Independent Schools Examinations Board

COMMON ENTRANCE EXAMINATION AT 11+ AND 13+

COMMON ACADEMIC SCHOLARSHIP EXAMINATION AT 13+

SCIENCE SYLLABUS

Revised spring 2015 for first examination at 11+ in autumn 2018 and first examination at 13+ in autumn 2017.

INTRODUCTION

The revised Common Entrance science syllabus for examination at 11+ and 13+ is based upon the programmes of study for key stage 2 and key stage 3 respectively of the National Curriculum for Science (2014 revision). At 11+, it is expected that material in key stage 1 has already been fully covered. At 13+, knowledge of the 11+ syllabus will be assumed and may be examined in the context of questions based on the content of the 13+ syllabus. Knowledge of the 11+ syllabus is presented in the 13+ syllabus as 'Preliminary Knowledge'.

The syllabus content is presented in a two-column format. The first column defines the learning objectives and locates the content within the framework of the relevant section of the revised National Curriculum of 2014. The second column defines the learning outcomes and includes a detailed description of the knowledge and skills which pupils will acquire and which will be examined at 11+ and 13+.

Examination questions will be drawn from all parts of the syllabus. Candidates will also be expected to work scientifically, to analyse and evaluate scientific knowledge, and apply it to unfamiliar situations. Sometimes this will involve comparing different pieces of evidence to make predictions. These are 'higher order' thinking skills.

The examination papers will contain questions about practical techniques and scientific processes. Candidates should be taught to record observations and measurements with appropriate precision. The analysis, interpretation, explanation and evaluation of their methods, results and conclusions will be examined. The impact of their own and others' experimental and investigative activities will also be tested. This is outlined in *Working Scientifically* below. At 13+, Level 1 candidates will be given more explanatory text in their questions, including some word equations, and, where calculations are required, formulae and units will be given. Due consideration will be given to the level of difficulty and content in Level 1 questions.

AIMS

A course leading to the 11+ and 13+ examinations should:

(i) stimulate curiosity, interest in and enjoyment of science

(ii) help candidates use the body of scientific knowledge they have already acquired and to extend their understanding of science, recognising connections between different areas of science

(iii) enable candidates to use scientific ideas and models to explain phenomena and events and to understand applications of science

(iv) develop an awareness of the impact of developments in technology on the environment and in other contexts

(v) develop experimental and investigative abilities, paying due regard to safe practice (see *Working Scientifically* on page 4)

(vi) develop an ability to evaluate and communicate scientific evidence, and understand the importance of experimental evidence in supporting scientific ideas (see *Working Scientifically* on page 4)

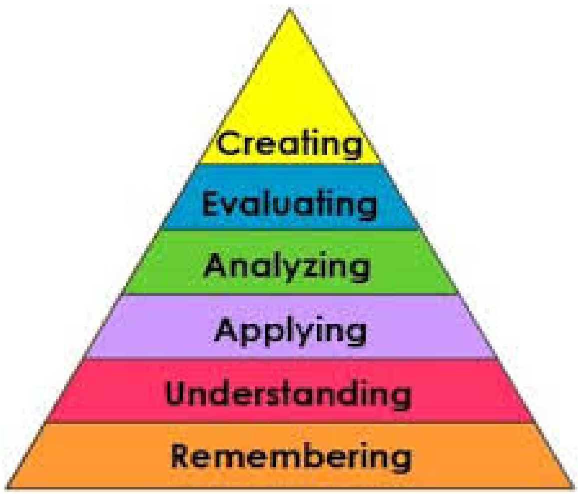
(vii) develop an awareness of science as a social and cultural activity which has responsibilities, strengths and limitations (see *Working Scientifically* on page 4)

(viii) enable candidates to acquire a sound foundation of knowledge and understanding for future studies, and facilitate the smooth transfer between schools in the independent and maintained sectors of education

ASSESSMENT OBJECTIVES

At both 11+ and 13+, candidates should develop their knowledge, skills and understanding in the disciplines of Biology, Chemistry and Physics. A minimum of 25% of the marks in every paper will be based on the *Working Scientifically* section of the syllabus.

The examinations are designed to test candidates' thinking skills and are based on Bloom's Taxonomy of cognitive learning. A revised version of this appears below.



Within each examination, marks will be allocated according to the following assessment objectives:

assessment objective	description
AO1	remembering and understanding
AO2	applying and analysing
AO3	evaluating and creating

The details of how this applies to the 11+ and 13+ examinations are given in the Scheme of Assessment section later in this syllabus.

WORKING SCIENTIFICALLY

There are a number of key concepts, skills and processes which pupils need to experience in order to deepen and broaden their understanding of science. These underpin science and complement the scientific content of the syllabus.

Scientific attitudes

- pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
- understand that scientific methods and theories develop as scientists modify earlier explanations to take account of new evidence and ideas, together with the importance of publishing results and peer review
- evaluate risks

At 13+ candidates should also:

- understand the power and limitations of science and potential ethical questions and debates
- consider the validity of experimental results in terms of fair testing

(The use of range bars to estimate reliability of data sets will not be examined in 11+ or 13+ papers.)

Experimental skills and investigations

- ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
- make predictions using scientific knowledge and understanding
- select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate
- use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety
- make and record observations and measurements using a range of methods for different investigations; evaluate the reliability of methods and suggest possible improvements or further investigations
- apply sampling techniques

At 13+ candidates should also:

- use scientific theories, models and explanations to develop hypotheses
- plan investigations to make observations and to test hypotheses, including identifying variables as independent, dependent or control, and measure and consider other factors which need to be taken into account when collecting evidence

- use knowledge of techniques, apparatus, and materials, during fieldwork and laboratory work, select those that are appropriate to the investigation, and use them appropriately, adapting apparatus and strategy flexibly when problems arise and paying attention to health and safety

- measure and manipulate concentrations

Analysis, evaluation and problem-solving

- apply mathematical concepts and calculate results

- undertake basic data analysis including simple statistical techniques

- use and derive simple equations and carry out appropriate calculations

- present observations and data, using appropriate methods, including tables and graphs; carry out and represent mathematical and simple statistical analysis

- interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions

- present reasoned explanations, including explaining data in relation to predictions and hypotheses

- evaluate data, showing awareness of potential sources of random and systematic error

- identify further questions arising from their results

At 13+ candidates should also:

- represent random distribution of results and estimate uncertainty; interpret observations and data, including identifying patterns and trends and use observations, measurements and data to make inferences and draw conclusions

- evaluate data critically, showing awareness of potential sources of random variations and systematic errors, and suggest improvements

- communicate the scientific rationale for the investigation and the methods used, giving accounts of findings, reasoned explanation of data in relation to hypotheses and reasoned conclusions through written reports and electronic presentations

Measurement

- understand and use SI units (see Appendix 5) and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature

At 13+ candidates should also:

- convert units

Important: teachers should assess risk and pay due regard to safety when planning and supervising practical activities. CLEAPPS and the Association of Science Education are valued and trusted sources of important information.

SYLLABUS CONTENT

(*IMPORTANT: please see Appendix 1 for a full schedule of assessment)*

11+ SCIENCE

The allocation of topics below for each year group is advisory, not prescriptive. Please note those topics which will be examined at 11+ and those which should be taught by the end of Year 6 but which will not be examined at 11+.

Please note that the spelling 'esophagus' will be used in examination papers, in line with GCSE, and candidates should be made aware that this is the standard spelling, in place of 'oesophagus'.

YEAR 3	
1. Living processes	
Pupils should be taught:	Candidates should know:
a. that the life processes common to humans and other animals include nutrition, movement, growth and reproduction	that living things all carry out life processes; about the distinction between living and non-living things
b. that the life processes common to plants include growth, nutrition and reproduction	that life processes are common to both plants and animals

2. Green plants	
Growth and nutrition	
Pupils should be taught:	Candidates should know:
a. to identify and describe different parts of flowering plants: roots, stem/trunk, leaves and flowers	about the basic relationship between structure and function about the root, stem, leaves and flower of a flowering plant *for flowering plants, real specimens should be examined*

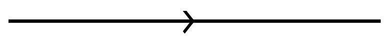
b. the effects of light, air, water and temperature on plant growth	how to demonstrate the effect of variation in light, temperature and water on plant growth; that air supplies a plant with carbon dioxide for making food; that plants also need oxygen *respiration will not be examined*
c. the role of the leaf in producing new material for growth	that green plants use energy from the Sun to produce food (photosynthesis); about the role of the green pigment (chlorophyll) in the leaf and stem in capturing this light energy
d. the root anchors the plant, and water and minerals are taken in through the root and transported through the stem to other parts of the plant	that mineral salts are nutrients which are needed for healthy growth
Reproduction	
Pupils should be taught:	Candidates should know:
e. the part which flowers play in the life cycle of flowering plants, including pollination, seed formation, germination and seed dispersal	about basic details of flower structure; the terms *carpel*, *stamen* and *petal;* that *pollination* is the transfer of pollen from one flower to another; about methods of seed dispersal; investigations into methods of seed dispersal (e.g. dandelion, sycamore or berries); experiments to show that water, air and warmth are needed for germination

3. Humans and other animals	
Parts of the body	
Pupils should be taught:	Candidates should know:
a. the names and locations of major organs	the names and positions of the following related organs: brain, heart, lungs, stomach, intestines *for humans, this can be based on pictures and models*

Nutrition	
Pupils should be taught:	Candidates should know
b. about the need for food for activity and growth, and the importance of an adequate and varied diet for health	about the value of a balanced diet, composed of carbohydrates, fats, proteins, vitamins, mineral salts, fibre and water in the maintenance of good health
c. the need for a balanced diet containing carbohydrates, proteins, fats, minerals, vitamins, fibre and water, and which foods are sources of these components	examples of foods which are rich in carbohydrates and proteins; vitamin C is an example of a vitamin, and calcium salts are an example of a mineral; the effects on humans of lack of vitamin C and calcium; the dangers of an excessive intake of animal fats; one good source of each food component
Movement	
Pupils should be taught:	Candidates should know:
d. that humans and some other animals have skeletons and muscles to support and protect their bodies and to help them to move	that some animals with internal skeletons are called vertebrates; about the role of the skeleton in providing support, protection and movement; the location of the skull, backbone (vertebral column), rib cage, pelvis, collarbone and shoulder blade
e. to observe and compare the movement of animals both with and without skeletons	what would happen if humans did not have skeletons

4. Rocks and soils	
Pupils should be taught:	Candidates should know:
a. to describe and group rocks and soils on the basis of their characteristics, including appearance, texture and permeability	about different kinds of soils, e.g. sand, clay, loam; how particle size affects drainage; the term humus and how this enriches the soil how to compare and group together different kinds of rock on the basis of their appearance and simple physical properties; how to use a hand lens to determine whether they contain grains or crystals
b. how to separate solid particles of different sizes by sieving (e.g. those in soil)	how to carry out simple experiments to separate solid particles of different sizes

c. how fossils are formed when things that have lived are trapped in sedimentary rock	how sedimentary rocks are formed; how to model fossil formation by making plaster casts of shells; understanding that it is usually only the hard parts of organisms which are preserved

5. Light	
Everyday effects of light	
Pupils should be taught:	Candidates should know:
a. that light travels from a source	that a luminous source gives out light; examples of luminous sources; that light travels in straight lines; how to indicate a ray of light like this: 
b. that light cannot pass through some materials, and how this leads to the formation of shadows	the terms *opaque*, *translucent* and *transparent*; how shadows are formed by opaque objects, investigating the effect of different distances between source, object and screen
c. that light is reflected from surfaces *(e.g. mirrors, polished metals)*	*quantitative experiments with mirrors will not be examined*
Seeing	
Pupils should be taught:	Candidates should know:
d. that we see things only when light from them enters our eyes	how we see luminous objects; how to draw simple diagrams to show that light rays, travelling in straight lines, enter the eye(s) directly from the luminous object *details of the structure of the eye will not be examined*
e. that light from the Sun can be dangerous and that there are ways to protect the eyes	about the protective use of sunglasses and filters; advice not to stare directly at the sun, with the naked eye or with telescopes or binoculars

6. Forces and magnets	
Types of force	
Pupils should be taught:	Candidates should know:
a. that forces can push and pull on an object	that all forces are pushes or pulls; everyday examples of forces in action
b. about the forces of attraction and repulsion between magnets; the forces of attraction between magnets and magnetic materials	how to classify materials into magnetic and non-magnetic groups; that magnetic materials such as iron and steel are attracted to a magnet; how to carry out experiments to discover that a magnet exerts a force on another magnet or any piece of magnetic material which is placed close to it; that a magnet has north-seeking and south-seeking poles and why they are so called; that a freely-suspended bar magnet comes to rest in a north-south direction and acts as a compass; that like poles repel and unlike poles attract each other; that magnetic effects will pass through some materials; how to compare the strength of two or more magnets
c. that some forces need contact between two objects but magnetic forces can act at a distance	that most forces require contact (e.g. opening and closing a door) compared with magnetic forces acting at a distance (e.g. moving iron filings or the movement of a compass needle)
d. about friction, including air resistance, as a force which slows moving objects and may prevent objects from starting to move	about the concept of friction as a force which opposes the relative movement of surfaces, with reference to everyday situations, e.g. the effect of friction between the wheels of a bicycle and the road; the effect of air resistance on the cyclist; how to carry out investigations involving friction, e.g. a toy car running over different types of surfaces

YEAR 4	
1. Living things in their environment	
Pupils should be taught:	Candidates should know:
a. to recognise that living things can be grouped in a variety of ways	about examples from the local environment that show how living things can be grouped in different ways
b. to explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment	how vertebrates can be divided into fish, amphibians, reptiles, birds and mammals and invertebrates into snails and slugs, worms, spiders and insects how plants can be divided into flowering plants (including grasses) and non-flowering plants such as ferns and mosses
c. that life processes occur in familiar animals and plants and how these are determined by the habitats in which they are found.	how living things, e.g. pets, farm animals, wildlife found in parks and gardens and the associated plant life, carry out these life processes within their respective habitats
d. that environments can change and that this can pose dangers to living things	how examples of human actions (both positive and negative) affect the environment
e. about ways in which living things and the environment need protection	about the need to protect and conserve living things and their environment, e.g. endangered species, effects of pollution, habitat destruction
Feeding relationships	
Pupils should be taught:	Candidates should know:
f. to use food chains to show feeding relationships in a habitat	how to place organisms in order in a food chain; the terms *producer*, *consumer*, *herbivore*, *carnivore* and *omnivore*; about the relationship between predator and prey
g. about how nearly all food chains start with a green plant	that a food chain represents the transfer of the energy content of food from one organism to another; that the energy is originally from the Sun and converted by plants to food at the start of each food chain

2. Humans and other animals	
Nutrition	
Pupils should be taught:	Candidates should know:
a. about the functions and care of teeth	the main kinds of teeth (incisors, canines, pre-molars and molars) and their functions; about the effect of bacteria (plaque), fluoride and diet on dental decay; the importance of dental care and hygiene
b. the difference between the teeth of carnivores and herbivores	how to identify skulls of animals with herbivore, carnivore and omnivore diets
c. about the simple functions of the basic parts of the digestive system in humans	about the main parts of the digestive system: mouth, tongue, teeth, esophagus (gullet), stomach, small and large intestine

3. States of matter	
Pupils should be taught:	Candidates should know:
a. to recognise differences between solids, liquids and gases, in terms of ease of flow and maintenance of shape and volume	how to use simple particle theory to describe the arrangement of particles in solids, liquids and gases
b. to describe changes which occur when materials (e.g. water, clay, dough) are heated or cooled	that heating or cooling can cause a change of state; the names given to these changes, i.e. *melting*, *boiling*, *condensing*, *evaporating*
c. the part played by evaporation and condensation in the water cycle	how to carry out simple experiments on evaporation and condensation; how these processes relate to the water cycle

4. Sound	
Pupils should be taught:	Candidates should know:
a. that sounds are made when objects (e.g. strings on musical instruments) vibrate but that vibrations are not always directly visible	the terms *vibrate* and *vibration*; that sound is emitted when an object vibrates, e.g. a stringed instrument, a tuning fork, a rubber band, a ruler, or when the air inside an object vibrates, (e.g. a recorder, a milk bottle); how to demonstrate that vibrations are not always visible, e.g. vibrations of a drum skin shown by using rice grains
b. how to change the pitch and loudness of sounds produced by some vibrating objects (e.g. a drum skin, a plucked string)	the term *pitch*; how the properties of sound such as pitch and loudness can be changed; that an increase/decrease in the size of the vibration produces a louder/quieter sound, and a faster/slower vibration produces a higher/lower-pitched sound; that on a stringed instrument, changing the length, tightness and thickness of a string will affect the pitch of a note the terms frequency and amplitude are not required
c. that sounds get fainter with distance	that as they move further from a sound it gets harder to hear; they should relate this to their everyday experience e.g. hearing their friends during playtime when they are far away
d. that vibrations from sound sources require a medium (e.g. air, metal, wood, glass,) through which to travel to the ear	that sound travels through solids, liquids and gases but not through a vacuum; these vibrations are detected by the ear
Hearing	
Pupils should be taught:	Candidates should know:
e. how the ear works; that sound causes the eardrum to vibrate and that different people have different audible ranges	that vibrations send messages to the brain that are heard as different sounds
f. some effects of loud sounds on the ear (e.g. temporary deafness)	that loud sounds can cause temporary or permanent damage to hearing

5. Electricity	
Simple circuits	
Pupils should be taught:	Candidates should know:
a. to construct circuits, incorporating a battery or power supply and a range of switches, to make electrical devices work (e.g. buzzers, motors)	how to construct series circuits involving up to three cells, up to three bulbs, a motor, a buzzer and a switch; that electrical devices will only work if they are part of a complete circuit between the terminals of an electrical supply, and that each part of the circuit must be a conductor of electricity; the term *in series*
b. that some materials are better electrical conductors than others	that metals and carbon (graphite) are conductors of electricity, e.g. copper for household wiring; that most other materials are insulators, e.g. plastic for plug covers
c. the importance of working safely with electricity; identifying common appliances which run on electricity	how to identify common dangers encountered when using electricity and how such dangers are avoided by, for example, the use of insulating materials and fuses

YEAR 5	
1. Living things and their habitats	
Pupils should be taught:	Candidates should know:
a. to describe the differences in life cycles between a mammal, an amphibian, an insect and a bird	about life cycles using examples from the local and wider environment about the work of naturalists and behavioural scientists, e.g. David Attenborough and Jane Goodall
b. to describe the life process of reproduction in some plants and animals	about sexual and asexual reproduction in plants compared with sexual reproduction in animals and understand that fertilisation is the fusing of male and female sex cells in sexual reproduction
Adaptation	
Pupils should be taught:	Candidates should know:
c. about the different plants and animals found in different habitats; how animals and plants in two different habitats are suited to their environment	about the features of animals and plants in one chosen habitat; these should include size, shape, colour and, where possible, methods of movement, feeding and protection; about the wide variety of responses to which animals living in different situations have developed; that some animals are nocturnal; that the activity of living things can be related to the time of day and season of the year; the terms *hibernation* and *migration*

2. Humans and other animals	
Pupils should be taught:	Candidates should know:
a. about the main stages of the human life cycle	how to compare different types of mammals, looking at the gestation periods of, for example, a mouse and an elephant; about changes in the length and mass of a baby as it grows; features of life cycles which are common to all animals
b. about the physical and emotional changes which take place during adolescence	about the principal changes which occur at adolescence

3. Properties and changes of materials	
Pupils should be taught:	Candidates should know:
Properties of materials	
a. to compare everyday materials and objects on the basis of their material properties, including hardness, strength, flexibility and magnetic behaviour, and to relate these properties to everyday uses of the materials	the terms *metal*, *non-metal*, *magnetic* and *non-magnetic* *a wide range of materials should be tested and included in as many practical situations as possible (see Appendix III)*
Physical change	
Pupils should be taught:	Candidates should know:
b. about reversible changes, including dissolving, melting, boiling, condensing, freezing and evaporating	that heating and cooling can cause a change of state; that water expands on freezing, causing pipes to burst and rocks to crack
c. to describe changes which occur when materials are mixed (e.g. adding salt to water)	how to carry out simple dissolving experiments; the terms s*olution*, *solvent*, *solute*, *soluble*, *insoluble* and *dissolving*
d that some solids (e.g. salt, sugar) dissolve in water to give solutions but some (e.g. sand, chalk) do not	about the factors affecting the rate of dissolving everyday substances in water, i.e. the temperature of the solvent, particle size of the solute and stirring; the concept of fair testing to compare rates of dissolving in water; that a solution contains at least two substances: water and the dissolved substance; how to draw and interpret bar charts and line graphs using data from dissolving experiments
Separating materials	
Pupils should be taught:	Candidates should know:
e. how to separate insoluble solids from liquids by filtering	how to carry out simple filtration experiments and decanting as another simple method of separating a solid from a liquid; the terms *filtrate* and *residue*
f. how to recover dissolved solids by evaporating the liquid from the solution	how to carry out simple evaporation experiments, e.g. evaporation of a salt solution *salt solutions should not be dried completely when heated*

g. to use knowledge of solids, liquids and gases to decide how mixtures might be separated	how to take an investigative approach to separate a variety of mixtures
h. that when physical changes (e.g. changes of state, formation of solutions) take place, mass is conserved	about simple experiments comparing the mass of the constituent parts of a solution before and after it is made
Chemical change	
Pupils should be taught:	Candidates should know:
i. that non-reversible changes (e.g. vinegar reacting with bicarbonate of soda, plaster of Paris with water) result in the formation of new materials that may be useful	about examples of useful non-reversible changes, e.g. making concrete, baking; that air and water are both needed for rusting to occur; about simple methods of preventing rusting, e.g. oiling, painting, galvanising, coating with plastic; how chemists create new materials, e.g. Spencer Silver (glue for sticky notes) and Ruth Benerito (wrinkle free cotton)
j. that burning materials (e.g. wood, wax, natural gas) results in the formation of new materials and that this change is not usually reversible	about simple burning experiments to demonstrate that burning is not reversible; the term *fuel;* the term *fossil fuel* and examples of solid, liquid and gaseous fossil fuels *knowledge of the formation of fossil fuels will not be examined*
k. that virtually all materials, including those in living systems, are made through chemical reactions, and to recognise the importance of chemical change in everyday situations, (e.g. ripening fruit, setting superglue, cooking food)	about a range of materials and how they are made as a result of both naturally-occurring and man-made (synthetic) processes

4. Earth and space	
Pupils should be taught:	Candidates should know:
a. that the Sun, Earth and Moon are approximately spherical	how we can observe that the Moon and Sun are circular; how evidence of disappearing ships over the horizon and, latterly, observation from orbiting spacecraft, have revealed that the Earth is spherical
Periodic changes	
Pupils should be taught:	Candidates should know:
b. how the position of the Sun appears to change during the day, and how shadows change as this happens	how to use a globe and lamp representing the Earth and Sun in order to show how the position of the Sun appears to change; about practical examples relating to the apparent movement of the Sun, e.g. sundials
c. how day and night are related to the spin of the Earth on its own axis	how to use a globe and lamp representing the Earth and Sun in order to show how day and night arise
d. that the Earth orbits the Sun once each year, and that the Moon takes approximately 28 days to orbit the Earth	*a small ball representing the Moon should be added to the model in (b.) above*
e. the relative positions of the Earth, Sun and planets in the solar system	about the concept of a moon as a satellite, as shown by our Moon and the moons of other planets; that the solar system is part of the Milky Way galaxy, and that the Universe contains many such groups of stars or galaxies; about the scale of astronomical distances consider the work of scientists such as Ptolemy, Alhazan and Copernicus *planetary and stellar distances need not be remembered*
f. that objects are pulled downwards because of the gravitational attraction between them and the Earth	how scientists, for example Galileo Galilei and Isaac Newton, helped develop the theory of gravitation *the distinction between mass and weight will not be examined*
g. about the movements of planets around the Sun and to relate these to gravitational forces	that it is gravitational forces which keep the Moon in orbit around the Earth and planets in orbit around the Sun

h. that the Sun and other stars are light sources and that the planets and other bodies are seen by reflected light	why the planets and our Moon are visible even though they are not light sources

5. Forces	
Pupils should be taught:	Candidates should know:
a. about forces	that the unit of force is the newton and that forces can be measured using a force meter (newton meter)
b. that when objects (e.g. a spring, a table) are pushed or pulled, an opposing pull or push can be felt	how to carry out simple experiments to experience these opposing forces
c. how to measure forces and identify the direction in which they act	about the different types of force: push, pull, frictional (including air resistance), magnetic, gravitational, support (reaction) and upthrust; how to use arrows to show the direction in which these forces are acting on an object; that the newton (N) is the unit of force; how to use a force meter (newton spring balance) to investigate the force required to do various jobs
d. about some mechanisms, including levers, pulleys and gears, allowing a smaller force to have a greater effect	about the effects of levers, pulleys and gears on movement *a qualitative understanding only is required*
e. ways in which frictional forces, including air resistance, affect motion (e.g. streamlining cars, friction between tyre and road)	about the force of friction, including air resistance (drag), and its applications; the different stopping distances as listed in the Highway Code *candidates do not have to memorise the different stopping distances*

YEAR 6	
1. Living things and their habitats	
Examinable at 11+.	
Pupils should be taught:	Candidates should know:
a. to make and use keys	how to design and use simple keys based on observable external features to help them to identify and group living things systematically
b. that the variety of plants and animals makes it important to identify them and assign them to groups	how some features of animals and plants are diagnostic when assigning them to groups and how some are not, e.g. the type of skin is diagnostic in vertebrates whereas size is not the significance of the work of Carl Linnaeus as a pioneer of classification
c. to classify living things into the major taxonomic groups	how to use a simple key to identify the group to which a specimen belongs; that animals and plants are classified into separate kingdoms; bacteria, fungi and single-celled organisms are placed in other kingdoms; about the characteristic features of the animal and plant kingdoms and why fungi are not included with plants; the diagnostic features of: single-celled organisms, fungi, arthropods (knowing the difference between insects and spiders), fish, amphibians, reptiles, birds, mammals and flowering plants

2. Humans and other animals	
Circulation	
Not examinable at 11+ but to be covered by the end of year 6.	
Pupils should be taught:	Candidates should know:
a. that the heart acts as a pump to circulate the blood through vessels round the body, including through the lungs	about the structure of the heart through the use of appropriate models or diagrams; that the heart forces blood round the body to the organs through arteries and that the blood returns to the heart through veins *the names of the chambers and valves of the heart will not be examined*
b. that nutrients, water and other substances are transported by the blood	how the circulatory system enables the body to function

Breathing	
Not examinable at 11+ but to be covered by the end of year 6.	
Pupils should be taught:	Candidates should know:
c. the role of lung structure in gas exchange, including the effect of smoking	about the structure of the lungs in outline only, i.e. the lung surface is greatly folded, creating a large surface area for gaseous exchange; that oxygen is taken into the lungs by breathing, and transported to the tissues by the circulatory system; smoking is one of the causes of lung cancer and heart disease; smoking reduces the surface area of the lungs, leading to severe breathing difficulties
Health and exercise	
Not examinable at 11+ but to be covered by the end of year 6.	
Pupils should be taught:	Candidates should know:
d. about the effect of exercise and rest on pulse rate	that during exercise the body needs more oxygen and food to provide the necessary energy, and that this can be demonstrated by comparing pulse rates at rest and after exercise; about the effect of exercise on the body and the benefits to health, e.g. reducing obesity, increasing stamina; the term *respiration* should be understood as the life process that releases energy
e. how the abuse of alcohol, solvents and other drugs affects health	about the effects on the human body of tobacco, alcohol and other drugs, and how these relate to personal health
f. how the growth and reproduction of bacteria and the replication of viruses can affect health; how the body's natural defences may be enhanced by medicines	one example of a bacterial disease and one example of a viral disease; about the importance of cleanliness at personal and community levels as a defence against disease; that the body's natural defences can be supplemented by medicines
g. that micro-organisms are living organisms which are often too small to be seen, and that they may be beneficial (e.g. in the breakdown of waste, in making bread) or harmful (e.g. in causing disease, in causing food to go mouldy)	that yeast is a micro-organism which is too small to be seen; yeast is important in making bread and wine; some micro-organisms help to break down the remains of dead organisms

Nutrition	
Not examinable at 11+ but to be covered by the end of year.	
Pupils should be taught:	Candidates should know:
h. that food is used as a fuel during respiration to maintain the body's activity and as a raw material for growth and repair	that carbohydrates are energy-containing foods and include glucose and starch; how to carry out the iodine test for starch that proteins are needed for growth and repair; that fats are an energy source and are also needed for insulation
Movement	
Not examinable at 11+ but to be covered by the end of year 6.	
Pupils should be taught:	Candidates should know:
i. the role of the skeleton and joints and the principle of antagonistic muscle pairs (e.g. biceps and triceps) in movement	that the skeleton protects delicate organs, supports the body and provides attachment for muscles; muscles can contract and are pulled back to their original length by the contraction of antagonistic muscles; muscles usually operate across moveable joints

3. Evolution and inheritance	
Not examinable at 11+ but to be covered by the end of year 6.	
Pupils should be taught:	Candidates should know:
a. that living things have changed over time and that fossils provide evidence about living things which inhabited the Earth millions of years ago	how the work of palaeontologists such as Mary Anning led to ideas about evolution
b. that living things produce offspring of the same kind, but that offspring vary and are not identical to their parents	e.g. about different breeds of dogs and the effects of cross breeding
c. how adaptation can lead to evolution	e.g. how the necks of giraffes got longer; the development of insulating fur on the arctic fox; about how Charles Darwin and Alfred Wallace developed their ideas about evolution

4. Properties of materials	
Examinable at 11+.	
Pupils should be taught:	Candidates should know:
a. that some materials are better thermal insulators than others	that air is a good insulator; examples of situations where trapped air is used for insulation in everyday life, e.g. winter clothing, sleeping-bags, expanded polystyrene for cups *comparison of electrical conductors and insulators is covered in the topic Electricity in Year 4*
b. that temperature is a measure of how hot or cold things are	how to compare different temperatures by feel and by the use of a thermometer; how to read a thermometer scale including values below 0 ºC; about the boiling point and freezing point of water and the temperature of a healthy human
Acids and alkalies	
Pupils should be taught:	Candidates should know:
c. that solutions can be classified as acidic, neutral or alkaline	how to use indicators (litmus and natural pigments e.g. red cabbage) to classify solutions as acidic, neutral or alkaline
5. Light	
The behaviour of light	
Not examinable at 11+ but to be covered by the end of year 6.	
Pupils should be taught:	Candidates should know:
a. how light is reflected at plane surfaces	how a plane mirror alters the path of a ray of light; the meaning of the *angle of incidence* and *angle of reflection*; how to measure these angles using a protractor, and that they are equal; practical applications of mirrors, e.g. construction of a periscope
b. that light travels in a straight line at a finite speed in a uniform medium	that light comes from a luminous source and travels in straight lines
c. light travelling in straight lines explains why shadows have the same shape as the objects that cast them	use practical examples of shadows with simple diagrams to explain them

Seeing	
Pupils should be taught:	Candidates should know:
d. that non-luminous objects are seen because light scattered from them enters the eye	that light from a luminous source is reflected from non-luminous objects to our eyes. *details of the structure of the eye will not be examined*

6. Electricity	
Examinable at 11+.	
Pupils should be taught:	Candidates should know:
a. how changing the number or type of components (e.g. batteries, bulbs/buzzers, wires) in a series circuit can make bulbs brighter or dimmer	the relative brightness of bulbs in series circuits *it is recommended that normal brightness describes one bulb lit by one cell; other circuits can be compared with this.*
b. compare and give reasons for the variations in how components work	for example the brightness of bulbs, loudness of buzzers and the on/off positions of switches
c. how to represent series circuits by drawings and conventional symbols, and how to construct series circuits on the basis of drawings and diagrams using conventional symbols	the electrical symbols for all the components mentioned above *(see Appendix V);* how to interpret and draw circuit diagrams where the components are connected in series; how to recognise a short circuit and be aware of the safety implications

COMMON ENTRANCE EXAMINATION AT 13+

(*IMPORTANT: please see Appendix 1 for a full schedule of assessment*)

BIOLOGY

B1. Structure and function of living organisms

1. Cells and organisation	
Preliminary knowledge: the names and positions of these organs: brain, heart, lungs, stomach, intestines in humans; the roots, stems, leaves and flowers of a flowering plant	
Pupils should be taught:	Candidates should know:
a. that cells are the fundamental unit of living organisms; the hierarchical organisation of multicellular organisms: from cells to tissues to organs to systems to organisms	how to observe, interpret and record cell structure using a light microscope; that in multi-cellular organisms, cells are massed together to form tissues, and tissues can be massed together to form organs; that organs work together in systems; organ systems work together in an organism; examples of organ systems in humans (e.g. digestive system, gaseous exchange system) and in flowering plants (e.g. leaves)
b. the similarities and differences between plant and animal cells; the functions of chloroplasts and cell walls in plant cells and the functions of the cell surface membrane, cytoplasm, mitochondria and nucleus in both plant and animal cells; the vacuole in plant cells	that a typical animal or plant cell has a nucleus, cytoplasm, mitochondria and cell surface membrane; that plant cells contain permanent fluid-filled vacuoles; the function of each component, stated briefly; that the nucleus contains genes which control the production of protein in the cell; that genes are made of DNA which determines an organism's characteristics; how to use a microscope to observe plant and animal cells and how to prepare a temporary microscope slide, e.g. using methylene blue as a stain for nuclei
c. the role of diffusion in the movement between plant and animal cells	in humans, about the movement of oxygen, glucose into cells and the movement of carbon dioxide out of cells; about diffusion across the membranes of alveoli; in plants, about gas exchanges in leaves
d. the structural adaptations of some unicellular organisms	about *Amoeba* and *Euglena* as examples of unicellular organisms; how the cells are adapted to feed, exchange gases and move

2. Nutrition and digestion	
Preliminary knowledge: the main kinds of teeth (incisors, canines, pre-molars and molars) and their functions; the effect of bacteria (plaque), fluoride and diet on dental care and hygiene; the value of a balanced diet, composed of carbohydrates, fats, proteins, vitamins, mineral salts, fibre and water, in the maintenance of good health	
Pupils should be taught:	Candidates should know:
a. the content of a healthy human diet: carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water the value of a balanced diet; foods which are good sources of nutrients.	that carbohydrates are energy containing foods; proteins are needed for growth and repair of tissues; fats are an energy source and also needed for insulation
b. the consequences of imbalances in the diet, including deficiency diseases, obesity and starvation	that glucose and starch are examples of carbohydrates; vitamin C is an example of a vitamin, and calcium salts are an example of a mineral; the effects on humans of lack of vitamin C and calcium; the dangers of an excessive intake of animal fats; one good source of each food component; how to carry out the iodine test for starch and the Benedict's test for sugar *no other food tests will be examined*
c. that food is used as a fuel during respiration to maintain the body's activity and as a raw material for growth and repair	that different foods have varying energy content and are the source of the materials for making new cells

3. Gas exchange systems	
Preliminary knowledge: the names and positions of the heart and the lungs; the structure of the heart; that the heart forces blood round the body to the organs through arteries and that the blood returns to the heart through veins	
Pupils should be taught:	Candidates should know:
a. the structure and functions of the gas exchange system in humans, including adaptations to function	about the structure of the lungs in outline only, i.e. the lung surface is greatly folded, creating a large surface area for gaseous exchange, and that they have thin walls and an extensive blood supply; that oxygen is taken into the lungs by breathing, and transported to the tissues by the circulatory system
b. the mechanism of breathing to move air in and out of the lungs, using a pressure model to explain the movement of gases, including simple measurements of lung volume	the terms *inspiration* and *expiration*; about the role of the diaphragm and the intercostal muscles in the rib cage; that vital capacity is a measure of lung volume
c. the impact of exercise, asthma and smoking on the human gas exchange system	that smoking is one of the causes of lung cancer and heart disease; that smoking reduces the surface area of the lungs, leading to severe breathing difficulties; about the importance of inhalers in treating asthma; the effects of athletic training on lung volume and heart rate; about pulse rate as a measure of heart rate

4. Reproduction in animals	
Preliminary knowledge: reproduction is a process in all living organisms; the main stages of the human life cycle	
Pupils should be taught:	Candidates should know:
a. reproduction in humans (as an example of a mammal), including the structure and function of the male and female reproductive systems; the menstrual cycle (without details of hormones), gametes, fertilisation	the terms *gamete* and *zygote*; the relative sizes and numbers of eggs and sperm and their roles; that fertilisation in humans occurs when the head of a sperm (a male cell) enters the ovum (a female cell) and the nuclei fuse together, bringing together through the genes some of the characteristics of both parents about the structure and functions of the human reproductive system and how sperm and egg are brought together; the menstrual cycle in outline only *hormonal control will not be examined*

b. gestation and birth, to include the effect of maternal lifestyle on the fetus	that the fetus is protected and nourished in the uterus and how its waste materials are eliminated; that molecules such as alcohol and nicotine can pass across the placenta and affect fetal development
c. the physical and emotional changes which take place during adolescence	about the principal changes that occur at adolescence and an understanding of why these occur

5. Reproduction in plants	
Preliminary knowledge: the parts flowers play in the life cycle of flowering plants, including pollination, seed formation, germination and seed dispersal; basic details of flower structure; the terms carpel, stamen and petal; that pollination is the transfer of pollen from one flower to another; methods of seed dispersal; investigations into methods of seed dispersal (e.g. dandelion, sycamore or berries); experiments to show that water, air and warmth are needed for germination	
Pupils should be taught:	Candidates should know:
a. reproduction in plants, including flower structure; wind and insect pollination, fertilisation; seed and fruit formation and dispersal, including quantitative investigation of some dispersal mechanisms	that fertilisation in flowering plants occurs when a male nucleus in a pollen tube fuses with a nucleus in a female egg cell (ovum) in an ovule about sexual reproduction in flowering plants including details of flower structure; the terms *carpel* (*stigma, style, ovary, ovule*), *stamen* (*anther, filament*), *petal, sepal*; that pollination is the transfer of pollen from an anther to a stigma; fertilisation is the fusing together of the male and female sex cells to produce a fertilised egg leading to the formation of a seed; fruit formation and seed dispersal; the germination of seeds; the main parts of a germinating seed: embryo shoot, embryo root, food store and seed coat

6. Health	
Preliminary knowledge: the effects on the human body of tobacco, alcohol and other drugs, and how these relate to personal health	
Pupils should be taught:	Candidates should know:
a. the effects of recreational drugs (including substance misuse) on behaviour, health and life processes.	about the effects of tobacco, alcohol, and marijuana on behaviour and long-term physical and mental health; the potential for addiction; the positive effects of exercise and healthy eating

b. that the growth and reproduction of bacteria and the replication of viruses can affect health; how the body's natural defences may be enhanced by medicines	about one example of a bacterial disease and one example of a viral disease; about the importance of cleanliness at personal and community levels as a defence against disease; that the body's natural defences can be supplemented by medicines

B2. Material cycles and energy

1. Photosynthesis	
Preliminary knowledge: that green plants use energy from the Sun to produce food in photosynthesis; the role of the green pigment (chlorophyll) in the leaf and stem in capturing light energy; the role of the leaf in producing new material for growth; that mineral salts are nutrients which are needed for growth of plants; that roots anchor the plant in the soil, and the water and minerals are taken in through the roots and transported through the stem to other parts of the plant; that nearly all food chains start with green plants	
Pupils should be taught:	Candidates should know:
a. the reactants in, and products of, photosynthesis, and a word summary for photosynthesis; that plants need carbon dioxide, water and light for photosynthesis, and produce biomass and oxygen	that photosynthesis is summarised by the word equation: $\text{carbon dioxide} + \text{water} \xrightarrow[\text{chlorophyll}]{\text{light energy}} \text{glucose} + \text{oxygen}$ that in most plants the glucose is then converted into starch which can be tested, using iodine solution
b. the dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules which are an essential energy source to maintain levels of oxygen and carbon dioxide in the atmosphere	about the global importance of photosynthesis in producing food and maintaining the composition of the atmosphere; about gas production during photosynthesis in, e.g. *Elodea*; how to perform a controlled experiment to show that light is needed for starch production by a potted plant, e.g. *Pelargonium*
c. the adaptations of leaves for photosynthesis; the role of stomata in gas exchange in plants	*in outline only:* about the role of cells containing chloroplasts as the sites of photosynthesis; the role of xylem in transporting water to the leaf; the role of phloem transporting sugar to the growing parts of the plant; the role of stomata in gas exchange during daylight

d. the role of root hairs in absorbing water and minerals from the soil; that nitrogen and other elements, in addition to carbon, oxygen and hydrogen, are required for plant growth	that root hairs increase the surface area for absorption of water and minerals such as nitrates; that nitrates are needed for healthy growth; that magnesium is needed for the production of chlorophyll

2. Cellular respiration	
Preliminary knowledge: that yeast is a micro-organism which is too small to be seen without a microscope; yeast is important in making bread and wine; some micro-organisms help to break down the remains of dead organisms	
Pupils should be taught:	Candidates should know:
a. that aerobic respiration involves a reaction in cells between oxygen and food, in which glucose is broken down to carbon dioxide and water to summarise aerobic respiration in a word equation	about the difference between breathing and respiration; that respiration in living organisms enables all the other chemical processes necessary for life; that aerobic respiration takes place in mitochondria that energy is made available by aerobic respiration, summarised by the word equation: glucose+oxygen $\longrightarrow$ water+carbon dioxide+energy how to test exhaled air for carbon dioxide using limewater
b. the process of anaerobic respiration in humans, including fermentation, and a word summary for anaerobic respiration	glucose $\longrightarrow$ carbon dioxide + ethanol + some energy (plants and yeast) glucose $\longrightarrow$ lactic acid + some energy (animals)
c. the differences between aerobic and anaerobic respiration; the implications for the organism	that for each molecule of glucose respired, aerobic respiration yields more energy than anaerobic respiration
d. that the reactants and products of respiration are transported throughout the body in the bloodstream	that oxygen and carbon dioxide are carried in the blood and exchanged with the atmosphere through the lungs

e. the global significance of photosynthesis and respiration in maintaining the levels of carbon dioxide in the atmosphere	that animals and plants respire and plants photosynthesise; how the carbon cycle maintains a balance between respiration and photosynthesis and the effect of this on the atmosphere; the impact of burning fossil fuels on the level of carbon dioxide in the atmosphere

B3. Interactions and interdependences

1. Relationships in an ecosystem	
Preliminary knowledge: that animals and plants in different habitats are suited to their environment; that nearly all food chains start with green plants; the order of organisms in a food chain and the relationship between predator and prey; the terms producer, consumer, herbivore, carnivore and omnivore	
Pupils should be taught:	Candidates should know:
a. the interdependence of organisms in an ecosystem, including food webs	how to study one simple food chain in a habitat; the differences between a food chain and a food web
b. about ways in which living things and the environment can be protected, and the importance of sustainable development	about the importance of conserving local habitats; that the resources of the Earth are limited and need to be managed
c. how predation and competition for resources affect the size of populations (e.g. bacteria, growth of vegetation)	about simple methods of estimating the population size of one type of organism by means of a quadrat; that population size is affected by predation and competition

B4. Genetics and evolution

1. Variation, classification and inheritance	
Preliminary knowledge: making and using simple identification keys based on observable external features to identify and group living organisms systematically; the terms vertebrate, invertebrate; how animals and plants are adapted to living in their environments	
Pupils should be taught:	Candidates should know:
a. the variation between individuals within a species being continuous or discontinuous, to include measurement and graphical representation of variation	about the environmental and inherited causes of variation within a species about blood groups as an example of discontinuous variation and height as an example of continuous variation; how to detect and describe variation within and between species and suggest possible causes
b. that differences exist between species	e.g. similarities and differences between the Great Apes (including chimpanzees and gorillas) and humans
c. the classification of living things into the major taxonomic groups	how to use a simple key to identify the group to which a specimen belongs; that animals and plants are classified into separate kingdoms; that bacteria, fungi and single-celled organisms are placed in other kingdoms; the characteristic features of the animal and plant kingdoms and why fungi are not included with plants; the diagnostic features of: single-celled organisms, fungi, arthropods (knowing the difference between insects and spiders), fish, amphibians, reptiles, birds, mammals and flowering plants

13+

CHEMISTRY

Please note that the spelling ‘sulfur’ will be used in examination papers, in line with GCSE, and candidates should be made aware that this is the standard spelling, in place of ‘sulphur’.

C1. The particulate nature of matter

Preliminary knowledge: recognise differences between solids, liquids and gases in terms of ease of flow and maintenance of shape and volume; how to use simple particle theory to describe the arrangement of particles in solids, liquids and gases	
Pupils should be taught:	Candidates should know:
a. the properties of the different states of matter (solid, liquid and gas) in terms of the particle model, including gas pressure and diffusion	about gas pressure explained in terms of collisions of particles with the container walls
b. Brownian Motion	that diffusion in liquids, solids and gases is a result of the random movement and collisions between particles; differences in concentration; examples of diffusion
c. changes of state in terms of the particle model; similarities and differences, including density differences, between solids, liquids and gases; changes with temperature in motion and spacing of particles	the variation in the arrangement and movement of particles associated with changes of state about the abundance of water in nature, including its existence as vapour in the air; the water cycle; the effect of air flow and temperature changes on evaporation from oceans or in laboratory experiments; how to make predictions about the amount of water lost

C2. Atoms, elements and compounds

Preliminary knowledge: how to use simple particle theory to describe the arrangement of particles in solids, liquids and gases	
Pupils should be taught:	Candidates should know:
a. the simple (Dalton) atomic model	the meaning of the words *atom* and *molecule*; about the term *element* as used in chemistry and the idea that samples of the same element contain the same type of atom *a knowledge of ions will not be examined*

b. chemical symbols and formulae for elements and compounds	the symbols for the elements H, C, O, N, S, Mg, Na, Cl, Ca, Cu, Fe and He; that the symbol can represent one atom of that element; simple formulae: H_2O, CO_2, O_2, CH_4, NaCl, HCl, NaOH, $CaCO_3$, $CuSO_4$, H_2SO_4 *equations using formulae will not be examined*
c. the differences between atoms, elements and compounds	that the elements are organised in the periodic table *details of the periodic table will not be examined* that compounds have different properties from the elements from which they are made
d. how elements vary widely in their physical properties, including appearance, state at room temperature, magnetic properties and thermal and electrical conductivity, and to how use these properties to classify elements as metals or non-metals	the terms *conductor* and *insulator* both in electrical and thermal contexts; about the grouping of elements into metals and non-metals according to physical characteristics such as electrical conductivity, shininess, malleability

C3. Pure and impure substances; physical changes

Preliminary knowledge: the terms *soluble, insoluble*, *solute*, *solvent*, *solution*; factors affecting the rate of dissolving everyday substances in water, i.e. the temperature of the solvent, particle size of the solute and stirring; the concept of fair testing to compare rates of dissolving in water; that a solution contains at least two substances: water and the dissolved substance; how to draw and interpret bar charts and line graphs using data from dissolving experiments

how to carry out simple experiments to separate solid particles of different sizes

how to carry out simple filtration experiments and decanting as another simple method of separating a solid from a liquid; the terms *filtrate* and *residue*

how to carry out simple evaporation experiments, e.g. evaporation of a salt solution; that salt solutions should not be dried completely when heated

how to take an investigative approach to separate a variety of mixtures

Pupils should be taught:	Candidates should know:
a. the concept of a pure substance	that pure substances comprise particles of the same type

b. the identification of pure substances	that a pure substance melts and boils at a particular temperature and this can be used to identify it
c. to relate changes of state to energy transfers (qualitative)	the terms *melting*, *freezing*, *boiling*, *condensation*, *evaporation* and *sublimation*; that most solids, liquids and gases expand on heating and contract on cooling, e.g. the use of mercury or alcohol in thermometers; that evaporation can occur at any temperature but boiling occurs at a specific temperature for a particular substance; about the anomalous behaviour of water when freezing
d. conservation of mass for physical changes	that when physical changes (e.g. changes of state, formation of solutions) take place, mass is conserved
e. mixtures, including dissolving	that the properties of a mixture are the same as its components; in a solution, the solute and solvent particles are arranged randomly
f. the composition of the atmosphere	that air is a mixture of gases; about the approximate percentages of nitrogen, oxygen and the relatively small proportion of other gases in the air; the uses of oxygen; that carbon dioxide is a product of respiration and a raw material for photosynthesis; the importance of oxygen as a reactant in respiration
g. simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography	about the following methods of separation: about filtration to remove insoluble solids from a suspension; the terms *filtrate* and *residue*; evaporation to recover a solute and the testing of water purity by measurement of its boiling point and freezing point; how to purify rock salt; the differences between sea, tap and distilled water, demonstrated by evaporation; the importance of water as a solvent; that ethanol and propanone are alternative solvents to water *chlorinated hydrocarbons must not be used;* about simple distillation to recover a solvent from a solution, e.g. how to obtain a sample of pure water from sea water or washable ink; of the need to prevent suck-back of the distilled sample if simple apparatus is used, and how to prevent it

g. (continued)	about use of the Liebig condenser; paper chromatography to separate a mixture of two or more coloured solutes from a solution, e.g. coloured inks, food dyes, Smartie-type sweets; how to interpret simple chromatograms
h. about the variation of solubility with temperature, the formation of saturated solutions and the differences in solubility of solutes in different solvents	that when soluble solids form a solution, a chemical change is not involved; that a solution is a mixture which may be separated using physical techniques;

C4. Chemical reactions

Preliminary knowledge: Non-reversible changes (e.g. rusting) result in the formation of new materials which may be useful; burning materials (e.g. wood, wax, natural gas) results in the formation of new materials and that this change is not usually reversible	
Pupils should be taught:	Candidates should know:
a. conservation of mass in chemical reactions	how mass is conserved when chemical reactions take place because the same atoms are present, although combined in different ways; about the experiment to demonstrate the conservation of mass in which lead iodide, or another suitable solid, is produced by mixing two solutions in a stoppered conical flask; that virtually all materials, including those in living systems, are made through chemical reactions; about the importance of chemical change in everyday situations, (e.g. *ripening fruit, setting superglue, cooking food*) *many examples of such reactions are given in other sections* copper oxide, zinc oxide and magnesium oxide (previously dried in an oven) may be used to illustrate that some substances do not change chemically when heated
b. combustion reactions	how to use the Bunsen burner for gentle warming, vigorous heating etc.; about the effect of air supply on the flame and relative temperatures of different parts of the roaring flame; that when things burn in air they react with oxygen; the glowing splint test for oxygen and the limewater test for carbon dioxide; how to identify the products of combustion, e.g. of a candle

b. (continued)	how to construct word equations for simple chemical reactions; about recognising chemical change by the new substances which are formed
c. the production of carbon dioxide by human activity and the impact on climate	about the importance of oxygen as a reactant in respiration; the effect of burning fossil fuels; that air is often polluted by sulfur dioxide and carbon monoxide and the sources of these pollutants; possible effects of the burning of fossil fuels on the environment, including climate (e.g. production of acid rain, carbon dioxide and solid particles) and how these effects can be minimised
d. thermal decomposition reactions	about hydrated copper sulfate, copper carbonate and potassium permanganate to illustrate thermal decomposition
e. oxidation and displacement reactions	how metals react with oxygen, water and acids and oxides of other metals, and the products of these reactions; how to apply the lighted splint test for hydrogen; about the rusting of iron; that oxygen in the air is involved in the rusting process; simple rusting experiments should be extended to show that air contains 20% oxygen the displacement reactions which take place between metals and solutions of salts (e.g. sulfates) of other metals *copper, iron, magnesium and zinc are suitable examples for experiments*
f. the order of metals and carbon in the reactivity series	how a reactivity series of metals can be determined by considering these reactions, and used to make predictions about other reactions; how to use the reactivity series of metals to deduce that those higher in the series might burn more vigorously in air, react faster with water and dilute acids, and displace a lower metal from its oxide; the uses of metals low down the series, such as lead and copper, for roofing and piping; about the need for methods of covering the surface when the more reactive iron is used; about the exceptional lack of reactivity of silver and gold which makes them useful for jewellery and electrical contacts

g. the use of carbon in obtaining metals from metal oxides	that most metals are not found in their free state and that chemical reactions are necessary to extract metals from their ores; that chemical reactions are needed for the extraction of copper, iron and aluminium from their ores
h. the definition of acids and alkalis in terms of neutralisation; the reactions of acids with metals to produce a salt plus hydrogen; reactions of acids with alkalis to produce a salt plus water	how metals and bases, including carbonates, react with acids and the products of these reactions; neutralisation and salt formation; about the addition of dilute sodium hydroxide solution to dilute hydrochloric acid and evaporation of the neutral solution, to illustrate neutralisation and salt formation *alternatively, salt formation could be illustrated by adding copper oxide or copper carbonate to warm dilute sulfuric acid and evaporating gently*
i. the pH scale for measuring acidity/alkalinity and indicators	about the use of indicators such as Universal Indicator and litmus to classify solutions as acidic, neutral or alkaline and to use the pH scale as a measure of the acidity of a solution
j. the chemical properties of metal and non-metal oxides with respect to acidity	about the grouping of elements into metals and non-metals according to physical characteristics such as electrical conductivity, shininess, malleability and according to whether they give acidic or basic oxides
k. the effect of acidity on the environment	how acids in the environment can lead to corrosion of metal and chemical weathering of rock (e.g. limestone); that carbon dioxide dissolves in water to form an acid and that rain is slightly acidic; the chemical composition of limestone; reaction with dilute hydrochloric acid; about the use of limestone as a building material and for the production of agricultural lime; about the weathering effect of acid rain on limestone

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PHYSICS

P1. Energy

1. Energy resources	
Preliminary knowledge: none	
Pupils should be taught:	Candidates should know:
a. fuels and energy resources, including oil, gas, coal, biomass, food, wind, waves and batteries; the distinction between renewable and non-renewable resources	that a renewable resource is one which can be replenished within a lifetime; some of the advantages and disadvantages of renewable and non-renewable resources
b. that the Sun is the ultimate source of most of the Earth's energy resources and to relate this to how coal, oil and gas are formed	the role of the Sun as the ultimate source of the energy in fossil fuels; its part in the water cycle and formation of wind and waves
c. that electricity is generated using a variety of energy resources	that a variety of processes are used to generate electricity

2. Changes in systems	
Preliminary knowledge: none	
Pupils should be taught:	Candidates should know:
a. energy as a quantity that can be quantified and calculated	That energy is a quantity which can be measured and that the unit of energy is the joule *calculations involving this unit in the context of 'work' will not be examined*

b. ways in which energy can be usefully transferred and stored, comparing the starting with the final conditions of a system and describing increases and decreases in the amounts of energy associated with movements, temperatures, changes in positions in a field, in elastic distortions and in chemical compositions	that energy can exist in many different forms: chemical, electrical, gravitational, kinetic, light, sound, strain (elastic) and thermal (internal); the form in which energy is stored in a particular situation (e.g. a stretched spring stores energy as strain energy) how to describe the energy transformation taking place in simple situations (e.g. a lamp transforming electrical energy into light and thermal energy) how different processes result in energy transfers

3. Conservation of energy	
Preliminary knowledge: none	
Pupils should be taught:	Candidates should know:
a. that the total energy has the same value before and after a change	that the total energy is conserved but that in doing work, energy is always spread out or diluted so as to become less useful
b. that although energy is always conserved, it may be dissipated, reducing its availability as a resource	about the significance of the Law of Conservation of Energy

P2. Motion and forces

1. Describing motion	
Preliminary knowledge: that objects are pulled downward because of the gravitational attraction between them and the Earth; that friction, including air resistance, is a force which slows down moving objects and may prevent objects from starting to move; that when objects are pushed or pulled, an opposing pull or push can be felt; measuring forces and identifying the direction in which they act.	
Pupils should be taught:	Candidates should know:
a. scientific units	how to use scientific units correctly in measurements and calculations

b. how to determine the speed of a moving object and to use the quantitative relationship between speed, distance and time; relative motion: trains and cars passing one another	about the timing of moving bodies to measure speed; the relationship between speed, distance and time; how to use this for simple quantitative work how to draw and interpret a distance-time graph for a journey; that speeds for vehicles approaching or passing each other in a straight line would add or subtract as seen from one vehicle
c. forces as pushes or pulls, arising from the interaction between two objects; forces measured in newtons, measurements of stretch or compression as force is changed	that the unit of force is the newton and that forces can be measured using a force meter (newton meter)
d. forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only)	the concept of constant speed and of speeding up and of slowing down, without a formal definition of acceleration; about the effects of forces on an object; that forces can act in different directions
e. using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces	that forces can be represented by arrows which can show both the size of the force by the length of arrow and the direction of the force by the direction of the arrow
f. that unbalanced forces change the speed or direction of objects and that balanced forces produce no change in the movement of an object	that when forces are added, both size and direction need to be taken into account *calculations will only involve forces acting in a straight line*
g. opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface	that there is an unbalanced force on an object when the result of adding the forces on the object is non-zero
h. forces: associated with deforming objects; stretching and squashing – springs; force-extension linear relation; Hooke's Law as a special case	that an unbalanced force can cause either a change in speed or a change in direction of motion and that both of these changes are acceleration; that if the result of adding the forces on an object is zero, the forces are balanced and there will be no change in the motion of the object; that an object is in equilibrium when the forces on it are balanced about experiments and calculations with springs and combinations of springs that obey Hooke's Law

i. forces: rubbing and friction between surfaces, pushing things out of the way; resistance to motion of air and water	about the force of friction, including air resistance (drag), and its applications about the different stopping distances as listed in the Highway Code *candidates do not have to memorise the different stopping distances*

2. Force and rotation	
Preliminary knowledge: none	
Pupils should be taught:	Candidates should know:
a. that forces can cause objects to turn about a pivot	about the use of levers to change direction and magnitude of a force
b. that simple machines give bigger force but at the expense of smaller movement (and vice versa) – product of force and displacement unchanged	about the use of levers in simple machines, e.g. crowbars, pliers, scissors
c. moment as the turning effect of a force the principle of moments and its application to situations involving one pivot	about simple quantitative examples involving moments about a single pivot; that the unit of a moment is a newton metre (or newton centimetre) *knowledge of classes of levers is not expected, although questions on class 1 and 2 levers will be set; and questions on class 3 levers may be set*

3. Force and pressure	
Preliminary knowledge: none	
Pupils should be taught:	Candidates should know:
a. pressure measured by ratio of force over area – acting normal to any surface	the relationship between force, area and pressure
b. the quantitative relationship between force, area and pressure and its application *(e.g. the use of skis and snowboards, the effect of sharp blades)*	how to use this relationship for simple quantitative work that the unit of pressure is N/m^2 or N/cm^2

4. Density	
Preliminary knowledge: none	
Pupils should be taught:	Candidates should know:
a. density and its measurement	about the relationship between density, mass and volume; how to use this for simple quantitative work that the unit of density is kg/m^3 or g/cm^3; about the measurement of the mass and volume of regularly-shaped solids and of irregularly-shaped solids (using the displacement of water to find a volume), and of liquids to calculate their density; that air has mass and that it is possible to measure its density

P3. Waves

1. Sound waves	
Preliminary knowledge: sounds are made when objects vibrate; vibrations are not always directly visible	
Pupils should be taught:	Candidates should know:
a. that sound needs a medium to travel; the speed of sound in air, in water, in solids; echoes, reflection and absorption of sound; that sound is produced by vibrations of objects, in loud speakers, detected by their effects on a microphone diaphragm	that sound travels through solids, liquids and air, but not through a vacuum; that an event observed from a distance is seen before it is heard; that sound can be reflected from a boundary, like all waves, and that an example of reflection of sound is an echo; that some materials will absorb sound; that sound is produced by a vibrating object which produces a sound wave which is able to travel through a medium; that sound is detected by causing the eardrum to vibrate or by a microphone which produces an electrical signal from a vibrating diaphragm *candidates will not be expected to memorise the numerical values for the speeds of sound and light but merely the comparison between the two*
b. the relationship between the loudness of a sound and the amplitude of the vibration causing it	that increasing amplitude increases the loudness of a sound

2. Hearing	
Preliminary knowledge: none	
Pupils should be taught:	Candidates should know:
a. that sound causes the eardrum to vibrate; the auditory range of humans and animals	*questions will not be set which require candidates to have experienced the use of a signal generator* *questions will not be set that require knowledge of the structure of the ear (that does not exclude questions where information is given about the structure of the ear)*
b. some effects of loud sounds on the ear (e.g. temporary deafness)	that loud sounds can cause temporary or permanent damage to hearing
c. the relationship between the pitch of a sound and the frequency of the vibration causing it; frequencies of sound waves, measured in hertz (Hz)	that increasing frequency increases pitch; that frequency is measured in hertz

3. Light waves	
Preliminary knowledge: that light travels from a source; light cannot pass through some materials, leading to the formation of shadows; light is reflected from some surfaces; we see things only when light from objects enters our eyes	
Pupils should be taught:	Candidates should know:
a. that light travels in a straight line at a finite speed in a uniform medium; that light can travel through a vacuum but sound cannot, and that light travels much faster than sound; that light waves can travel through a vacuum; speed of light *(qualitative only)*	that light comes from a luminous source and travels in straight lines; that light travels much faster than sound or any other mechanical wave; that the ultimate speed is the speed of light in a vacuum
b. that non-luminous objects are seen because light scattered from them enters the eye	that some objects give out light but that light is reflected from non-luminous objects and this is how we are able to see them *details of the structure of the eye will not be examined*

c. how light is reflected at plane surfaces; the use of a ray model to explain imaging in mirrors; the pinhole camera	how a plane mirror alters the path of a ray of light; the meaning of the angle of incidence and angle of reflection; how to measure these angles using a protractor, and that they are equal; practical applications of mirrors, e.g. construction of a periscope
d. how light is refracted at the boundary between two different materials	that, on a qualitative basis, light changes direction when it reaches the boundary between two different materials and that this phenomenon is called refraction *Snell's Law and knowledge of optical devices which require the use of lenses will not be examined*
e. the transmission of light through materials: absorption, diffuse scattering	that light will be transmitted through a material if it is not absorbed; such a material is transparent; some materials will absorb light and re-emit it in all directions, called scattering, and that such a material is translucent
f. that white light can be dispersed to give a range of colours; colours and the different frequencies of light, white light and prisms (qualitative only)	that white light is a mixture of all colours; that different colours have different frequencies; how a prism disperses white light and that a similar effect occurs naturally in a rainbow

P4. Electricity and electromagnetism

1. Circuits	
Preliminary knowledge: about constructing circuits, incorporating a battery or power supply and a range of switches to make electrical devices work; changing the number or type of components to make bulbs brighter or dimmer; representing series circuits by drawings and conventional symbols; constructing series circuits on the basis of drawings and diagrams using conventional symbols	
Pupils should be taught:	Candidates should know:
a. to design and construct series and parallel circuits, and how to measure current	about parallel and series circuits, involving cells, lamps, switches (push button, SPST, reed switches), resistors, variable resistors, motors, buzzers, LDRs, LEDs, fuses, AND and OR circuits (as constructed using switches); about truth tables for these *logic gates, SPDT switches and the use of the voltmeter will not be examined*
b. about electric current, measured in amperes, series and parallel circuits, currents add where branches meet; that the current in a series circuit depends on the number of cells and the number and nature of other components; current as flow of charge that is not 'used up' by components; differences in resistance between conducting and insulating components *(qualitative only)*	that the unit of current is the ampere (amp); that current is measured with an ammeter and that it should be connected in series in the circuit *knowledge of resistors should be qualitative and no formal statement of Ohm's Law or definition of resistance will be required*
c. that energy is transferred from batteries and other sources to other components in electrical circuits	that a battery or cell transforms chemical energy into electrical energy and that electrical energy is converted into other forms in electrical components

2. Magnetism	
Preliminary knowledge: about the forces of attraction and repulsion between magnets, and the forces of attraction between magnets and magnetic materials	
Pupils should be taught:	Candidates should know:
a. about magnetic fields as regions of space where magnetic materials experience forces, and that like magnetic poles repel and unlike magnetic poles attract; magnetic fields by plotting with a compass; representation by field lines Earth's magnetism, compass and navigation	that like poles repel and unlike poles attract; that magnetic forces occur even without contact between the magnets that both poles will attract unmagnetised iron; that lines showing the direction of the field should have arrows pointing away from the north-seeking pole; that repulsion by a known magnet is the only true test for another magnet that the Earth has a magnetic field, and that a freely-suspended bar magnet will align itself north–south; the terms north-seeking and south-seeking poles

3. Electromagnets	
Preliminary knowledge: none	
Pupils should be taught:	Candidates should know:
a. that a current in a coil produces a magnetic field pattern similar to that of a bar magnet	how to use plotting compasses and/or iron filings to show that current in a coil produces a magnetic field
b. how electromagnets are constructed and used in devices (e.g. lifting magnets, relays, DC motors [principles only])	how to construct a simple electromagnet using an iron core and insulated wire, and that the strength of the electromagnet depends on the number of turns on the coil and on the current; how to use relays

P5. Space Physics

Preliminary knowledge: that the Sun, Earth and Moon are approximately spherical; the position of the Sun appears to change during the day, and shadows change as this happens; day and night are related to the spin of the earth on its own axis; the Earth orbits the Sun once each year, and the Moon takes approximately 28 days to orbit the Earth	
Pupils should be taught:	Candidates should know:
a. how the movement of the Earth causes the apparent daily and annual movement of the Sun and other stars; the seasons and the Earth's tilt; day length at different times of year, in different hemispheres	that the Earth is one of several planets which orbit the Sun; the reasons for the changes causing night and day, seasons and eclipses of the Sun and Moon
b. the relative positions of the Earth, Sun and planets in the solar system the light year as a unit of astronomical distance	about the concept of a moon as a satellite, as shown by our Moon and the moons of other planets; that the solar system is part of the Milky Way galaxy, and that the Universe contains many such groups of stars or galaxies about the scale of astronomical distances *planetary and stellar distances need not be remembered*
c. gravity forces acting at a distance on Earth and in space; that the weight of an object on Earth is the result of the gravitational attraction between its mass and that of the Earth	that there is a gravitational force of attraction between any two masses; that this force causes bodies to fall towards the centre of the Earth; that the weight of a body is the pull of gravity on it weight = mass x gravitational field strength (g) on Earth: g = 10 N/kg
d. about the movements of planets round the Sun and to relate these to gravitational forces.	that it is gravitational forces which keep the Moon in orbit round the Earth and planets in orbit round the Sun
e. that the Sun and other stars are light sources and that the planets and other bodies are seen by reflected light	why the planets and our Moon are visible even though they are not light sources

f.	the use of artificial satellites and probes to observe the Earth and to explore the solar system	*factual details about Man's exploration of space will not be examined, but candidates should have heard of the development of manned space flight and of the use of satellites for communication, for monitoring conditions on Earth and for exploration of the solar system*

SCHEME OF ASSESSMENT

11+ (80 marks; 60 minutes)
The paper will test the three disciplines of biology, chemistry and physics with approximately equal weighting. Questions will be included to enable candidates to demonstrate their developing skills in *Working Scientifically*. Each paper may contain a question giving candidates the opportunity for free writing.

There will be no choice of questions. The use of calculators will be allowed in the examination.

The minimum weighting of the assessment objectives in the examination will be as follows:

assessment objective	description	minimum % mark allocation
AO1	remembering and understanding	30
AO2	applying and analysing	30
AO3	evaluating and creating	5

13+

Assessment of the 13+ syllabus can occur at two levels: Level 1 and Level 2. The syllabus is common for both levels, but Level 1 Candidates will be given more explanatory text and, where calculations are required, formulae and units will be given. It is envisaged that candidates who are expected to achieve less than an average of 35% on the three Level 2 papers should consider using the Level 1 paper.

Level 1 (80 marks; 60 minutes)

There will be one paper with approximately equal numbers of questions based on 13+ biology, chemistry and physics syllabuses. Preliminary knowledge from the 11+ syllabus will be assumed (legacy, 2010, syllabus until autumn 2019). The paper will consist of a mixture of closed items, e.g. multiple-choice, matching pairs, completing sentences and some open questions. Open questions will have several parts, some of which will require answers of one or two sentences. These parts will carry a maximum of three marks. At least 25% of the paper will be testing *Working Scientifically*.

For quantitative questions which require the use of formulae, equations will be provided. Rearrangement of equations will not be required.

There will be no choice of questions. The use of calculators and protractors will be allowed in the examination.

The minimum weighting of the assessment objectives in the examination will be as follows:

assessment objective	description	minimum % mark allocation
AO1	remembering and understanding	35
AO2	applying and analysing	35
AO3	evaluating and creating	5

Level 2 (60 marks per paper; 40 minutes per paper)

There will be three papers, one in each of biology, chemistry and physics, and preliminary knowledge from the 11+ syllabus will be assumed (legacy, 2010, syllabus until autumn 2019). Some of the questions may be closed, although most will be open with several parts requiring candidates to answer in sentences. These parts will carry a maximum of 4 marks. In addition, 1 mark may be given for an acceptable standard of spelling, punctuation and grammar in one part of the paper. The maximum number of marks per question will be 12. At least 25% of the paper will be testing *Working Scientifically*.

There will be no choice of questions. The use of calculators and protractors will be allowed in the examination.

For quantitative questions which require the use of formulae, equations given in the syllabus will **not** be provided.

The minimum weighting of the assessment objectives in the examination will be as follows:

assessment objective	description	minimum % mark allocation
AO1	remembering and understanding	35
AO2	applying and analysing	35
AO3	evaluating and creating	10

SCHOLARSHIP

Scholarship papers are based on this syllabus. The examination (90 minutes) will be divided into three sections: **A (biology), B (chemistry)** and **C (physics)**. Candidates will be required to attempt all the questions. Each section is worth 25 marks but the number of questions will vary. The use of calculators and protractors will be allowed in the examination.

The minimum weighting of the assessment objectives in the examination will be as follows:

assessment objective	description	minimum % mark allocation
AO1	remembering and understanding	25
AO2	applying and analysing	25
AO3	evaluating and creating	25

For quantitative questions which require the use of formulae, equations given in the syllabus will **not** be provided. Rearrangement of equations may be required.

APPENDIX I

SCHEDULE OF ASSESSMENT FROM 2015/16

The tables below clarify when syllabuses will be taught and examined from 2015/16 onwards. 'Legacy' refers to the syllabus updated in 2010, and 'revised' refers to the new syllabus, published in 2015.

Year 6 non-examinable topics at 11+ will be assumed to have been taught in the setting of examinations at 13+ based upon the new syllabus. The table below gives guidance on which examination syllabus year groups should follow for the academic years 2015-2019.

CE Science syllabus: teaching cycle					
		academic year			
year	syllabus	15/16	16/17	17/18	18/19
3	11+	revised (2015)	revised (2015)	revised (2015)	revised (2015)
4	11+	legacy (2010)	revised (2015)	revised (2015)	revised (2015)
5	11+	legacy (2010)	legacy (2010)	revised (2015)	revised (2015)
6	11+	legacy (2010)	legacy (2010)	legacy (2010)	revised (2015)
7	13+	legacy (2010)	revised (2015)	revised (2015)	revised (2015)
8	13+	legacy (2010)	legacy (2010)	revised (2015)	revised (2015)

The table below shows which syllabus will be assessed in the Common Entrance examinations for the academic years 2015-2019.

academic year	syllabus	CE Science syllabus: assessment cycle		
		11+	13+	CASE
15/16		legacy (2010)	legacy (2010)	legacy (2010)
16/17		legacy (2010)	legacy (2010)	legacy (2010)
17/18		legacy (2010)	revised (2015)	revised (2015)
18/19		revised (2015)	revised (2015)	revised (2015)

Note: For the 13+ syllabus, the preliminary knowledge for the 16/17, 17/18, 18/19 and 19/20 assessment cycle will be based on the legacy (2010) syllabus. These statements are included in the 13+ syllabus in the 2015 revision. The first 13+ examination using preliminary knowledge from the revised (2015) 11+ syllabus will be in 2020/21 i.e. the 2015/16 Year 3 cohort.

APPENDIX II

NOT EXAMINED AT 13+ BUT RECOMMENDED FOR TEACHING IN YEAR 9

BIOLOGY

Structure and function of living organisms

The skeletal and muscular systems

- the structure and functions of the human skeleton, to include support, protection, movement and making blood cells
- biomechanics – the interaction between skeleton and muscles, including the measurement of force exerted by different muscles
- the function of muscles and examples of antagonistic muscles

Nutrition and digestion

- calculations of energy requirements in a healthy daily diet
- the tissues and organs of the human digestive system, including adaptations to function and how the digestive system digests food (enzymes simply as biological catalysts)
- the importance of bacteria in the human digestive system

Interactions and interdependencies

Relationships in an ecosystem

- the importance of plant reproduction through insect pollination in human food security
- how organisms affect, and are affected by, their environment, including the accumulation of toxic materials

Genetics and evolution

Inheritance, chromosomes, DNA and genes

- heredity as the process by which genetic information is transmitted from one generation to the next
- a simple model of chromosomes, genes and DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model
- the variation between species and between individuals of the same species means some organisms compete more successfully, which can drive natural selection
- changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction
- the importance of maintaining biodiversity and the use of gene banks to preserve hereditary material

CHEMISTRY

Chemical reactions

- what catalysts do

Energetics

- exothermic and endothermic chemical reactions (qualitative)

The Periodic Table

- the principles underpinning the Mendeleev Periodic Table
- the Periodic Table: periods and groups; metals and non-metals
- how patterns in reactions can be predicted with reference to the Periodic Table

Materials

- properties of ceramics, polymers and composites (qualitative)

Earth and atmosphere

- the composition of the Earth
- the structure of the Earth
- the rock cycle and the formation of igneous, sedimentary and metamorphic rocks
- Earth as a source of limited resources and the efficacy of recycling
- the carbon cycle

PHYSICS

Energy

Calculation of fuel uses and costs in the domestic context

- comparing energy values of different foods (from labels) (kJ)
- comparing power ratings of appliances in watts (W, kW)
- comparing amounts of energy transferred (J, kJ, kW hour)
- domestic fuel bills, fuel use and costs

Energy changes and transfers

- heating and thermal equilibrium: temperature difference between two objects leading to energy transfer from the hotter to the cooler one, through contact (conduction) or radiation; such transfers tending to reduce the temperature difference: use of insulators
- other processes that involve energy transfer: changing motion, dropping an object, completing an electrical circuit, stretching a spring, metabolism of food, burning fuels

Changes in systems

- using physical processes and mechanisms, rather than energy, to explain the intermediate steps that bring about such changes

Forces

- work done and energy changes on deformation
- non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets and forces due to static electricity

Pressure in fluids

- atmospheric pressure, decreases with increase of height as weight of air above decreases with height
- pressure in liquids, increasing with depth; upthrust effects, floating and sinking

Forces and motion

- change depending on direction of force and its size

Waves

Observed waves

- waves on water as undulations which travel through water with transverse motion; these waves can be reflected, and add or cancel – superposition

Energy and waves

- pressure waves transferring energy; use for cleaning and physiotherapy by ultra-sound; waves transferring information for conversion to electrical signals by microphone.

Light waves

- the similarities and differences between light waves and waves in matter
- the refraction of light and action of convex lens in focusing (qualitative); the human eye
- light transferring energy from source to absorber leading to chemical and electrical effects; photo-sensitive material in the retina and in cameras

Electricity and electromagnetism

Current electricity

- potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current

Static electricity

- separation of positive or negative charges when objects are rubbed together: transfer of electrons, forces between charged objects
- the idea of electric field, forces acting across the space between objects not in contact

APPENDIX III

SUGGESTED MATERIALS FOR GROUPING AND CLASSIFYING MATERIALS

aluminium
brass
bronze
carbon (graphite)
ceramic
chalk
clay
copper
cork
cotton cloth
expanded polystyrene
glass
granite
hardwood
iron
lead
leather
limestone
marble
nylon
paper
perspex
polystyrene
polythene
PVC
rubber
slate
soft wood
steel wool
zinc

APPENDIX IV

The terminology used in the biology papers is based on *Cassidy, M., Lakin, L., Madden, D., Meatyard, B. (ed), Roberts, R. & Tribe, M. (2009). Biological Nomenclature. London: Institute of Biology.*

Other useful sources are:

Association of Science Education: www.ase.org.uk
CLEAPSS: www.cleapss.org.uk

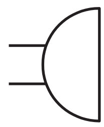
APPENDIX V

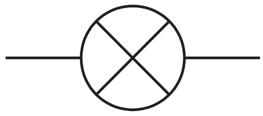
ELECTRICAL SYMBOLS
WHICH MAY BE USED IN COMMON ENTRANCE PAPERS

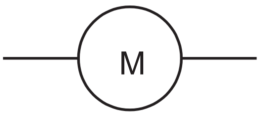
11+


cell


terminals


buzzer


lamp / bulb

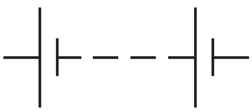


motor

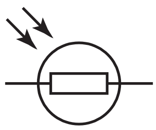

switch
(open)

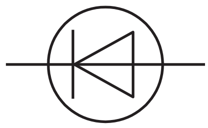

switch
(closed)

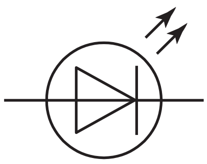
Additional symbols required for 13+


battery

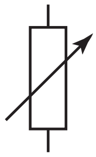

fuse

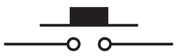

light dependent
resistor

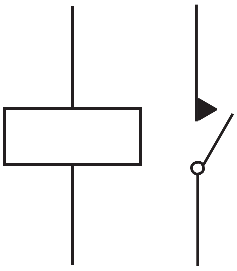

semiconductor
diode

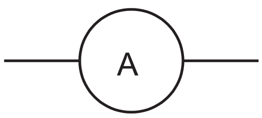

light emitting
diode


resistor


variable
resistor

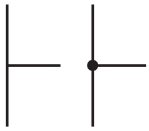

push-button
switch


relay
(normally open)



ammeter


reed switch


junction of
conductors

APPENDIX VI

SI UNITS

Scientists use the following units:

- mass – kilogramme or gram
- length – metre, kilometre, centimetre or millimetre
- time – second, minute or hour

Candidates need to know:

- the abbreviations for the above units and their relative sizes (e.g. 1 m = 100 cm)
- that area can be measured in m^2 or cm^2
- that volume can be measured in m^3 or cm^3