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# The Cayman Islands

# National Curriculum
# 2008

## Science
## Programme of study and attainment targets for
## Key Stage 3

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The overview document sets out the guiding philosophy and principles of the new Cayman Islands curriculum. It guides all the subject documents and approaches to teaching and learning in the revised curriculum.

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## Aims

Learning in and about science contributes to the achievement of the curriculum aims for all young people (the 'Educated Caymanian') to become:

- Enthusiastic and motivated about learning, and willing to continue to extend his/her knowledge and skills after leaving school
- Well rounded, good at finding solutions to problems, flexible and adaptable to changing circumstances and demands
- Literate, numerate and adept at using information and communication technology
- Aware of global issues affecting life in the 21st century
- Confident individuals who are able to live safe, healthy and fulfilling lives

## Overview

Science exists because it serves an innate human desire to make sense of the world. Science is a collection of theories and knowledge about the physical and natural world and a system of inquiry involving a variety of investigative skills.

Learning about and through science should help children to make sense of and interact with their increasingly technological world. Science affects our environment, our standard of living, and our quality of life. Students need to start considering the ethical and social issues to which the advances of science give rise. Learning in this subject will develop attitudes, skills and knowledge that will help students solve problems and be more prepared for life, further study and future careers in this rapidly changing world. Tomorrow's citizens will need special knowledge and skills if they are to evaluate and deal with this change. The subject will also encourage students to seek scientific explanations of natural phenomena, build their confidence and ability to effect changes and improvements in their environment and most importantly develop their critical thinking ability.

# How teachers should use the programme of study and attainment targets

The programme of study identifies the experiences and opportunities that students must be given to enable them to achieve the knowledge, skills and understanding specified in the attainment targets.

## The strands

The programme for science is divided into four strands:

i. Investigating
ii. Living things
iii. Materials
iv. Physical processes

This division into strands is a convenient way of emphasising the outcomes for science education in schools. It does not mean that learning in each strand has to be developed independently. In Key Stage 3, students should be given regular planned opportunities to develop the knowledge and ideas of the subject through a practical, hands-on, process-approach. They should acquire an understanding of the nature of the scientific method. Consequently, when planning and implementing a science programme, the first strand of investigating, should be interwoven within the other three strands.

Progression in this subject requires students to develop skills in investigating alongside their knowledge and understanding. They should start with activities linked to themselves and their immediate environment and move on to less familiar situations and contexts.

Each strand has been divided into a number of sub-headings. It should not be felt, however, that this sub-division should dictate the way teachers should plan their teaching schemes.

During the key stage, students should be offered the following opportunities to enhance their learning, understanding and enjoyment of the subject, through:

- Researching, experimenting, discussing and developing arguments
- Independent inquiry or research into scientific aspects of personal interest
- Relating their learning to everyday, real life examples
- Studying science in local, national and global contexts and appreciate the connections between these
- Experiencing science outside the school environment including the workplace, where possible
- Using creativity and innovation in science, and appreciate their importance in enterprise
- Recognising the importance of sustainability in scientific and technological developments and their design
- Exploring contemporary and historical scientific, design and technological developments and how they have been communicated
- Making links between science and other subjects and areas of the curriculum

**Progression** in this subject requires students to develop their skills in investigating, living things, materials and physical processes. They should start with activities linked to themselves and their immediate environment and move on to less familiar situations and contexts.

**The attainment targets** specify the knowledge, understanding and skills that students should acquire through the key stage. More detail is given about how to interpret them in appendix 1 Levels 3 through 8 have been included here, although most students will be working between levels 4 and 6 in Key Stage 3. Exceptionally gifted students will need to be given work from the Key Stage 4 programme of study so they can access work of an examination standard.

# Science programme of study for Key Stage 3

## Introduction

Building on experiences gained in Key Stage 2, students should continue to be given opportunities to develop their skills, understanding and knowledge of science. They should build on the working vocabulary that has been developed in Key Stage 2 and be encouraged to communicate with other students and their teachers through group and class discussions.

Students should be given opportunities to increase their awareness of the importance of science in everyday life. This understanding may arise from everyday experiences in school, at home and in the local environment. Students should develop an awareness and an understanding of the need to conserve the natural environment. They should appreciate the need for the sensitive collection and care of living things that are used as the subject of any study of the environment. Activities and experiences in science may sometimes link into themes and topics incorporating other areas of the curriculum, and may be integrated with them, where appropriate.

It is important in science that students are given opportunities to:

- Solve problems
- Carry out investigations
- Make observations
- Ask and answer questions
- Present their ideas
- Plan independently
- Record observations
- Work methodically
- Interpret evidence
- Construct using a wide variety of materials
- Plan and adapt as they work
- Evaluate and revise their work
- Make suggestions for improvement
- Develop oral, written and graphic communication skills

## i Investigating

Activities in this strand should be introduced through the other three strands of the programme of study.

Students should be encouraged to adopt safe practices when undertaking science activities. They should be made aware of potential hazards and the appropriate actions necessary to avoid risks.

This work should build upon students' everyday experiences and introduce wider contexts, for example, through field work.

Students should be encouraged to use previously encountered concepts and skills in order to solve practical problems.

Experimental and investigative work should form a major element of science activity at this key stage, however, there will be aspects of science knowledge and understanding that will not lend themselves to a practical approach.

While there should be opportunities throughout the key stage for students to undertake complete investigations, it will be appropriate in some cases to focus on particular aspects of the investigative process.

An important aspect of this is the development of skills that allow students to handle, with confidence and familiarity, standard laboratory equipment for experimental purposes. Students should be encouraged to adopt safe practices when undertaking scientific experiments. They should be made aware of potential hazards and the appropriate actions necessary to avoid risks.

**Planning**

**Students should be given opportunities to:**

- Use their scientific knowledge and understanding to turn ideas into a form that can be investigated
- Make predictions where appropriate to do so
- Design a fair test
- Consider the factors, qualitative and/or quantitative, which need to be taken into account in investigations
- Draw up procedures for the investigation, taking into account the observations or measurements that need to be made
- Select appropriate apparatus, instruments and techniques for the investigation, taking into account criteria, for example, the range and accuracy of the measurements and observations required, and the need for safe working procedures

**Carrying out**

**Students should be given opportunities to:**

- Use apparatus and materials in a safe and competent manner
- Use apparatus and instruments to make observations and measurements to an appropriate degree of accuracy
- Understand the need to repeat observations and measurements
- Record observations and measurements systematically using methods appropriate to the information collected and to the purpose of the investigation, *for example, a computer database*

**Presenting and interpreting results**

**Students should be given opportunities to:**

- Present results in ways appropriate to the data collected and the purpose of the investigation, including, where appropriate, the use of graphs
- Interpret and evaluate results using, where appropriate, simple calculations
- Identify any trends, patterns and conclusions emerging from the results
- Draw valid conclusions and decide whether these conclusions agree with the original idea/ prediction
- Explain the conclusions in the light of their scientific knowledge and understanding
- Consider their observations and measurements, including anomalies, and suggest, where appropriate, improvements that could be made if they repeated the investigation
- Produce a written report of their investigation, using appropriate scientific vocabulary

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## ii Living things

### Variation

**Students should be given opportunities to:**

***The cell***

- Learn that plants and animals are composed of cells
- Use a microscope and slide to study the structure and function of a typical plant and animal cell, including nucleus, cytoplasm, cell membrane, nuclear membrane, cell wall, chloroplast, permanent vacuole and chromosomes

***Specialisation***

- Understand that cells become specialised to carry out different functions, including the root hair in plants, sperm cell and ciliated epithelium in animals

***Levels of organisation***

- Understand that cells are the building units of tissues, organs, organ systems and organisms

***Genetics***

- Learn that genetic information is carried in the form of genes found on chromosomes in the nucleus of cells, genes as short lengths of DNA, for example, eye colour and tongue rolling
- Find out that variation can be measured in living organisms, including height as an example of continuous variation and tongue rolling as an example of discontinuous variation

### Environment

**Students should be given opportunities to:**

***Habitat***

- Find out, by the study of a local habitat, that physical factors affect the distribution and type of living organisms found in a local habitat, including:
    - Changes in seasonal temperature
    - Availability of light
    - Availability of water

***Conservation***

- Find out that humans may contribute to improving the environment for themselves and the plants and animals that live there, including:
    - Air - catalytic convertors
    - Land – reafforestation, recycling
    - Water - sewage disposal (detail of plant treatment is not required)

***Classification***

- Assign organisms to their major groups using keys and observable features, including:
- Flowering plants - root, stem and leaves, flowers and seed production
- Annelids - segmentation
- Arthropods (insects only) - exoskeleton, 3 pairs of jointed legs, two pairs of wings
- Vertebrates - animals with backbones
- Bony fish - gills, fins, scales
- Amphibians - lungs in adult, moist skin, eggs laid in water, tadpole
- Reptiles - scales, shelled eggs laid on land, parental care
    - Birds - feathers, shelled eggs, parental care
    - Mammals - mammary glands, hair, ear pinna, parental care

***Life cycles***

- Learn about the stages in the life cycle of some living things, including a plant, butterfly and frog

***Adaptation***

- Learn that living organisms are adapted to survive in the environment, *for example, adaptation to life on land,* including:
    - Waterproof covering
    - Ability to breathe air
    - Development of a skeleton
    - Internal fertilization
    - Shelled eggs
- Understand the components of food chains and food webs, including:
    - sun as a primary source of energy
    - Producers
    - Consumers
    - Decomposers
    - Nature of energy flow

***Pollution***

- Find out that human activity can damage the environment, both locally and in the wider world, and affect the plants and animals living there, including:
    - Air - effects of pollution by soot and sulphur dioxide on plants
    - Land - deforestation, household refuse, biodegradable and non-biodegradable materials
    - Water - sewage, oil, effluent from water cooling processes

## Organ systems

***Plants***

- Learn the basic functions of the organs in a flowering plant, including:
  - The root - to absorb water and mineral salts and provide anchorage
  - The stem - to support and transport water and food in veins
  - The leaf - large surface area to absorb light energy for photosynthesis
  - The flower - to reproduce

***Animals***

- Learn the basic functions of the major organ systems of the human body, including:
  - Digestive system - where large molecules are broken down to simple soluble molecules that are absorbed into and transported by the blood
  - Respiratory system - for gas exchange, oxygen for carbon dioxide in the lungs
  - Skeletal system - support, movement and protection
  - Circulatory system - transport of materials, protection, and maintaining body temperature
  - Excretory systems - removal of toxic waste products at the kidneys

## Nutrition

**Students should be given opportunities to:**

***Plants***

- Find out that photosynthesis is a key process that is essential to plant life, including:
  - Oxygen and starch are produced by photosynthesis
  - The word equation for photosynthesis
  - Plants require specific minerals for healthy growth (limited to calcium, magnesium and nitrogen)

***Digestive system***

- Be introduced to the structure and functions of the component parts of the digestive system in humans, including identification of the parts of the human alimentary canal, in relation to ingestion, digestion, absorption, assimilation and egestion (no detail of enzymes required)

***Diet***

- Find out that food is an energy source, and compare the energy content of different foods, including:
  - The functions of food - energy, growth and protection
  - The roles of carbohydrates, fats, proteins, fibre, vitamins (C and D only) and minerals (calcium and iron only) in the diet
  - The comparisons of energy content of carbohydrates, fats and proteins in different foods
  - Variation in energy required, depending on age, gender, activity
- Learn about the diet required to maintain healthy bodies, including:
  - A balanced diet
  - The relationship between diet and heart disease
  - The difference between malnutrition and starvation
  - Dental care

## Respiration

**Students should be given opportunities to:**

***Plants***

- Understand that plants respire, including the exchange of oxygen and carbon dioxide by the leaf

***Animals***

- Understand the structure and function of the component parts of the respiratory system, including:
  - Identification and function of the major organs of the respiratory system - nasal cavity, trachea, bronchus, bronchioles, lungs, alveolus, diaphragm and ribs,
  - Mechanism of breathing
  - Investigate the composition of inhaled and exhaled air

***Cell respiration***

- Understand how the cells use oxygen to provide energy for other life processes to take place (limited to the word equation for respiration)

***Smoking and health***

- Find out how cigarette smoke affects health, including:
  - Tar as a trigger for lung cancer
  - Nicotine contributing to heart disease
  - Carbon monoxide
  - Passive smoking

**Transport**

**Students should be given opportunities to:**

***Plants***

- Find out about the movement of substances in plants, including transpiration and translocation

***Animals***

- Be introduced to the structure and functions of the component parts of the circulatory system in humans, including:
  - Structure of the blood, red blood cells (transport of oxygen), white blood cells (defence), plasma (transport of food, waste in solution), platelets (blood clotting)
  - The heart, limited to names of the four chambers and the direction of blood flow and double circulation
  - Blood vessels - arteries, veins and capillaries

***Heart disease***

- Find out the relationship between diet, fitness and circulatory disorders, including:
- Obesity and increased blood pressure
  - Investigate the effects of exercise on heart rate
  - Heart attack as reduced coronary circulation

## Reproduction

**Students should be given opportunities to:**

***Plants***

- Learn about the structure and functions of the component parts of the flower (limited to a named dicotyledonous plant), including:
  - Name the parts - sepals, petals, nectaries, stamens, (anthers and filaments), carpels (stigma, style and ovary) and receptacle
  - Self and cross-pollination
  - Insects and wind as agents of pollination
  - Fruit and seed dispersal - wind, animals, water and explosive mechanisms
  - Seed structure - radicle, plumule, cotyledon, testa, endosperm,
  - Seed germination (limited to a hypogeal seed)
  - Investigate the conditions which affect germination - temperature, adequate water, oxygen supply

***Animals***

- Be introduced to the structure and functions of the component parts of the reproductive systems in humans, including:
  - Naming the parts of the male system - testes, scrotum, sperm ducts, prostate gland, urethra and penis
  - Naming the parts of the female system - ovaries, oviducts, uterus, cervix, vagina and vulva
  - Fertilization in the oviduct
  - Role of the placenta
  - Birth (limited to contraction of the uterus and dilation of the cervix)
  - Find out about the requirements to maintain healthy bodies and healthy babies during pregnancy, including diet, Rubella, smoking, alcohol, and drugs

***Puberty***

- Learn about the physical and emotional changes that take place during adolescence, including:
  - Girls - growth spurt, development of body hair, growth of breast and menstruation (no detail of hormonal control needed)
  - Boys - growth spurt, body hair, facial hair, voice deepening and growth of testes and penis
- Learn about the need for a responsible attitude to sexual behaviour, including interpersonal relationships, contraception and sexually transmitted diseases

***Childhood***

- To learn about the needs of young children in the early stages of their development, including:
  - Breast feeding, balanced diet, immunisation programme, parental care and a loving environment

## iii Materials

### Properties and uses

**Students should be given opportunities to:**

- Understand the physical properties of gases and relate these to everyday uses, *for example, gases are often stored under pressure because they can be compressed*
- Prepare and identify common gases, including carbon dioxide, hydrogen, nitrogen and oxygen
- Investigate everyday materials, both natural and man-made, in terms of their physical properties, such as lustre, strength, hardness, elasticity, solubility in water, melting and boiling point, electrical and thermal conductivity, and density
- Relate the uses of everyday materials to their physical properties, *for example, use of aluminium in aircraft manufacture because of its strength and density, diamond in cutting tools because of its hardness, and copper for making electrical cable because it conducts electricity*

### Classification

**Students should be given opportunities to:**

- Understand classifications used in chemistry, including:
  - Substances as solids, liquids and gases
  - Solutions as acidic, alkaline or neutral, and the use of the pH scale in the classification of solutions
  - Elements, compounds and mixtures, and to compare the physical and chemical properties of mixtures and compounds
- Be introduced to the Periodic Table and use it in investigations about physical and chemical properties of elements in terms of their position in the periodic table, including:
  - Physical state, appearance, trends in melting points and boiling points
  - Chemical properties of metals and non-metals
- Investigate techniques for separating and purifying mixtures, including:
  - The preparation of pure salt from rock salt
  - The separation of dyes in inks
  - Recovery of solvent from solutions using simple distillation

### Environment

**Students should be given opportunities to:**

- Understand that some waste products can be recycled, including glass, paper and aluminium cans, and why this process is desirable
- Find out about the positive and negative effects of the exploitation of raw materials, *for example, the effect of quarrying on the local environment*
- Find out about the methods used to monitor water purity, including the measurement of pH and the presence of soluble and insoluble materials
- Learn about the effects of corrosive gas pollutants, f*or example, sulphur dioxide on building materials*

### Chemical reactions

***Chemical change***

**Students should be given opportunities to:**

- Investigate that when permanent changes occur new substances are formed and that these new substances have distinctive properties, *for example, compare the properties of magnesium with those of magnesium oxide*
- Investigate how rusting can be controlled
- Learn that useful products can be manufactured from various raw materials, *for example, the production of lime from limestone, glass from sand or plastics from oil*
- Investigate different types of chemical reaction, including:
  - Oxidation, f*or example, burning magnesium and rusting*
  - Reduction, *for example, removal of oxygen from copper oxide*
  - Thermal decomposition, *for example, effect of heat on calcium carbonate or copper carbonate*
  - Neutralisation, f*or example, reaction of dilute hydrochloric acid and sodium hydroxide*
- Investigate the relative reactivity of metals based on their reactions with water, oxygen, dilute acids and the results of displacement reactions
- Understand the applications of chemical reactions in everyday contexts, including the extraction of iron in the Blast Furnace (details of the process are not required), the liming of soil in agriculture, indigestion (acid neutralisation)

**Students should be given opportunities to:**

- Find out that some chemical reactions are exothermic while others are endothermic, *for example, that an increase in temperature occurs when water is added to calcium oxide*
- Be introduced to word equations and to represent chemical reactions using word equations

## Kinetic theory

***Particles***

**Students should be given opportunities to:**

- Learn that all matter is made up of small particles

***States of matter***

**Students should be given opportunities to:**

- Learn that heat changes ice to water and water to water vapour, and to relate these changes to the water cycle
- Understand the differences between solids, liquids and gases in terms of the proximity and motion of particles, including that:
    - Ice cubes have a fixed shape as the particles are held together strongly
    - Water can change shape because the particles are held less strongly and are able to move around
    - Steam can spread around the room because the particles are separate and move rapidly
- Understand changes of state, diffusion and dissolving in terms of simple kinetic theory, including that heat is required to increase the movement and separation of particles and that heat must be supplied to vaporise liquids and melt solids

***Electronic structure***

**Students should be given opportunities to:**

- Learn about the structure of atoms in terms of electrons, protons and neutrons, and to understand the structure of the first twenty elements of the Periodic Table

## Geological changes

**Students should be given opportunities to:**

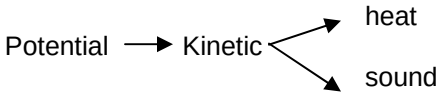
- Learn how forces generated by expansion, contraction and the freezing of water can lead to the physical weathering of rocks
- Learn about the formation of rocks by processes that take place over different timescales, and that the mode of formation determines their texture and the minerals they contain
- Learn about the formation of igneous, sedimentary and metamorphic rocks

## iv Physical processes

## Transfer and conservation

**Students should be given opportunities to:**

- Learn about energy transfer in a range of domestic contexts and in familiar devices, such as coiled springs, elastic bands and batteries
- Understand the distinction between temperature and thermal energy and know their metric units
- Investigate the process of heat transfer, including the difference between good thermal conductors and thermal insulators, convection in a liquid, the effect of the nature of surface on the emission, reflection and absorption of radiation
- Understand that energy is conserved
- Learn about some energy conversions in terms of the principle of conservation of energy, *for example, when a weight falls and hits the ground*




- Understand that energy may be dissipated and become less useful
- Learn that there is a variety of energy sources, including, oil, gas, coal, nuclear, biomass, wind, wave and solar
- Learn that energy sources, for example, wind or fossil fuels, are ultimately dependent on the sun's energy
- Learn the difference between renewable energy sources, such as wind, wave, tidal, solar and biomass, and non-renewable sources, such as fossil fuels and nuclear fuel (uranium)
- Learn that global resources are limited and need to be shared, and understand why energy should be used efficiently

**Forces**

**Students should be given opportunities to:**

***Linear***

- Learn that forces can:
  - change the shape of things
  - start objects moving
  - cause them to stop
  - change the direction of motion
- Learn that the movement of an object depends on the size and direction of the forces exerted on it
- Understand that change in movement or direction results from unbalanced forces and that balanced forces produce no change
- Calculate average speed from measurements of distance and time
- Investigate the effect of friction on moving objects, *for example, the effect of air resistance on a descending parachute and the effect of friction between a tyre and the road*

***Turning***

- Learn that forces can cause objects to turn
- Understand that the turning effect of a force depends on its size and where it is applied, *for example, use of force to loosen a wheel nut on a car wheel*
- Learn the principle of moments and describe some practical applications, for example, the use of levers

***Pressure***

- Understand how the effect of a force over different areas results in different pressures and describe some practical applications, for example, the use of snow shoes and the effect of stiletto heels

**Electricity and magnetism**

**Students should be given opportunities to:**

***Circuits***

- Identify the role of conductors, insulators and switches in simple circuits
- Learn about the effects of varying current in a series circuit including changes in bulb brightness and temperature
- Measure current in series and parallel circuits and hence discover that current is not 'used up' in circuits

***Static charge***

- Learn that insulating materials can be charged by friction
- Learn that like-charged objects repel each other and unlike-charged objects attract each other

***Charge flow***

- Understand that current is a flow of charge

***Magnetism***

- Find out about the properties of magnets, including attraction and repulsion
- Find out about the magnetic field pattern produced by a bar magnet
- Investigate the properties of electromagnets and describe some practical applications, *for example, lifting of scrap metal and relay switches*

**Sound and light**

**Students should be given opportunities to:**

***Sound***

- Know that sounds are produced by vibrations
- Know that sound can travel through different materials at different speeds, but cannot travel through a vacuum
- Know that the loudness of a sound is related to the amplitude of the vibration causing the sound
- Know that the pitch of a sound is related to the frequency of the vibration causing the sound
- Find out that different people have different audible ranges
- Know about the effects of loud sounds on the ear, including loss of hearing due to damage to the eardrum
- Understand the need to control noise levels in the environment

***Light***

- Know that light comes from a variety of sources
- Find out about the formation of shadows
- Know that light travels in straight lines at a finite speed
- Find out how light is reflected from plane surfaces, including the relationship between the angle of incidence and the angle of reflection
- Find out how light is refracted at the boundary between two materials
- Investigate the dispersion of white light to a range of colours

**Earth in space**

**Students should be given opportunities to:**

- Learn that changes in day length, seasons and changes in the elevation of the sun can be explained in terms of the tilt of the earth's axis
- Use a simple model to learn about the changing phases of the Moon
- Learn about the position of the sun and planets within the solar system and how they move relative to each other including the use of terms, for example, elliptical orbits, rotation and satellites
- Learn that the solar system forms part of a galaxy that is part of a larger system called the Universe

## Appendix 1 Attainment targets

The learning outcomes or attainment targets are expressed at eight levels of increasing difficulty. These levels are the same for all key stages and are not age or year-group-dependent, which will make it easier to see how a student progresses as he/she moves up the year groups and from primary to secondary school.

Students learn at different rates and, therefore, individual students or groups of students of the same age could be working towards different levels within and across the key stage boundaries. By the end of a key stage, **most** students should be performing at the **'expected'** level, but some will be above this level and others will be below.

The range of levels covered by the key stage and the 'expected' levels for the end of each key stage are given in the table below:

| Key Stage | Year Groups | Range of levels covered by the programme of study | Expected level at end of the Key Stage |
|---|---|---|---|
| 1 | 1 - 3 | 1-3 | 2 |
| 2 | 4 - 6 | 2-5 | 4 |
| 3 | 7 - 9 | 3-7 | 5 or 6 |

Teachers will be expected to make judgements about the levels attained by each of their students, particularly at the end of a key stage. In deciding on a student's level of attainment, teachers should judge which description in the attainment targets best fits the student's performance. When doing so, each description should be considered alongside those for adjacent levels. It is not necessary for a student to have satisfied the entire range of a particular level to be awarded it.

It can be helpful to divide levels into three sub-levels to support tracking of progress and target setting.

For example:

- 3a – Represents a performance that demonstrates a good understanding of all the descriptors in level 3
- 3b – Represents understanding of the majority of level 3 descriptors
- 3c– Represents understanding at level 2a (ie the full understanding of the previous level) plus an understanding of some of the descriptors at level 3

## Appendix 2 Attainment targets for Key Stage 3 science

### Strand i Investigating

| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| •Students generate ideas to describe simple features of objects, living things and events they observe.<br><br>•They communicate their plans and findings in simple ways, such as by talking about their work and what they will do and use, often using drawings or simple charts.<br><br>•They use tools and equipment with help, where needed.<br><br>•They describe how something works and can talk about their own and other people's work in simple terms. | •Students respond to suggestions of how to find things out, and, with help, make their own suggestions.<br><br>•They use equipment provided to investigate.<br><br>•They compare objects, living things and events they observe.<br><br>•They make and describe observations related to their task and record them using simple tables where it is appropriate to do so.<br><br>•They say whether what happened was what they expected, recognise what they have done well as their work progresses, and suggest things they could do better in the future. | •Students suggest how ideas can be investigated and make predictions about what might happen.<br><br>•They use appropriate instruments to make measurements.<br><br>•They know when a test is fair and recognise why it is fair.<br><br>•They provide simple reasoned explanations for observations and measurements and record these in a variety of ways, *such as writing, or using drawings or bar charts.*<br><br>•They describe in sequence what they did and begin to identify patterns which emerge from their observations.<br><br>•They select and construct using a range of materials, components and construction kits.<br><br>•They explain their choice of materials and components, describe the success of what they have made and suggest improvements. | •Students carry out a fair test indicating factors which need to be kept constant.<br><br>•They make predictions about what they think will happen.<br><br>•They select and use appropriate apparatus and equipment to make a series of observations and measurements.<br><br>•They record and present their findings choosing appropriate methods *such as diagrams, simple tables, graphs or a written record.*<br><br>•They use results to draw conclusions related to their knowledge and understanding.<br><br>•They use their knowledge of the properties of materials to plan and construct and use with competence, appropriate tools and techniques to cut, shape and join materials.<br><br>•They evaluate what they have made, bearing in mind their original intentions. |

| Level 5 | Level 6 | Level 7 | Level 8 |
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| •Students design fair tests to answer questions that arise from their work in science.<br><br>•They identify factors that will need to be considered and, using their knowledge, make predictions about what they think will happen.<br><br>•They use a range of apparatus with appropriate precision and safety.<br><br>•They decide on appropriate methods for making observations and measurements, taking account of the required degree of accuracy.<br><br>•They begin to recognise the need for repeating observations and measurements and handle the data gathered in a systematic way.<br><br>•They select methods of recording appropriate to their observations or measurements including line graphs.<br><br>•They interpret data in a variety of forms and from a variety of sources.<br><br>•They make written statements about patterns or conclusions derived from their own results and begin to explain these in terms of their own scientific knowledge and understanding. | •Students apply the scientific knowledge they have gained from comparable situations to prepare plans in which they identify key factors that need to be considered.<br><br>•They make predictions for their own investigations.<br><br>•They use data from other sources, such as database packages.<br><br>•They describe procedures, using scientific vocabulary, and make measurements and observations appropriate to the task.<br><br>•They demonstrate a competence in practical skills, such as in the selection of appropriate apparatus and the precision with which they make their observations and measurements.<br><br>•They use sensors to monitor or respond to changes occurring during their investigations.<br><br>•They decide on the most appropriate ways to record and present their results and draw valid conclusions from these results.<br><br>•They explain these conclusions in terms of the evidence obtained and their knowledge and understanding of science. | •With guidance, students prepare systematic plans for investigations in which they identify key factors that need to be considered.<br><br>•They make use of their scientific knowledge and understanding to make predictions.<br><br>•They make decisions about the type, range and precision of observations and measurements to be taken.<br><br>•They identify when they need to repeat measurements and observations in order to obtain reliable data.<br><br>•They present qualitative observations clearly and concisely.<br><br>•They present quantitative data in graphs and use, where appropriate, lines of best fit.<br><br>•They draw valid conclusions and explain these using scientific knowledge and understanding including relevant data from other sources.<br><br>•They begin to consider further their scientific procedures and suggest ways of improving their investigations. | •Students apply their knowledge and understanding in a range of contexts including unfamiliar situations.<br><br>•They recognise that investigations of different kinds can require different approaches.<br><br>•They select a strategy or strategies appropriate to the specific investigation.<br><br>•Unaided, they prepare systematic and precise plans for their investigations including a strategy for dealing with results.<br><br>•They offer more detailed predictions based on reasoned scientific models.<br><br>•They decide on the observations and measurements that need to be taken and the degree of accuracy that is required.<br><br>•They set up and use scientific apparatus with precision and skill.<br><br>•They repeat observations and measurements, where appropriate, and identify and explain anomalies in their results, allowing for these when they represent their results graphically.<br><br>•They evaluate the designs of their investigations and produce systematic and structured reports. |

**Strand ii Living things**

| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| •Students recognise and name simple internal and external parts of the body, *such as heart, lungs, brain, head, arm, and of plants, using words such as leaf or flower.*<br><br>•They observe and describe a range of animals and plants in terms of features *such as colour of coat, or size of leaf.*<br><br>•They recognise and identify a range of common animals, *using terms such as fly, goldfish, or parrot.* | •Students use their knowledge about living things to describe basic conditions, *such as a supply of food, water, air, light or shelter, that animals or plants need in order to survive.*<br><br>•They recognise that living things grow and reproduce.<br><br>•They sort living things into groups, using simple features<br><br>•They describe the basis for their groupings in terms such as number of legs or shape of leaf.<br><br>•They recognise that different living things are found in different places, *such as ponds or woods.* | •Students use their knowledge of basic life processes, such as growth or reproduction, when they describe differences between living and non-living things.<br><br>•They provide simple explanations for changes in living things, *such as diet affecting the health of humans or other animals, lack of light or water altering plant growth, or seasons.*<br><br>•They identify ways in which an animal is suited to its environment, *such as a fish having fins to help it swim.*<br><br>•They identify ways in which humans interact with their environment.<br><br>•They describe the conditions necessary to keep healthy. | •Students, through first hand experiences and using a range of resources, identify and classify locally occurring species of animals and plants using observable features.<br><br>•They relate them to the location in which they were found and describe the conditions necessary for their growth.<br><br>•They sequence the main stages of a life cycle *such as that of a butterfly or a flowering plant.*<br><br>•They name the major organs of the human body, *such as brain, heart or lungs,* and identify the position of these organs in the human body.<br><br>•They recognise that living things are made up of cells.<br><br>•They identify organs, such as petal, stamen or stigma, of different plants they observe.<br><br>•They describe feeding relationships between plants and animals in a habitat, using food chains and terms *such as predator and prey.*<br><br>•They are able to describe ways in which humans can affect or change the environment |

| Level 5 | Level 6 | Level 7 | Level 8 |
|---|---|---|---|
| •Students assign organisms to their major groups and understand the main stages in a life cycle.<br><br>•They explain, in simple terms, the process of photosynthesis in green plants.<br><br>•They know the functions of food, the roles of nutrients in the diet and the reasons for maintaining a healthy diet.<br><br>•They describe, in simple terms, the parts and basic functions of the major organ systems in humans.<br><br>•They describe the ways by which human activity, *such as de-forestation,* can change the environment and affect the plants and animals living there, and suggest suitable conservation strategies.<br><br>•They describe the reproductive parts in both plants and humans.<br><br>•They explain the requirements to maintain a healthy body and identify the health issues which are associated with diet, drugs and the need for responsible attitudes to sexual behaviour. | •Students explain the differences between plant and animal cells.<br><br>•They describe ways that living organisms show variation.<br><br>•They explain how cells become specialised in multicellular organisms, leading to varying levels of organisation in plants and animals.<br><br>•They explain why food chains and food webs exist in the environment.<br><br>•They explain that the distribution and abundance of organisms in habitats are affected by environmental factors, such as the availability of light or water.<br><br>•They explain the circulatory digestive and respiratory systems in humans, using appropriate scientific terminology.<br><br>•They explain pollination and fertilization in plants, leading to germination and dispersal.<br><br>•They discuss the requirements to maintain a healthy body and a healthy baby during pregnancy, and the needs of young children in the early stages of their development. | •Students show an increasing knowledge of cell structure that incorporates an understanding that genetic information is carried in the form of chromosomes and genes.<br><br>•They explain how cells are adapted to their function.<br><br>•They explain the processes of cell respiration and photosynthesis in terms of the main underlying chemical changes.<br><br>•They explain the need for additional elements in plants for healthy growth.<br><br>•They compare the energy content of different foods and explain how energy requirements vary according to age, gender and activity.<br><br>•They explain the processes of human fertilization, the role of the placenta and the process of birth.<br><br>•They discuss the physical and emotional changes which occur during adolescence and of contraception and sexually transmitted diseases. | • Students demonstrate an extensive knowledge and understanding of life processes and living things drawn from the Key Stage 3 programme of study, in explaining how biological systems function.<br><br>•They use their knowledge of the cellular structure of organs to explain the associated life processes, *such as the absorption of food in the digestive system or gas exchange in the lungs.*<br><br>•They recognise, predict and explain changes in biological systems, *such as the effect of increased carbon dioxide concentration on the growth of greenhouse crops, or the consequences of smoking for organ systems.*<br><br>•They explain how characteristics can be inherited by individuals and apply their knowledge to contexts such as selective breeding.<br><br>•They predict the short-term and long-term effects of environmental change on ecosystems and use their understanding of such systems to justify their predictions. |

**Strand iii Materials**

| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| •Students know about a range of properties, such as texture or appearance, and they describe materials they observe in terms of these properties. | •Students identify a range of common materials and know about some of their properties.<br><br>•They describe similarities and differences between materials<br>•They sort materials into groups and describe in everyday terms, *such as shininess, hardness, or smoothness, the basis for their groupings.*<br><br>•They describe ways in which some materials are changed by heating or cooling, or by processes *such as bending or stretching.* | •Students use their knowledge and understanding of materials when they describe a variety of ways of sorting them into groups according to their properties.<br><br>•They describe how some materials are particularly suitable for specific purposes, *such as a metal for making electrical cables, or aluminium cans for recycling.*<br><br>•They recognise that some changes, such as the freezing of water, can be reversed, and some, *such as the baking of clay, cannot, and they classify changes in this way.* | •Students demonstrate knowledge and understanding of aspects of materials and their properties drawn from the Key Stage 2 or Key Stage 3 programme of study.<br><br>•They describe differences between the properties of different materials and explain how these differences are used to classify substances as solids, liquids and gases.<br><br>•They can distinguish between elements and compounds.<br><br>•They describe some methods, such as filtration, that are used to separate simple mixtures.<br><br>•They use scientific terms, such as evaporation or condensation, to describe changes of state.<br><br>•They use knowledge about some reversible and irreversible changes to make simple predictions about whether other changes are reversible or not. |

| Level 5 | Level 6 | Level 7 | Level 8 |
|---|---|---|---|
| •Students understand the physical properties of gases and relate these to everyday uses.<br><br>•They know how to prepare and identify common gases.<br><br>•They use the pH scale when classifying solutions as acidic, alkaline or neutral.<br><br>•They understand that when new materials are formed, the change is permanent.<br><br>•They explain rusting in terms of oxidation and know how rusting can be controlled.<br><br>•They understand that there are limited amounts of raw materials in the environment<br><br>•They discuss the positive and negative effects of obtaining and using the raw materials from the earth.<br><br>•They relate changes in state to the water cycle. | •Students use their knowledge and understanding of the nature and behaviour of materials to explain chemical and physical changes and how new materials can be made.<br><br>•They use their knowledge and understanding of particles to explain the differences in the three states of matter.<br><br>•They extend their knowledge of classification to explain the differences between elements, compounds and mixtures<br><br>•They describe some methods of separation to obtain pure substances from mixtures.<br><br>•They recover a solvent from solution using simple distillation.<br><br>•They know about the methods of monitoring water purity.<br><br>•They explain what happens in a range of chemical reactions and relate these to everyday contexts giving word equations where appropriate.<br><br>•They use the reactivity series to make predictions about reactions of metals. | •Students use their knowledge and understanding to relate the properties and uses of everyday materials.<br><br>•They apply their knowledge of particles to explain changes of state, diffusion and dissolving.<br><br>•They recognise the Periodic Table as a means of arranging elements and describe the physical and chemical properties of elements in terms of their position.<br><br>•They explain the differences between mixtures and compounds in terms of their physical and chemical properties.<br><br>•They explain the effects of corrosive gas pollutants.<br><br>•They discuss the positive and negative effects of the exploitation of raw materials. | •Students describe and explain the physical and chemical properties of metals and non-metals and their compound.<br><br>•They extend their understanding of the Periodic Table to explain the atomic structure of the first twenty elements.<br><br>•They recognise and classify a range of chemical reactions, *such as reduction or thermal decomposition*.<br><br>•They apply their knowledge of patterns in a chemical reaction to explain how substances, such as salts, could be made.<br><br>•They explain the applications of chemical reactions in everyday contexts, *such as the extraction of iron in the blast furnace.*<br><br>•They explain the differences between chemical reactions which are exothermic and those which are endothermic. |

**Strand iv Physical processes**

| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| •Students describe the changes in light, sound, or movement, that result from actions such as switching on a simple electrical circuit, or pushing or pulling objects.<br><br>•They recognise that sound and light come from a variety of sources and name some of these sources. | •Students describe and compare the way in which devices, such as bulbs, work in different series circuits.<br><br>•They compare the effects of similar phenomena, *such as the brightness or colour of lights, or the loudness or pitch of sounds.*<br><br>•They compare the movement of different objects in terms of speed or direction. | •Students know that there are different sources of energy, *such as oil, gas or coal.*<br><br>•They outline the dangers of the misuse of mains electricity and know how to use electrical appliances safely.<br><br>•They describe how sounds are produced by vibrations. They know that light does not pass through all materials. | •Students describe how forces can affect the movement and shape of objects.<br><br>•They identify a range of energy sources, *such as a battery for a flashlight.*<br><br>•They describe how to construct simple series circuits using terms *such as switches, bulbs or batteries* and identify materials as to whether they are insulators or conductors.<br><br>•They know how shadows are formed.<br><br>•They describe the relative movement of the sun and planets within the solar system. |

| Level 5 | Level 6 | Level 7 | Level 8 |
|---|---|---|---|
| •Students identify a variety of energy sources and explain the difference between renewable and non-renewable sources.<br><br>•They explain the effect of friction on moving objects.<br><br>•They know the properties of magnets and the magnetic field pattern produced by a bar magnet.<br><br>•They describe how light is reflected from plane surfaces in simple terms, the relationship between the angle of incidence and the angle of reflection.<br><br>•They explain the relationship between loudness and amplitude, and pitch and frequency of a sound.<br><br>•They describe the affect of changing current in an electric circuit and explain what happens in series and parallel circuits.<br><br>•They use models to explain the changing phases of the Moon and to describe how day, night and year length are caused by the movement of the earth. | •Students understand the relationship between applied force, the area over which it acts and the resulting pressure.<br><br>•They calculate average speed from measurements made of distance and time.<br><br>•They distinguish between temperature and thermal energy and know their units.<br><br>•They explain energy conversions in terms of the principle of the conservation of energy.<br><br>•They explain how light is reflected from plane surfaces and that white light can be dispersed to give a range of colours.<br><br>•They explain the need to control noise levels in the environment.<br><br>•They know the properties of electromagnets and can explain them in simple applications.<br><br>•They explain changes in day length, seasonal changes and changes in the elevation of the sun. | •Students use models to describe and explain phenomena, *such as the flow of charge in parallel circuits.*<br><br>•They use the principle of moments in practical situations.<br><br>•They explain the process of energy transfer by conduction, convection and radiation.<br><br>•They know that global resources are limited and discuss why energy should be used efficiently.<br><br>•They describe common electrostatic phenomena and can explain that electric current is a flow of charge.<br><br>•They give detailed interpretations of graphs, *such as speed/time graphs.*<br><br>•They apply science concepts in explanations of a range of physical phenomena *(for example, the appearance of objects in different colours of light, the relationship between the frequency of vibration and the pitch of a sound, the role of gravitational attraction in determining the motion of bodies in the solar system, the dissipation of energy during energy transfers).* | •Students consider physical phenomena from different perspectives, *such as relating the dissipation of energy during energy transfer to the need to conserve limited energy resources.*<br><br>•They extend their understanding of the principle of moments to situations involving stability.<br><br>•They explain the heating effect of a current in terms of vibration of particles.<br><br>•They consider ways of obtaining data *(for example, of the solar system)* and they use their knowledge of physical processes to explain patterns that they find.<br><br>•They use quantitative relationships between physical quantities in calculations that may involve more than one step. |