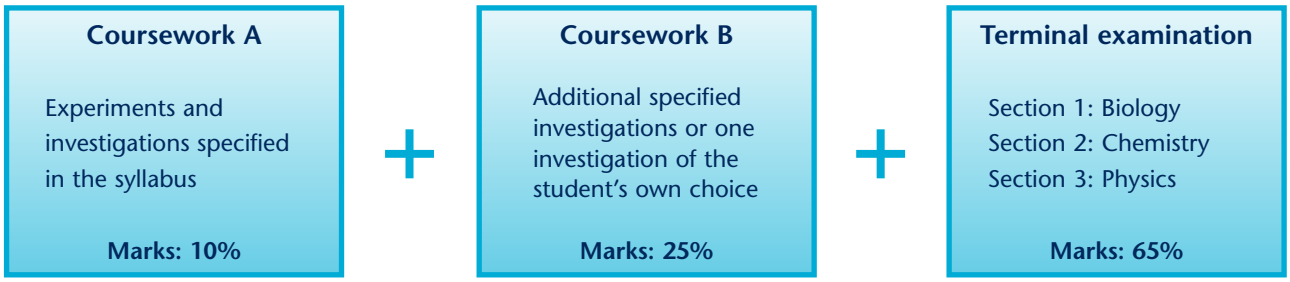
OP58 set up simple series circuits using switches, buzzers, LEDs and resistors

OP59 measure the resistance of a light-dependent resistor (LDR) under varying degrees of brightness of light

OP60 identify everyday applications of the diode, including the LED, and of the LDR.

6. ASSESSMENT

Junior Certificate Science will be assessed at two levels, Higher and Ordinary. At each level, assessment will be by means of a terminal examination paper and coursework. The assessment arrangements are illustrated below.



COURSEWORK A – MANDATORY EXPERIMENTS AND INVESTIGATIONS

Students must complete the mandatory experiments and investigations specified in the syllabus. Over the three years of the course each student is also required to maintain a laboratory notebook, in which a record of these experiments and investigations is kept according to specified criteria. This record must be available for inspection. As part of the assessment, marks will be awarded on a pro rata basis for the satisfactory completion of this required coursework.

COURSEWORK B – ADDITIONAL STUDENT INVESTIGATIONS

In addition, each student will be required to undertake two specified investigations in the third year and to submit a pro forma report on these for assessment. These additional investigations, based on the topics and learning outcomes in the syllabus, will be set by the examining body and will vary from year to year. Instead of the set investigations, students may substitute an investigation of their own choice that meets required criteria.

TERMINAL EXAMINATION PAPER

There will be separate Ordinary level and Higher level examination papers. At each level the examination paper will consist of three sections. These will assess students' knowledge and skills in relation to syllabus material and learning outcomes in the areas of biology, chemistry and physics.

NCCA

National Council for Curriculum and Assessment
An Chomhairle Náisiúnta Curaclaim agus Measúnachta

Procedures for drawing up National Syllabuses

The NCCA's Course Committees for the Junior Certificate have the following membership:

- Association of Secondary Teachers, Ireland
- Teachers' Union of Ireland
- Joint Managerial Body
- Association of Community and Comprehensive Schools
- Irish Vocational Education Association
- Subject Association
- Department of Education and Science (Inspectorate)
- State Examinations Commission

Recommendations of Course Committees are submitted to the Council of NCCA for approval. The NCCA, having considered such recommendations, advises the Minister for Education and Science accordingly.

Further information is available from
NCCA, 24 Merrion Square, Dublin 2.
Tel: (01) 6617177
Fax: (01) 6617180
Email: info@ncca.ie
URL: www.ncca.ie

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