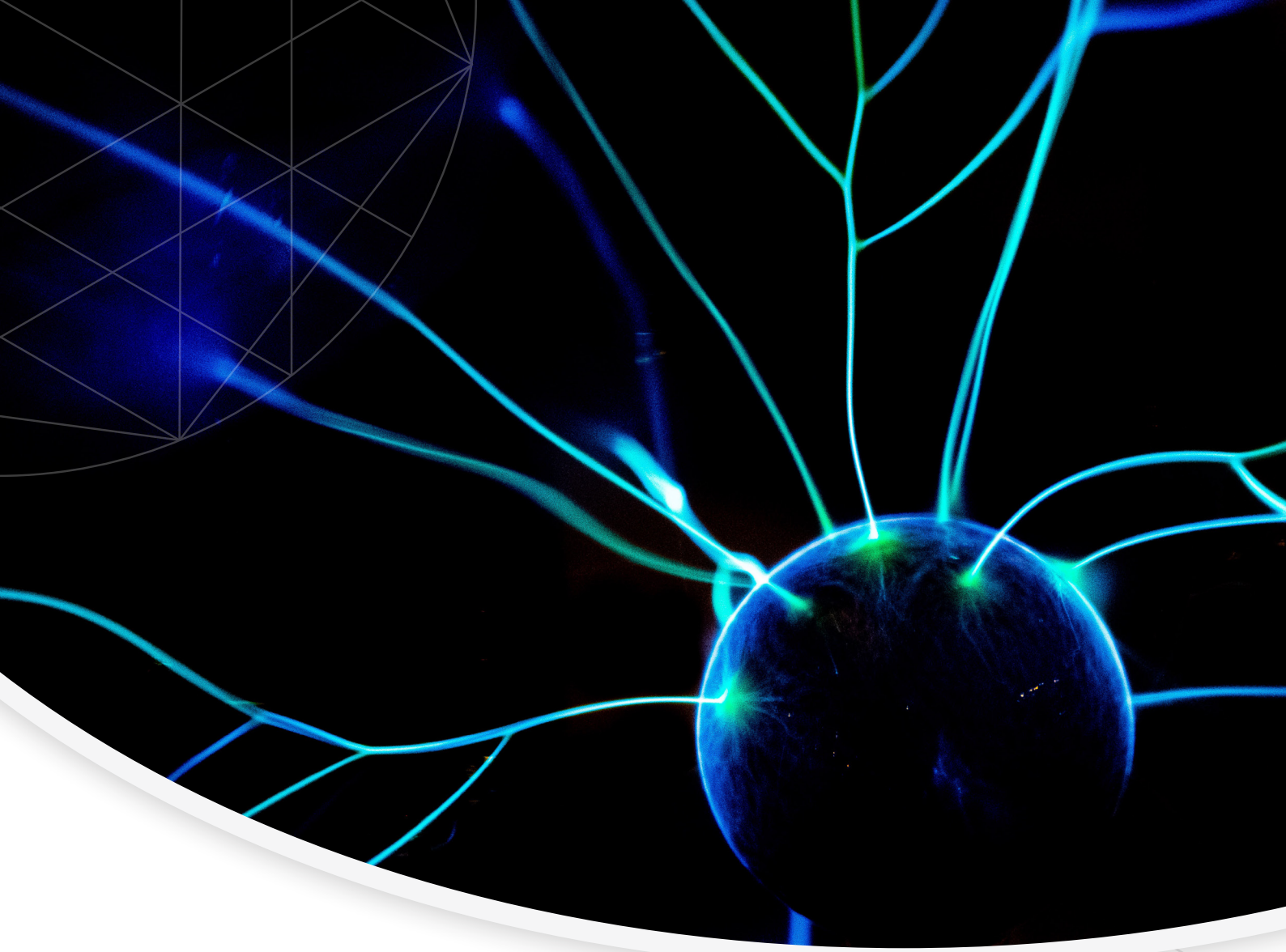
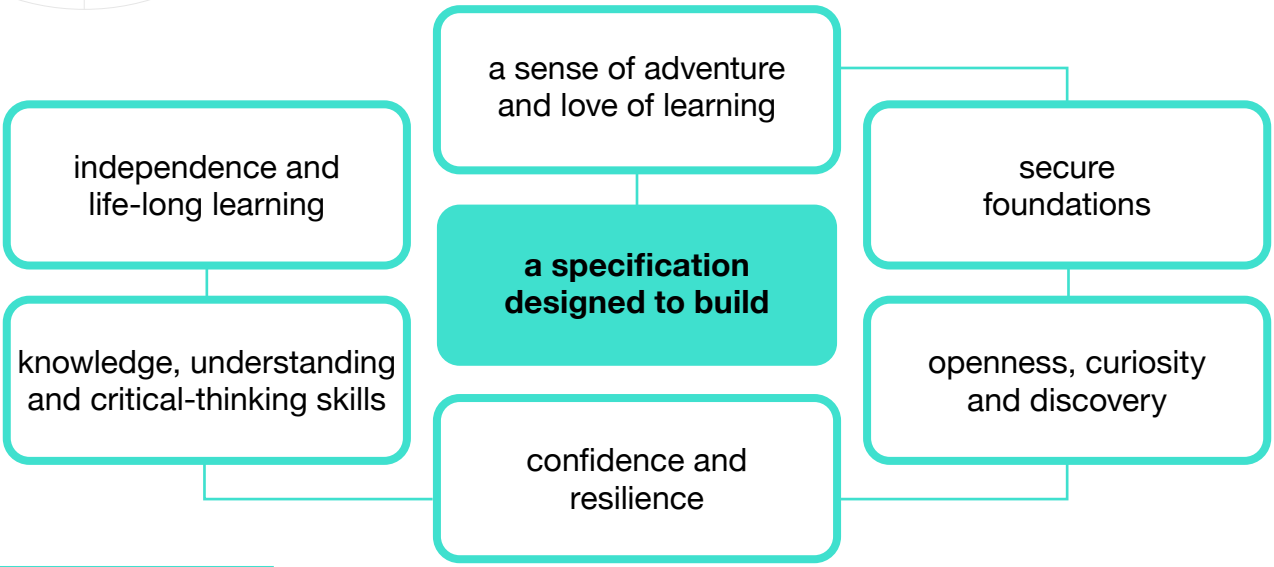


ISEB
Independent Schools Examinations Board

SCIENCE

CE AT 11+ & 13+
COMMON ACADEMIC SCHOLARSHIP AT 13+

Specification
For teaching from September 2021 onwards
For examinations from November 2022 onwards



ISEB CORE AIMS

Pupils who have pursued a course of study based on CE specifications and assessments will:

- be equipped not only for the next stage of their education, but for life-long learning based on a secure foundation of subject knowledge, concepts and skills and be able to apply what they know to new situations
- be enthusiastic learners who are open to new ideas and experiences, curious, questioning and keen to experiment.

They will:

- enjoy reading and be able to articulate clearly orally and in writing
- have the confidence to think, weigh up evidence and make up their own minds, and the resilience to learn from their mistakes
- have the skills to work independently and collaboratively
- understand how subjects connect with each other
- demonstrate cultural and environmental awareness and empathy, developing an understanding of their place in the world.

IMPORTANT INFORMATION | DISCLAIMER

Specifications are updated over time. Whilst every effort is made to check all documents, there may be contradictions between published resources and the specification, therefore please use the information on the latest specification at all times.

When we make changes to the specifications:

- we will indicate the change clearly in th specification
- there will be a new version number indicated
- a summary of changes will be published as a seperate document

If you do notice a discrepancy between the specification and a resource please contact us at: common-entrance@iseb.co.uk

INTRODUCTION

N.B. The content of this specification is a major revision of the syllabus released in 2015 for 13+. The content of this specification for 11+ is unchanged.

The revision continues the tradition of rigorous subject assessment based on a specification which emphasises knowledge and its application to the needs of modern society.

The specification presumes that pupils construct their understanding of science based on their prior learning and by observation and evaluation of their first-hand experiences of scientific phenomena. The specification intentionally builds on and develops pupils' prior learning.

In terms of assessment, this means that the specification content from earlier years will be assumed and can be examined. Teachers should approach the teaching of a new topic by establishing the prior learning and understanding of their pupils and build on these foundations.

The specification content at 11+ is unchanged from the 2015 revision. The revised 13+ specification is presented separately for biology, chemistry and physics, each in a four-column format. The first column specifies the topic title, and the second column defines the learning outcomes. The third column recommends suitable practical activities and the fourth column specifies curriculum links to learning at 11+.

The learning outcomes have three command words:
Know specifies knowledge to be learned and recalled.
Understand requires pupils to apply their knowledge to familiar and novel contexts, including processes and applications.
Recognise requires pupils to show an awareness of the significance of their knowledge and understanding to science and to society.

The recommended practical activities are selected to give pupils first-hand experiences of the scientific phenomena they are studying. They form the core of a practical science course, and it is anticipated that teachers will use these as a basis for developing their own practical science courses that allow the full range of 'Thinking and Working as a Scientist' skills to be developed (see below).

Practical science courses should include demonstrations, individual and group activities, investigations, opportunities for discovery learning and research through extended project work. The ISEB Project Qualification (iPQ) provides accreditation for extended project work.

Pupils learn to think and work as scientists during the full range of practical activities. This will be discussed further in the section below entitled 'Thinking and Working as a Scientist'.

The recommended practical activities will be examinable at 11+ and 13+.

AIMS

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

- stimulate curiosity, interest in and enjoyment of science
- help candidates to use the body of scientific knowledge they have already acquired and to extend their understanding of science, recognising connections between different areas of science
- enable candidates to use scientific ideas and models to explain phenomena and events and to understand applications of science
- develop an awareness of the impact of developments in technology on the environment and in other contexts
- develop experimental and investigative abilities, paying due regard to safe practice
- develop an ability to evaluate and communicate scientific evidence, and understand the importance of experimental evidence in supporting scientific ideas
- develop an awareness of science as a social and cultural activity, which has responsibilities, strengths and limitations
- 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.

Thinking and Working as a Scientist (TWAS)

Giving pupils opportunities to learn to think and work as a scientist is central to the CE Science specification, and is integral to the development of scientifically literate citizens in a technological world. Such opportunities may also inspire some pupils to study science further and pursue scientific professions.

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. Opportunities for all pupils to practise these skills regularly should be incorporated into departmental schemes of work.

The mathematical and statistical skills needed to analyse and interpret experimental data should be taught in conjunction with the Mathematics departmental schemes of work. Pupils should be made aware of the overlap between these two subjects.

Likewise, teaching the environmental aspects of the Science specification should be co-ordinated with the Geography specification.

Literacy, a common feature of all aspects of the Science specification, should be taught in conjunction with the English specification.

The recommended practical activities included in the specification should be regarded as the minimum practical experience that pupils should be given. It is anticipated that teachers will use these as a foundation for building a scheme of work for practical activities that allow the full range of ‘Thinking and Working as a Scientist’ skills to be developed.

Modelling scientific attitudes

Pupils should:

- be given opportunities to think about objectivity when measuring, with increasing awareness of the needs for accuracy, precision, repeatability and reproducibility; they should consider the validity of experimental results in terms of fair testing
- understand that ideas about science, its methods and theories, change as scientists modify earlier explanations to take account of new evidence and ideas
- think about possible risks before undertaking practical work and plan suitable safety precautions for any practical work they undertake
- begin to understand that there are questions that science cannot answer and be aware of the potential impact of scientific advances on society and on the welfare of the planet. Pupils should discuss the advantages and disadvantages of scientific and technological developments.

Developing experimental skills

Pupils should be given opportunities to:

- use a variety of practical techniques, using appropriate apparatus and materials during laboratory work and fieldwork; pupils should pay attention to health and safety at all times
- make and record observations and measurements using a range of methods for different investigations; they should evaluate the reliability of methods and suggest possible improvements or further investigations
- apply sampling techniques in ecological fieldwork
- use scientific theories, models and explanations to develop hypotheses.

Devising and Carrying out Investigations

Pupils should be given opportunities to:

- make predictions using scientific knowledge and understanding, to plan and carry out investigations, making observations and measurements to test hypotheses
- identify independent, dependent or control variables and consider other factors which need to be taken into account when collecting evidence
- select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate.

Pupils should be given opportunities to:

- undertake extended project work, asking questions and developing a line of enquiry based on observations of the real world, alongside scientific knowledge and experience.

Analysis, evaluation and problem-solving

Pupils should be given opportunities to:

- apply statistical techniques to calculate the results of experiments: means (11+); means, medians, modes and percentages (13+)
- use simple equations and carry out appropriate calculations; they should be able to rearrange the subject of equations (13+ Core and CASE)
- present observations and data, using appropriate methods, including tables and graphs
- present and interpret discontinuous (discrete) and continuous data using appropriate graphical methods, including bar charts, time graphs and scatter graphs
- 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 (13+ Core and CASE only)
- convert units (13+ Core and CASE only)
- 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.

Units of Measurement

Pupils should be given opportunities to understand and use:

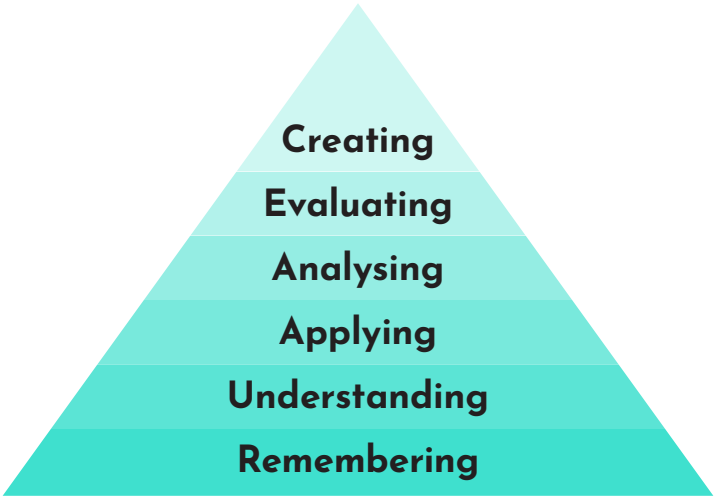
- SI units (*see Appendix I*)
- IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature.

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.

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 Thinking and Working as a Scientist section of the specification.

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:

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 specification.

Examination questions will be drawn from all parts of the specification. Candidates will also be expected to think and work as a scientist, analysing and evaluating scientific knowledge, and applying it to unfamiliar situations. Sometimes this will involve comparing different pieces of evidence to make predictions. These are 'higher order' thinking skills, associated with AO3.

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 detailed in the section entitled 'Thinking and Working as a Scientist' above.

At 13+, Foundation level 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 Foundation level questions.

ASSESSMENTS

Command words in the 11+ and 13+ assessment

The examination papers at 11+ and 13+ will use a system of command words which indicate the type of response required and the depth of the answers. The system used is compatible with that used by GCSE awarding bodies in England and Wales.

We recommend that candidates become familiar with the use of command words in the examination papers. These are useful metacognitive skills which will form a foundation for their future studies in science.

The depth of answers expected is given by the number of marks and the number of lines in a response, and candidates can be guided by this.

In addition, the following command words will be used:

Calculate	Use the numbers given in the question to work out the answer. *Calculate the mass of air in the laboratory, in kg.*
Compare	Describe the similarities and/or differences between things. *Compare how the mistletoe plant and the tree obtain their water.*
Complete	Add missing information to a table, diagram or graph. *Complete the table by calculating the mean time taken to slide down the slide.*
Describe	Recall some facts, patterns in results or a sequence of events accurately. *Describe the relationship between current and number of paperclips lifted.*
Discuss	Write about a topic in detail, taking into account different ideas, and sometimes different opinions. *Discuss the advantages and disadvantages to society of these projects.*
Draw	To produce, or add to, a diagram or graph. *Draw straight lines to match the parts labelled from V to Z with the word which best describes them.* *Draw a curve of best fit through the points.*
Estimate	Give an approximate value to a quantity. *Estimate the speed of sound.*
Explain	State the reasons for something happening, using scientific knowledge and understanding. *Explain how these results suggest that the pondweed is photosynthesising.*
Extend	Draw on a diagram or graph to complete it. *Extend the light ray to show…*
Give	Write a brief response. Only a short answer is required, not an explanation or a description. *Give the correct unit.*
Identify/Name	Write the recognised name of something. *Name the parts of the cell.* *Name the force which keeps a satellite in orbit round the Earth.*

Label	Add appropriate names to a diagram. *Label the nucleus on the diagram.*
Measure	Read a scale to get a quantity. *Measure the width of the cell along line X.*
Outline	An answer that gives only the most important points. Detailed responses are not needed. *Outline a difficulty the pupils may experience in obtaining an accurate result.*
Plot	Add points to a graph using data given. *Plot points on the grid below for the height of the dough left at 35 °C.*
Predict	Write a plausible outcome. *Predict the position of an ice cube when it is added to this mixture.*
Show	Provide structured evidence to reach a conclusion. *Show that the volume of the laboratory, in m3, is about 190 m3.* *Show clearly on your graph how you obtained your answer.*
State	Give a brief definition of facts. *State the equation which links density, mass and volume.* *State two features of mammals.*
Suggest	Apply knowledge and understanding to a new situation. *Suggest three reasons why Chlorella might be useful as part of a balanced diet.*
Use/using	The answer must be based on the information given in the question. In some questions, candidates will use their own knowledge and understanding. *Using the tables at the beginning of this question, describe all the colour changes…*
Write	Only a short answer is required, not an explanation or a description. *Write the word equation for aerobic respiration.* *Write a food chain using information in a food web.*

There are occasions when a rigid use of command words can lead to comprehension difficulties for candidates. In such circumstances more direct questions will be asked, which are indicated by the use of a question mark, ?.

The following direct questions will be used:

How … ?	In what way … *How could your teacher show that carbon dioxide has formed?*
What … ?	Asks for information about something *What is the name of the blue solid?*
Which … ?	Asks for information about something by selecting from a list *Which of these fuels is a renewable source?*
Why … ?	Asks for an explanation, using scientific knowledge and understanding *Why is the sky blue?*

Direct questioning will be used in those circumstances where it improves the flow of the question.

11+ SCIENCE

CE at 11+	Marks	
One combined science paper	80	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 skills in Thinking and Working as a Scientist. These questions will contain appropriate supporting information for candidates unfamiliar with the practical activity.

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:

CE 11+ Science		minimum % mark allocation
AO1	remembering and understanding	30
AO2	applying and analysing	30
AO3	evaluating and creating	5

13+ SCIENCE

Assessment of the 13+ specification can occur at two levels: Foundation and Core. The specification is common for both levels, but Foundation level candidates will be given more explanatory text and, where calculations are required, formulae and units will be given.

Preliminary knowledge from the 11+ specification will be assumed and can be examined.

We recommend that candidates who are expected to achieve less than an average of 35% on the three Core papers consider using the Foundation level paper.

CE at 11+		Marks	
Foundation	One combined science paper	80	60 minutes
Core	Biology	60	40 minutes
	Chemistry	60	40 minutes
	Physics	60	40 minutes

ADDITIONAL DETAILS

Foundation

There will be one paper with approximately equal numbers of questions based on the 13+ biology, chemistry and physics specifications. 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 allow candidates to demonstrate their skills in Thinking and Working as a Scientist. These questions will contain appropriate supporting information for candidates unfamiliar with the practical activity.

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:

	CE 13+ Science – Foundation	minimum % mark allocation
AO1	remembering and understanding	35
AO2	applying and analysing	35
AO3	evaluating and creating	5

Core

There will be three papers, one in each of biology, chemistry and physics. 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. The maximum number of marks per question will be 12. At least 25% of the paper will allow candidates to demonstrate their skills in Thinking and Working as a Scientist. These questions will contain appropriate supporting information for candidates unfamiliar with the practical activity.

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 specification will not be provided.

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

	CE 13+ Science – Core	minimum % mark allocation
AO1	remembering and understanding	35
AO2	applying and analysing	35
AO3	evaluating and creating	10

SCHOLARSHIP

Scholarship papers are based on the 13+ specification. The examination (90 minutes) will be divided into three sections: A (biology), B (chemistry) and C (physics).

	Common Academic Scholarship	Marks	
Section A	Biology	25	
Section B	Chemistry	25	90 minutes
Section C	Physics	25	

Candidates will be required to attempt all the questions. Each section is worth 25 marks, but the number of questions may 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:

	CE 13+ Science – Scholarship	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 specification will not be provided. Rearrangement of equations may be required.

Guidance or appropriate formulae will be given in questions that are not directly specified in the specification.

11+ SUBJECT CONTENT

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

	Pupils should be taught:	Candidates should know:
1. Living processes		
	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	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	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

11+ SCIENCE *(continued)*

YEAR 3 *(continued)*

		Pupils should be taught:	Candidates should know:
3. Humans and other animals			
Parts of the body	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	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	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			
	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

11+ SCIENCE *(continued)*

YEAR 3 *(continued)*

	Pupils should be taught:	Candidates should know:
5. Light		
Everyday effects of light	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	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

11+ SCIENCE *(continued)*

YEAR 3 *(continued)*

	Pupils should be taught:	Candidates should know:
6. Forces and magnets		
Types of force	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 nonmagnetic 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

11+ SCIENCE *(continued)*

YEAR 4

	Pupils should be taught:	Candidates should know:
1. Living things in their environment		
	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, farms 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
Feeding relationships	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

11+ SCIENCE *(continued)*

YEAR 4 *(continued)*

	Pupils should be taught:	Candidates should know:
2. Humans and other animals		
Nutrition	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		
	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

11+ SCIENCE *(continued)*

YEAR 4 *(continued)*

	Pupils should be taught:	Candidates should know:
4. Sound		
	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	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

11+ SCIENCE *(continued)*

YEAR 4 *(continued)*

	Pupils should be taught:	Candidates should know:
5. Electricity		
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

11+ SCIENCE *(continued)*

YEAR 5

	Pupils should be taught:	Candidates should know:
1. Living things and their habitats		
	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	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		
	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

11+ SCIENCE *(continued)*

YEAR 5 *(continued)*

	Pupils should be taught:	Candidates should know:
3. Properties and changes of materials		
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	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 *solution, 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	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

11+ SCIENCE *(continued)*

YEAR 5 *(continued)*

	Pupils should be taught:	Candidates should know:
3. Properties and changes of materials (continued)		
Chemical change	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

11+ SCIENCE *(continued)*

YEAR 5 *(continued)*

	Pupils should be taught:	Candidates should know:
4. Earth and space		
	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	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

11+ SCIENCE *(continued)*

YEAR 5 *(continued)*

	Pupils should be taught:	Candidates should know:
5. Forces		
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*

11+ SCIENCE *(continued)*

YEAR 6		Examinable at 11+
	Pupils should be taught:	**Candidates should know:**
1. Living things and their habitats		
	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

11+ SCIENCE *(continued)*

YEAR 6 ***(continued)*** Not examinable at 11+ but to be covered by the end of Year 6

	Pupils should be taught:	Candidates should know:
2. Humans and other animals		
Circulation	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	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	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

11+ SCIENCE (continued)

YEAR 6 (continued) Not examinable at 11+ but to be covered by the end of Year 6

	Pupils should be taught:	Candidates should know:
2. Humans and other animals (continued)		
	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	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	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		
	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

11+ SCIENCE *(continued)*

YEAR 6 *(continued)*		Examinable at 11+
	Pupils should be taught:	**Candidates should know:**
4. Properties of materials		
	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 °C; about the boiling point and freezing point of water and the temperature of a healthy human
Acids and alkalis	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

11+ SCIENCE *(continued)*

YEAR 6 (continued)	Not examinable at 11+ but to be covered by the end of Year 6	
	Pupils should be taught:	**Candidates should know:**
5. Light		
The behaviour of light	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	d. that non-luminous objects are seen because light scattered from them enters the eye	that light from a luminous source is reflected from nonluminous objects to our eyes *details of the structure of the eye will not be examined*

11+ SCIENCE *(continued)*

YEAR 6 *(continued)*		Examinable at 11+
	Pupils should be taught:	**Candidates should know:**
6. Electricity		
	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 II*); 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

13+ SUBJECT CONTENT

A brief outline of topics for the 13+ Core papers is provided on the following pages. Some candidates may be entered for the Foundation paper, which is one paper covering elements of Biology, Chemistry and Physics, outlined on the following pages.

A comparison of these topics with the National Curriculum KS3 programme of study is available on the Schools/ Subject Information page on the ISEB website.

BIOLOGY

Topic	Learning outcomes	Recommended practical activities	Links to prior learning at 11+
The organisation of living organisms	**Know** that living organisms are made of cells, the fundamental unit of living organisms **Understand** that living organisms are arranged as a hierarchy: cells > tissues > organs > systems **Recognise** that each of these arrangements show the seven life processes: movement, respiration, sensitivity, growth, reproduction, excretion and nutrition	observe, interpret and record how animal and plant cells are arranged into tissues and organs	
Comparing plant and animal cells	**Recognise** that a typical animal or plant cell has: a nucleus, cytoplasm, mitochondria and cell surface membrane **Recognise** that plant cells contain cell walls, and often vacuoles and chloroplasts **Know** the functions of each cell component above	use a microscope to observe plant and animal cells prepare a temporary stained microscope slide to observe animal and plant cells calculate the magnification of a light microscope	Y3: 3b, 3c Y6: 2h
Food nutrients	**Know** the roles of carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water in maintaining healthy bodies	carry out tests for food nutrients, in foods (e.g. starch, sugar, fat, protein)	Y6: 2h
A healthy diet	**Understand** how to interpret nutritional information on food labels **Recognise** foods that are a good source of each of the above **Recognise** the consequences of imbalances in diet for healthy living	analyse food labels to investigate nutritional quality write a food diary to investigate dietary preferences	Y6: 2h
Breathing in humans	**Know** how the movements of the diaphragm and ribcage lead to breathing in humans **Understand** how changes in pressure lead to breathing in and out in humans **Recognise** that medical conditions such as emphysema and asthma reduce the movement of oxygen into the lungs	demonstrate, using the bell jar and parallelogram models, the role of the diaphragm and ribs in breathing measure vital capacity in humans, using peak flow meters	Y5: 2a, 2b Y6: 2c

BIOLOGY (continued)

Topic	Learning outcomes	Recommended practical activities	Links to prior learning at 11+
Reproduction in humans	**Know** the names and functions of the organs in the male and female reproductive systems **Understand** haow these parts work together to lead to fertilisation. The development of a fetus, including the role of the placenta and the birth of a baby **Recognise** the importance of the menstrual cycle **Recognise** that the lifestyle of parents can affect the healthy development of a fetus (e.g. smoking, diet, alcohol dependency)	observe, using photographs, the development of a fertilised egg into a fetus	Y5: 1b Y5: 2a, 2b
Photosynthesis	**Know** the word equation for photosynthesis **Understand** the importance of carbon dioxide, water and light in the production of new biomass **Recognise** the importance of photosynthetic organisms as producers in food chains **Recognise** the importance of photosynthesis in maintaining the concentrations of oxygen and carbon dioxide in the atmosphere	investigate photosynthesis in variegated plant leaves using a starch test investigate the effect of light intensity on the rate of photosynthesis in an aquatic plant	Y3: 2a-2d
Respiration	**Know** the word equation for aerobic respiration and the word equations for anaerobic respiration in humans and in yeast **Understand** the importance of respiration, releasing energy from food, which is used by the organism for essential processes **Recognise** the importance of fermentation in yeast to human society	investigate the exhalation of carbon dioxide during gas exchange in humans, using limewater and hydrogen carbonate indicator investigate fermentation in yeast	
Reproduction in flowering plants	**Know** the similarities and differences between insect and wind pollinated flowers **Understand** the role of pollen grains in transporting male gametes to the female egg cell **Recognise** that different seed dispersal mechanisms result in new plants growing away from the parent plants	observe, interpret and record the similarities and differences between a wind and an insect pollinated flower	Y5: 1b

BIOLOGY *(continued)*

Topic	Learning outcomes	Recommended practical activities	Links to prior learning at 11+
Recreational drugs and human health	**Know** that many substances, including alcohol, can affect the brain and nervous system and that these can affect behaviour and health. The potential for addiction to certain medical and recreational drugs **Understand** the importance of cleanliness at personal and community levels as a defence against disease **Recognise** the risks of common medical and recreational drugs	make a presentation of the risks of common medical and recreational drugs	
The interdependence of organisms in an ecosystem	**Know** how food webs give information about producers and consumers within an ecosystem **Understand** the impact of human activities on food webs and the need for conservation and sustainable development **Recognise** the interdependence of organisms in food webs	investigate producers and consumers in a local habitat, using quadrats, pitfall traps and other sampling techniques	Y4: 1f, 1g
Classification of living organisms	**Know** how living organisms are classified into five kingdoms (bacteria, fungi, protists, plants and animals) **Recognise** the similarities and differences between the structures and life processes of organisms in the different kingdoms	observe the structures of various organisms, relating structure to function, for example: bird feather and flight, conifer cones and seed dispersal, dry scaly skin of snake, gills of fish	Y6: 1b, 1c
Variation in living organisms	**Recognise** the diagnostic features of arthropods (including the differences between insects and spiders) and the vertebrate groups (fish, amphibians, reptiles, birds and mammals) **Know** the distinction between continuous and discontinuous variables, how the data can be recorded and presented graphically	observe and interpret photographs, specimens and video to compare diagnostic features of key groups of organisms measure and compare biometric data of living organisms, e.g. of members of class (height, eye colour and hand span)	

CHEMISTRY

Topic	Learning outcomes	Recommended practical activities	Links to prior learning at 11+
States of matter – the particle model	**Know** the properties of solids, liquids and gases and understand in terms of movement and arrangement of particles **Understand** that pressure of a gas is caused by collisions with walls of container **Recognise** diffusion – examples and explanation in terms of the random movement of particles **Understand** that changes of state, including sublimation, are due to changes in motion and arrangement of particles	melting solids, e.g. sulfur, ice boiling liquids, e.g. water subliming solids, e.g. iodine diffusion of gases, e.g. ammonia diffusion of solids in solutions, e.g. KMnO4	Y4: 3a, 3c Y5: 3h
Atoms and elements	**Understand** the simple Dalton atomic model **Understand** the idea of an element containing one type of atom **Know** some symbols for elements: H C N O S Mg Na Cl Ca Cu Fe He **Know** there are about 100 elements in the Periodic Table. **Recognise** that a symbol stands for one atom of the element **Know** about types of element – metals and non-metals- their physical characteristics and differences in conductivity	testing elements for conductivity, e.g. Fe, Al, S, graphite hardness, appearance and other physical characteristics of a variety of elements	Y4: 5b Y6: 4a
Compounds and molecules	**Understand** how a small number of elements can lead to millions of different compounds **Understand** the idea of a molecule and simple formulae. **Know** the formulae H2O, CO2, O2, CH4, NaCl, HCl, NaOH, CaCO3, CuSO4, H2SO4 **Recognise** that compounds have different properties to the elements from which they are made	making iron sulfide from its elements comparing the properties of Fe, S and FeS	

CHEMISTRY *(continued)*

Topic	Learning outcomes	Recommended practical activities	Links to prior learning at 11+
Pure substances	**Know** that pure substances can be identified by their melting and boiling points. Evaporation can happen at any temperature **Understand** that pure substances comprise particles of the same type **Know** and understand the anomalous properties of water	measuring melting point of a solid (e.g. stearic acid) and an impure substance (e.g. candle wax) ice floating on water freezing plastic bottle full of water	Y4: 5b Y6: 4b
Mixtures including solutions	**Know** that the properties of a mixture are the same as its components **Understand** the idea of a saturated solution **Know** that air is a mixture of gases – proportions. Uses of oxygen – oxygen and carbon dioxide in respiration and photosynthesis	mixture of Fe/S same properties as elements experiment to determine proportion of oxygen in air – candle, rusting etc.	Y5: 3c*
Separating mixtures	**Know** about distillation – e.g. purifying sea water **Understand** that substances with different boiling points are separated by distillation	distillation of ink/sea water effect of evaporating tap water, pure water and sea water	Y5: 3d-3g
Separating mixtures	**Know** the technique of chromatography **Understand** the factors which affect the separation of spots and how it can be used for identification **Know** about using different solvents	chromatography of felt-tip pens /M&Ms etc. using water / propanone	
Combustion – chemical reactions	**Know** how to use a Bunsen burner Combustion of elements e.g. Mg, S, C **Recognise** the need for oxygen **Understand** the idea of a reaction as a rearrangement of particles – conservation of mass. **Know** the tests for oxygen and carbon dioxide **Know** the test for water using anhydrous copper sulfate Understand and devise word equations	burning elements in air and oxygen mass changes in burning Mg	Y5: 3k
Fuels and production of carbon dioxide	**Know** that burning of compounds – hydrocarbons, coal are used as energy sources **Understand** how the products of combustion are formed **Recognise** the impact on climate of burning fossil fuels – climate change **Know** that sulfur dioxide and carbon monoxide are polluting gases and understand how they are formed **Recognise** the causes of acid rain	testing products of burning natural gas/candle	Y5: 3j

* examinable from autumn 2024 onwards

CHEMISTRY (continued)

Topic	Learning outcomes	Recommended practical activities	Links to prior learning at 11+
Oxidation of metals	**Know** the reaction of metals with oxygen, water and acids **Know** the test for hydrogen **Know** about rusting of iron and understand how it can be prevented	reacting Mg with air, cold water, steam and acid necessity for both air and water for rusting of iron	
Thermal decomposition reactions	**Know** that heating copper carbonate, calcium carbonate and hydrated copper (II) sulfate brings about decomposition **Recognise** the products formed **Know** that some substances (e.g. copper oxide) do not change chemically when heated	heating copper carbonate heating hydrated copper sulfate	
Acids and Alkalis	**Know** the pH scale, indicators and use of pH meter **Recognise** neutralisation reactions **Know** the acid/base properties of metal oxides and non-metal oxides	testing acids and alkalis with litmus and Universal Indicator measuring pH with Universal Indicator and pH meter adding alkali to acide and measuring pH	Y6: 4c
Neutralisation reactions	**Know** reactions of acids with metals, alkalis, metal oxides and carbonates. **Recognise** the formation of salts **Recognise** the effect of acidity on the environment **Know** about the use of limestone as a building material and as agricultural lime. Weathering effect of acid rain on limestone	reaction of an acid (e.g. HCl) with alkali, metal, metal oxide and carbonate	

PHYSICS

Topic	Learning outcomes	Recommended practical activities	Links to prior learning at 11+
Energy resources	**Know** that the Sun is the ultimate source of energy **Know** about the range of fossil fuels **Understand** the difference between renewable and non-renewable energy resources and their advantages and disadvantages **Understand** that a non-renewable resource is one that cannot be replenished within a lifetime **Recognise** that a variety of processes are used to generate electricity	observe solar cells in operation to light a LED or power a motor or buzzer investigate the uses of fossil fuels and the possible alternatives research the use of renewable energy resources to generate electricity or provide heating	
Energy transfers Conservation of Energy	**Know** that energy resources can be measured and stored in a number of different ways: as a chemical store as a gravitational potential energy store as a kinetic energy store as an internal (heat / thermal) store as an elastic energy store as a nuclear energy store **Understand** that energy is conserved **Understand** that when energy is converted from one store to another it is sometimes via a pathway or process such as electricity, light or sound **Recognise** that although energy is always conserved, it may be dissipated, reducing its availability as a resource	observe and carry out different energy conversions, for example: > heating substances > using solar energy to light a LED > dropping a ball and describing the energy changes research where and how energy is wasted in power stations and cars	
Speed and movement	**Know** that speed is measured using a variety of units but that it is always the distance covered in a given time, often m/s **Know** the quantitative relationship between speed, distance and time **Understand** how to measure and calculate the speed of a moving object **Recognise** that speeds for vehicles approaching or passing each other in a straight line would add or subtract as seen from one vehicle	measure and calculate the speeds of different vehicles, for example: > a trolley or model car in the lab > a falling ball > runners on a track > cars passing the school gates	

PHYSICS (continued)

Topic	Learning outcomes	Recommended practical activities	Links to prior learning at 11+
Measuring force	**Know** the unit used to measure force is the newton (N) **Know** that weight is a force caused by gravity and that weight = mass x gravitational field strength (g) **Understand** that forces arise from the interaction between two objects **Understand** that forces can cause stretching or compression **Recognise** that friction and air resistance are examples of an unbalanced force	measure the stretching or compression of a spring when weights are added	Y5: 5a Y5: 5c
Effects of forces	**Know** that un unbalanced force will cause a change of speed or direction of an object and a balanced force will cause no change **Understand** how to represent balanced and unbalanced forces by the use of force arrows in one dimension **Recognise** that friction and air resistance have a number of advantages and disadvantages	investigate the effect of an unbalanced force on a trolley or model car investigate a model parachute with different canopy areas research the thinking, braking and stopping distances given in the highway code	Y5: 5e
Pressure	**Know** the quantitative relationship between force, area and pressure **Know** that the unit of pressure is N/cm^2 or N/m^2 **Understand** how to use the relationship for simple quantitative work **Recognise** applications of pressure, e.g. skis, snowboards, sharp objects	measure and calculate the pressure exerted by different shaped objects investigate the effects of pressure, for example: > shoes on snow or sand > heels on floors research the way in which tyre pressure affects the area of contact between road and tyre	
Density	**Know** the relationship between density, mass and volume and how to use this for simple quantitative work **Know** that the unit of density is kg/m^3 or g/cm^3 **Understand** how to measure the density of regularly-shaped solids and of irregularly-shaped solids (using the displacement of water to find a volume), and of liquids **Recognise** that air has mass and that it is possible to measure its density	measure the density of different objects, some regular and some irregular investigate the effect of density for immiscible liquids of different densities, for example oil and water research the effect of temperature on the density of water	

PHYSICS (continued)

Topic	Learning outcomes	Recommended practical activities	Links to prior learning at 11+
Sound	**Know** that sound is produced by vibrations of objects **Understand** that sound has a different and finite speed in different mediums **Understand** the relationship between the loudness of a sound and the amplitude of vibration causing it **Understand** the relationship between the pitch of a sound and the frequency of the vibration causing it **Recognise** that humans and animals can hear different ranges of sounds	measure the speed of sound by an echo method or by direct measurement investigate the range of sounds that humans of different ages can hear research the range of sounds that different animals can hear research the effects of loud sounds on hearing	Y4: 4a-d Y4: 5e-f
Light	**Know** that light can travel through a vacuum, but sound cannot **Know** that light travels much faster than sound **Understand** how and why light is refracted at the boundary between two different materials **Understand** that light passing through materials can be absorbed or scattered **Recognise** that different frequencies of light are refracted differently and that this causes dispersion	use a ray model to show how light is reflected in a mirror construct and use a periscope construct and use a pinhole camera investigate the dispersion of white light through prism research the way in which dispersion causes us to see a rainbow	Y6: 5a, 5b, 5d
Circuits	**Know** the function and symbols for switches (push button, SPST, reed switches), resistors, variable resistors, motors, buzzers, LDRs, LEDs, fuses **Understand** the difference between a parallel and series circuit **Recognise** that the current in a series circuit depends on the number of cells and the number and nature of other components	construct series and parallel circuits from circuit diagrams	Y6: 6a, 6c
Currents	**Know** how to measure current and its unit, the ampere **Understand** current as flow of charge that is not 'used up' by components **Recognise** differences in resistance between conducting and insulating components (qualitative only)	measure the current in different parts of circuits using an ammeter investigate the resistance of different materials using a series circuit and ammeter research circuits for alarms, light gauges, etc.	Y6: 6b

PHYSICS (continued)

Topic	Learning outcomes	Recommended practical activities	Links to prior learning at 11+
Magnetic fields and electro-magnets	**Know** about magnetic fields as regions of space where magnetic materials experience forces **Know** that a current in a coil produces a magnetic field **Understand** how to represent a magnetic field using field lines with arrows **Understand** that the Earth has a magnetic field **Recognise** that repulsion by a known magnet is the only true test for another magnet **Recognise** that electromagnets have a wide range of uses	investigate the field of a bar magnet and an electromagnet using a plotting compass or iron filings investigate what affects the strength of an electromagnet research the uses of electromagnets	Y3: 6b
Space	**Know** how the movement of the Earth causes the apparent daily and annual movement of the Sun and other stars **Know** about the seasons and the Earth's tilt and how this affects the day length at different times of year, in different hemispheres **Understand** that the Earth is one of several planets which orbit the Sun **Understand** that the positions of the Moon and Earth relative to the Sun can cause solar or lunar eclipses **Recognise** that artificial satellites and probes are used to observe the Earth and to explore the solar system	research on-line telescope resources to observe the Moon planets in the solar system research on-line telescope resources to observe solar or lunar eclipses research the use of artificial satellites for observations, global positioning and communications	Y5: 4e

APPENDIX I

SI UNITS

Scientists use the following units:

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

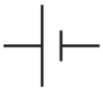
Candidates need to know:

- 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^2 or cm^2

APPENDIX II

ELECTRICAL SYMBOLS WHICH MAY BE USED IN CE PAPERS

11+

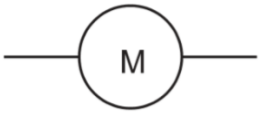


cell

terminals

buzzer

lamp / bulb

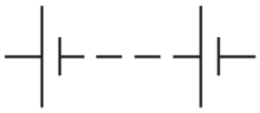


motor

switch (open)

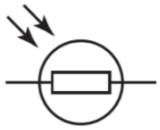
switch (closed)

Additional symbols required for 13+



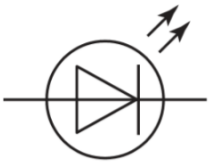
battery

fuse



light dependent resisitor

semiconductor diode

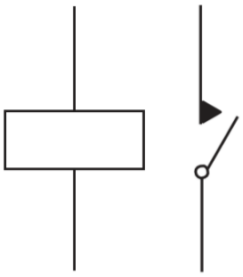


light emitting diode

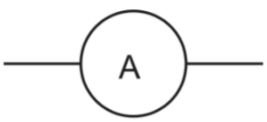
resistor

variable resistor

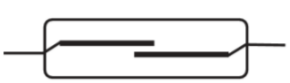
push-button switch



relay (usually open)



ammeter



reed switch

junction of conductors

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