

13+ Entrance Examination Syllabus Science

Introduction

This syllabus:

- recognises the need for scientific literacy and engagement with science.
- Takes account of the need to provide a conceptual foundation for further science studies.

Topics

The examination will last 45 minutes. Candidates will answer 30 multiple choice questions: 10 Biology, 10 Chemistry, 10 Physics and 3 short answer questions on each subject each worth 5 marks.

Biology Topics

- **Safety** in the Laboratory
- **Characteristics of Living Things**
- **Animal Cells** – appearance, organelles: nucleus (inc chromosomes), mitochondria, vacuoles, food granules and droplets
- **Plant Cells** – as above and chloroplasts, cell wall, middle lamella, starch grains
- **Microscopy** – parts of a microscope and their function / how to set up and use a microscope. How to estimate sizes with a microscope. Simple staining of cells. Units for measuring small specimens – mm, micrometer, nanometre, picometre
- **Tissues and Organs** – plant and animal types
- **Human Organ Systems** – main organs and their essential functions of all systems, to include gross anatomical details, such as kidney regions & ducts, naming major blood vessels

- **Dichotomous Keys** – how to use and how to write them – as branching keys, and as number keys
- **Classification of Organisms** – five kingdoms and their features. – details of Phyla of plants and animals and Classes of Arthropods and Vertebrates – The binomial naming system
- **Elements of Cell Division** – for growth and gamete production
- **Asexual Reproduction in Plants** – vegetative propagation – tubers, bulbs and runners – artificial propagation – cuttings
- **Sexual Reproduction in Plants** – Flower structure – function of parts / pollination / fertilisation / seed and fruit formation / dispersal
- **Sexual Reproduction and Life Cycles in Animals** – amphibians and insects
- **Experimental Design** / Hypotheses, predictions, recording results, plotting line, bar, column, scatter graphs – designing own experiments around concept of a fair test.
- **Invertebrate behaviour** – choice chambers and woodlice or maggots
- **Growth** – of plants, insects, humans – growth curves / growth hormones
- **Skeleton** – bones, muscles, joints and locomotion

Topics to be covered by end of Year 8, but not examined in the entrance paper

Please note that some elements of the systems below will be covered by the Organ Systems section in previous list.

- **Circulation** – blood components & functions, vessel structure and heart function & cycle
- **Nervous System** – reflexes / the senses / skin / temperature control
- **Excretion** and kidney

- **Sexual Reproduction in Humans** / basic inheritance
- **Carbon & Nitrogen Cycles** / Man's effects on cycles – basic pollution
- **Food chains** / webs / energy flow / Field

Chemistry Topics

- **Safety** and recognition and correct use of apparatus.
- **Materials** - Sources of raw materials: plants and animals, coal and crude oil, rocks and minerals, the sea and the air. Manmade and naturally occurring substances.
- **Solids, Liquids and Gases** - Characterisation of materials using melting point, boiling point, electrical conductivity and density. How the particle theory of matter can be used to explain the properties of solids, liquids and gases and their changes of state.
- **Elements** - That elements are shown and organised in the Periodic Table. How elements vary widely in their physical properties, including appearance, state, melting point, boiling point, electrical conductivity, density and malleability, and to use these properties to classify elements as metals or non-metals. The terms conductor and insulator in electrical terms only. Uses of elements such as iron, aluminium, copper, oxygen, helium.
- **Mixtures** - That mixtures are composed of constituents that are not combined. How to separate mixtures including filtration, simple distillation, evaporation, chromatography, decantation and centrifuging. Separation of rock salt, sea water, inks, food dyes. The terms: filtrate and residue; solution, solute and solvent, soluble and insoluble; dissolving. Melting point and boiling point as a test of purity.
- **Acids and Bases** - How to use indicators to classify solutions as acidic, neutral or alkaline and to use the pH scale as a measure of acidity and alkalinity of strong and weak acids and alkalis. Indicators such as litmus, Universal indicator, wide range indicator, making simple indicators from e.g. red cabbage and beetroot. pH and temperature change during neutralization. Everyday uses of neutralisation: bee and wasp stings, acid indigestion, acid soil.

- **Heating substances** - How to use the Bunsen burner and the appearance and relative temperatures of the different flames. Physical changes and simple chemical changes on heating, thermal decomposition. Simple word equations including state symbols. The terms melting, freezing, boiling, evaporating, condensing and subliming including the difference between boiling and subliming. Conservation of mass during physical and chemical changes. Test for water using anhydrous cobalt chloride and anhydrous copper sulphate.

Topics to be covered by the end of Year 8, but not examined

- **Elements, compounds and mixtures** - How elements combine through chemical reactions to form compounds. Iron/sulphur mixture and the iron/sulphur compound.
- **Oxygen** - Laboratory preparation of oxygen
Test for oxygen
Burning elements in oxygen to give oxides
Tests for water, carbon dioxide and hydrogen
Oxygen and respiration
Burning fossil fuels and carbon, carbon monoxide and sulphur dioxide pollution and acid rain
- **Earth Science**
The structure of the Earth
Plate tectonics
Extraction of metals from ores

Physics Topics

- **Awareness of safety.**
- **To understand quantities and units:**
- Concept of **measuring** a quantity with its S.I. unit such as measuring distance and area.

- **To understand mass, volume and density:-** (a) Definition of mass as a measure of the amount of matter (b) To be familiar with techniques to measure regular and irregular solids. (c) To be able to determine the density of solids using $D=M/V$ in g/cm^3 only. Then be able to identify materials from a knowledge of densities.
- To understand flotation comparing the density of materials to that of water.
- **To be aware of some different energy forms:-**
 - (a) Light
 - (b) P.E.
 - (c) K.E.
 - (d) Electrical

Pupils should be able to understand energy flow charts and be able to compare and contrast renewable and non-renewable sources of energy. Ideas of work/energy equivalence is required as is the equation $\text{Work} = \text{Force} \times \text{Distance}$.
- To appreciate temperature is a measure of the degree of hotness of a body and understand the need for a scale of temperature i.e. Celsius scale.
- To describe the flow of heat in every day situations and relate the flow of heat to a change in temperature.
- **To know that forces are pushes and pulls.** Also that there are different types of forces e.g. magnetic, electrostatic, elastic and frictional. Forces are to be known to be measured with a Newton meter. To understand elastic and plastic behaviour of metals including the elastic limit. The idea of pressure as spreading the force should be met and that forces can produce motion where average speed distance/time .
- **Review the meaning of mass and define weight as a measure of gravitational force.** Equilibrium and centre of gravity should be studied coupled with how moments can be used to explain stability.
- **To understand the fact that the Earth is part of the Solar System.** To understand why we have night and day and seasons. To familiarise pupils with phases of the Moon and understand how eclipses occur,

- **To appreciate light travels in straight lines and that reflections occur in plane mirrors.**

Topics to be covered by the end of Year 8 but not examined

- An understanding that optics can be described in terms of wave properties.
- Introduce the idea that there are two types of wave propagation: transverse and longitudinal.
- Appreciate that light behaviour can be understood by studying ripples on the surface of water.
- Relate the idea that a ray of light is the direction taken by a wavefront.
- Contrast sound as a wave process which is longitudinal and can be reflected similarly to light but travels at different speeds.
- To introduce the idea of expansion of solids and liquids and the positive and negative outcomes.
- To introduce the idea of conduction as a process of thermal transmission.
- To introduce the contrasting properties of convection and radiation

Skills

Candidates should be able to:

- Represent data in graphical form;
- Interpret, analyse and evaluate data;
- Use scientific knowledge to explain patterns and trends seen in data;
- Apply scientific principles to unknown situations