

Science

1 How science works

Level 1 Pupils respond to prompts to suggest practical ways to find answers to questions. They make observations about features of objects, living things and events. They communicate their findings in ways such as talking about their work in everyday terms, or through drawings or by completing pictograms.

Level 2 Pupils respond to suggestions and make their own suggestions, with help, about how to collect relevant data and answer questions. They find information by using texts, with help. They follow direct instructions in order to stay safe. They make observations and measurements to compare living things, objects and events, using equipment provided for them. They record findings using prepared tables and communicate observations using scientific vocabulary. They say whether what happened was what they expected and, when prompted, suggest different ways they could have done things.

Level 3 Pupils respond to suggestions and put forward their own ideas about how to investigate an idea or find answers to questions. They recognise why it is important to collect data to investigate ideas and answer questions, and use texts to find information. They begin to recognise risks with help. They make relevant observations and measure quantities, such as length or mass, selecting and using a range of simple equipment. They carry out fair tests with some help, recognising and explaining what makes them fair. They record findings in a variety of ways, including tables or charts. They give explanations for observations and for patterns in measurements they have made and recorded. They communicate in a scientific way what they have found out and suggest improvements in their work.

Level 4 Pupils decide on an appropriate approach, including using a fair test to answer a question, and select suitable equipment and information from that provided. They select and use methods that are adequate for the task. Following instructions, they take action to control obvious risks to themselves. They make a series of observations and measurements and vary one factor while keeping others the same. They record their observations, comparisons and measurements using tables and bar charts and begin to plot points to form simple graphs. They interpret data containing positive and negative numbers. They begin to relate their conclusions to patterns in data, including graphs, and to scientific knowledge and understanding. They communicate their conclusions using appropriate scientific language. They suggest improvements in their work, giving reasons.

Level 5 Pupils decide appropriate approaches to a range of tasks, including selecting sources of information and apparatus. They select and use methods to obtain data systematically. They recognise hazard symbols and make, and act on, simple suggestions to control obvious risks to themselves and others. They use line graphs to present data, interpret numerical data and draw conclusions from them. They analyse findings to draw scientific conclusions that are consistent with the evidence. They communicate these using scientific and mathematical conventions and terminology. They evaluate their working methods to make practical suggestions for improvements.

Level 6 Pupils identify an appropriate approach in investigatory work, selecting and using sources of information, scientific knowledge and understanding. They select and use methods to collect adequate data for the task, measuring with precision, using instruments with fine scale divisions, and identify the need to repeat measurements and observations. They recognise a range of familiar risks and take action to control them. They record data and features effectively, choosing scales for graphs and diagrams. They analyse findings to draw conclusions that are consistent with the evidence and use scientific knowledge and understanding to explain them and account for any inconsistencies in the evidence. They manipulate numerical data to make valid comparisons and draw valid conclusions. They communicate qualitative and quantitative data effectively, using scientific conventions and terminology. They evaluate evidence, making reasoned suggestions about how their working methods could be improved.

Level 7 Pupils plan appropriate approaches and procedures, by synthesising information from a range of sources and identifying key factors in complex contexts and in which variables cannot readily be controlled. They select and use methods to obtain reliable data, including making systematic observations and measurements with precision, using a range of apparatus. They recognise the need for a risk assessment and consult appropriate sources of information, which they follow. They record data in graphs, using lines of best fit. They analyse findings to draw conclusions that are consistent with the evidence and use scientific knowledge and understanding to explain these conclusions and identify possible limitations in primary and secondary data. They use quantitative relationships between variables. They communicate effectively, using a wide range of scientific and technical conventions and terminology, including symbols and flow diagrams. They begin to consider whether the data they have collected are sufficient for the conclusions they have drawn.

Level 8 Pupils recognise that different strategies are required to investigate different kinds of scientific questions, and use scientific knowledge and understanding to select an appropriate strategy. In consultation with their teacher they adapt their approach to practical work to control risk. They record data that are relevant and sufficiently detailed, and choose methods that will obtain these data with the precision and reliability needed. They analyse data and begin to explain, and allow for, anomalies. They carry out multi-step calculations and use compound measures, such as speed, appropriately. They communicate findings and arguments, showing awareness of a range of views. They evaluate evidence critically and suggest how inadequacies can be remedied.

Exceptional Performance Pupils recognise that different approaches are required to investigate different kinds of scientific questions, and use scientific knowledge and understanding to select appropriate strategies. They readily identify hazards, seek appropriate risk assessment information and advice, select that which is relevant and, in consultation with their teacher, adjust practice as required. They make records of relevant observations and comparisons, clearly identifying points of particular significance. They decide the level of precision needed for measurements and collect data that satisfy these requirements. They analyse findings to interpret trends and patterns and draw conclusions from their evidence. They make effective use of a range of quantitative relationships between variables in calculations or when using data to support evidence. They communicate findings and arguments, showing their awareness of the degree of uncertainty and a range of alternative views. They evaluate evidence critically and give reasoned accounts of how they could collect additional evidence.

Science

2 Organisms, their behaviour and the environment

Level 1 Pupils use their knowledge related to organisms, their behaviour and the environment to recognise, identify and describe a range of common plants, animals and natural events. They name and describe external parts or features of plants, such as leaf colour; humans, such as head, arm; and other animals, such as coat colour. They use that evidence to identify plants or animals and make links between science and everyday objects and experiences.

Level 2 Pupils use their knowledge related to organisms, their behaviour and the environment to describe plants and animals, the places they are found and the basic conditions they need in order to survive. They recognise and describe similarities and differences between the plants, humans and other animals they observe, using these to sort them into groups. They use questions based on their own ideas and evidence such as finding different types of plants and animals in different places. They identify science in everyday contexts and say whether it is helpful, for example ways of growing vegetables for food.

Level 3 Pupils use knowledge and understanding of organisms, their behaviour and the environment, such as the basic life processes of growth and reproduction, to describe similarities, differences and changes in the plants, animals, and non-living things they observe. They use simple scientific ideas with evidence they have collected to give explanations of their observations, linking cause and effect, for example lack of light or water affecting plant growth and the ways in which animals or plants are suited to their environments. They recognise and explain the purpose of a variety of scientific and technological developments in their everyday lives, for example medicines helping people get better when they are ill.

Level 4 Pupils describe some processes and phenomena related to organisms, their behaviour and the environment, drawing on scientific knowledge and understanding and using appropriate terminology, for example using food chains to describe feeding relationships between plants and animals in a habitat. They recognise that evidence can support or refute scientific ideas, such as in the identification and grouping of living things. They recognise some applications and implications of science, such as the use of predators to control pest populations.

Level 5 Pupils describe processes and phenomena related to organisms, their behaviour and the environment, drawing on abstract ideas and using appropriate terminology, for example the main functions of plant and animal organs and how these functions are essential. They explain processes and phenomena, in more than one step or using a model, such as the main stages of the life cycles of humans and flowering plants. They apply and use knowledge and understanding in familiar contexts, such as different organisms being found in different habitats because of differences in environmental factors. They recognise that both evidence and creative thinking contribute to the development of scientific ideas, such as the classification of living things. They describe applications and implications of science, such as solving some of the health problems that arise when organ damage occurs.

Level 6 Pupils describe processes and phenomena related to organisms, their behaviour and the environment, using abstract ideas and appropriate terminology, for example simple cell structure and function. They take account of a number of factors or use abstract ideas or models in their explanations of processes and phenomena, such as environmental factors affecting the distribution of organisms in habitats. They apply and use knowledge and understanding in unfamiliar contexts, such as a food web in a habitat. They describe some evidence for some accepted scientific ideas, such as the causes of variation between living things. They explain the importance of some applications and implications of science, such as the use of selective breeding.

Level 7 Pupils describe a wide range of processes and phenomena related to organisms, their behaviour and the environment, using abstract ideas and appropriate terminology and sequencing a number of points, for example respiration and photosynthesis, or pyramids of biomass. They make links between different areas of science in their explanations. They apply and use more abstract knowledge and understanding, in a range of contexts, such as inherited and environmental variation. They explain how evidence supports some accepted scientific ideas, such as the structure and function of cells. They explain, using abstract ideas where appropriate, the importance of some applications and implications of science, such as the uses of cells in stem cell research.

Level 8 Pupils demonstrate extensive knowledge and understanding related to organisms, their behaviour and the environment. They use and apply this effectively in their descriptions and explanations, identifying links between topics, for example relating cellular structure of organs to their associated life processes. They interpret, evaluate and synthesise data from a range of sources and in a range of contexts, for example environmental data from fieldwork. They show they understand the relationship between evidence and scientific ideas, and why scientific ideas may need to be changed, for example the short-term and long-term effects of environmental change on ecosystems. They describe and explain the importance of a wide range of applications and implications of science, such as relating photosynthesis and respiration to changes in the atmosphere and growth of crops.

Exceptional Performance Pupils demonstrate both breadth and depth of knowledge and understanding of organisms, their behaviour and the environment. They apply this effectively in their descriptions and explanations, identifying links and patterns within and between topics, for example linking internal and external cell structures to life processes. They interpret, evaluate and synthesise data, from a range of sources in a range of contexts, and apply their understanding to a wide range of biological systems. They demonstrate an understanding of how scientific knowledge and understanding changes, building on processes such as questioning, investigating and evidence-gathering, for example in the study of global climate change. They describe and explain the importance of a wide range of applications and implications of science in familiar and unfamiliar contexts, such as addressing problems arising from global climate change.

Science

3 Materials, their properties and the earth

Level 1 Pupils use their knowledge related to materials, their properties and the Earth, to recognise, and describe some common materials, and their sensory properties, such as the texture and appearance of soils. They communicate their descriptions and observations in terms of these properties. They recognise evidence that has been used to answer a question such as identifying similar materials and make links between science and everyday objects and experiences such as waterproof materials being used to keep things dry.

Level 2 Pupils use their knowledge related to materials, their properties and the Earth to identify a range of common materials and some of their properties. They recognise, and describe similarities and differences between the materials they observe, using these to sort them into groups. They recognise and describe ways in which some materials are changed by heating or cooling or by processes such as bending or stretching. They suggest answers to questions, such as the best material to reflect light, based on their own ideas and evidence. They identify science in everyday contexts and say whether it is helpful, for example ice melting.

Level 3 Pupils use knowledge and understanding of materials, their properties and the Earth to sort materials into groups in a variety of ways, according to their properties. They explain the ways in which some materials are suited to specific purposes such as glass for windows or copper for electrical cables. They classify changes in materials as reversible, such as water freezing, and non-reversible, such as baking of cakes. They use simple scientific ideas with evidence they have collected to give explanations of their observations, linking cause and effect, for example the evaporation of water. They recognise and explain the purpose of a variety of scientific and technological developments in their everyday lives, for example sustainable packaging.

Level 4 Pupils describe some processes and phenomena related to materials, their properties and the Earth, drawing on scientific knowledge and understanding and using appropriate terminology, for example separation methods. They recognise that evidence can support or refute scientific ideas, such as the classification of reactions as reversible and irreversible. They recognise some applications and implications of science, such as the safe use of acids and alkalis.

Level 5 Pupils describe processes and phenomena related to materials, their properties and the Earth, drawing on abstract ideas and using appropriate terminology, for example the weathering of rocks. They explain processes and phenomena, in more than one step or using a model, such as the deposition of sediments and their formation into rocks. They apply and use knowledge and understanding in familiar contexts, such as identifying changes of state. They recognise that both evidence and creative thinking contribute to the development of scientific ideas, such as basing separation methods for mixtures on physical and chemical properties. They describe applications and implications of science, such as the uses of metals based on their specific properties or the benefits and drawbacks of the use of fossil fuels.

Level 6 Pupils describe processes and phenomena related to materials, their properties and the Earth, using abstract ideas and appropriate terminology, for example the particle model applied to solids, liquids and gases. They take account of a number of factors or use abstract ideas or models in their explanations of processes and phenomena, such as word equations. They apply and use knowledge and understanding in unfamiliar contexts, such as relating changes of state to energy transfers in a range of contexts such as the formation of igneous rocks. They describe some evidence for some accepted scientific ideas, such as the patterns in the reactions of acids with metals and the reactions of a variety of substances with oxygen. They explain the importance of some applications and implications of science, such as the production of new materials with specific desirable properties.

Level 7 Pupils describe a wide range of processes and phenomena related to materials, their properties and the Earth, using abstract ideas and appropriate terminology and sequencing a number of points, for example the rock cycle. They make links between different areas of science in their explanations, such as between the nature and behaviour of materials and their particles. They apply and use more abstract knowledge and understanding, in a range of contexts, such as the particle model of matter, and symbols and formulae for elements and compounds. They explain how evidence supports some accepted scientific ideas, such as the reactivity series of metals. They explain, using abstract ideas where appropriate, the importance of some applications and implications of science, such as the need to consider the availability of resources, and environmental effects, in the production of energy and materials.

Level 8 Pupils demonstrate extensive knowledge and understanding related to materials, their properties and the Earth. They use and apply this effectively in their descriptions and explanations, identifying links between topics, for example relating mode of formation of rocks to their texture and mineral content. They represent common compounds by chemical formulae and use these formulae to form balanced symbol equations for reactions. They interpret, evaluate and synthesise data from a range of sources and in a range of contexts, such as describing chemical reactions, classifying them and suggesting how new substances could be made. They show they understand the relationship between evidence and scientific ideas, and why scientific ideas may need to be changed. They describe and explain the importance of a wide range of applications and implications of science.

Exceptional Performance Pupils demonstrate both breadth and depth of knowledge and understanding of materials, their properties and the Earth, for example the different timescales over which rock formation and deformation take place. They apply this effectively in their descriptions and explanations, identifying links and patterns within and between topics, for example relating the properties of materials to the nature of their constituent particles. They interpret, evaluate and synthesise data from a range of sources in a range of contexts, and apply their understanding to a wide range of chemical systems, such as explaining chemical behaviours that do not fit expected patterns. They demonstrate an understanding of how scientific knowledge and understanding changes, building on processes such as questioning, investigating and evidence-gathering. They describe and explain the importance of a wide range of applications and implications of science in familiar and unfamiliar contexts.

Science

4 Energy, forces and space

Level 1 Pupils use their knowledge related to energy, forces and space to describe some changes in light, sound or movement, that result from actions, such as those caused by pushing and pulling objects or switching on an electrical circuit. They recognise that light and sound come from a variety of sources, such as the Sun or a musical instrument. They recognise evidence that has been used to answer a question, such as how a musical instrument makes a noise, and make links between science and everyday objects and experiences such as the Sun being a light source.

Level 2 Pupils use their knowledge related to energy, forces and space to recognise, describe and compare a range of properties and effects of light, sound, forces, and electricity, such as the ways in which devices work in different electrical circuits, the brightness or colour of lights, the loudness of sounds or the speed or direction of different objects. They suggest answers to questions such as which sound is loudest based on their own ideas and evidence. They identify science in everyday contexts and say whether it is helpful, for example electricity in domestic appliances.

Level 3 Pupils use their knowledge and understanding of energy, forces and space to link cause and effect in their observations of the properties and effects of light, sound, forces, and electricity, such as a bulb failing to light because of a break in an electrical circuit, or a push or pull changing the speed or direction of a moving object. They begin to make generalisations such as sounds getting fainter the further the listener is from the source. They use simple scientific ideas with evidence they have collected to give explanations of their observations, linking cause and effect, for example using a switch to turn off a light bulb in an electrical circuit. They recognise and explain the purpose of a variety of scientific and technological developments in their everyday lives, for example streamlining and air resistance.

Level 4 Pupils describe some processes and phenomena related to energy, forces and space, drawing on scientific knowledge and understanding and using appropriate terminology, for example the observed position of the sun in the sky over the course of a day. They recognise that evidence can support or refute scientific ideas, such as sounds being heard through a variety of materials. They recognise some applications and implications of science, such as the use of electrical components to make electrical devices.

Level 5 Pupils describe processes and phenomena related to energy, forces and space, drawing on abstract ideas and using appropriate terminology, for example 'balanced forces'. They explain processes and phenomena, in more than one step or using a model, such as the length of a day or a year. They apply and use knowledge and understanding in familiar contexts. They recognise that both evidence and creative thinking contribute to the development of scientific ideas, such as objects being seen when light from them enters the eye. They describe applications and implications of science, such as the ways sound can be produced and controlled, for example in musical instruments.

Level 6 Pupils describe processes and phenomena related to energy, forces and space, using abstract ideas and appropriate terminology, for example electric current as a way of transferring energy. They take account of a number of factors in their explanations of processes and phenomena, for example in the relative brightness of stars and planets. They also use abstract ideas or models, for example sustainable energy sources and the refraction of light. They apply and use knowledge and understanding in unfamiliar contexts. They describe some evidence for some accepted scientific ideas, such as the transfer of energy by light, sound or electricity, and the refraction and dispersion of light. They explain the importance of some applications and implications of science, such as the responsible use of unsustainable sources of energy.

Level 7 Pupils describe a wide range of processes and phenomena related to energy, forces and space, using abstract ideas and appropriate terminology and sequencing a number of points, for example how energy is transferred by radiation or by conduction. They make links between different areas of science in their explanations, such as between electricity and magnetism. They apply and use more abstract knowledge and understanding in a range of contexts, such as the appearance of objects in different colours of light. They explain how evidence supports some accepted scientific ideas, such as the role of gravitational attraction in determining the motion of bodies in the solar system. They explain, using abstract ideas where appropriate, the importance of some applications and implications of science, such as the uses of electromagnets.

Level 8 Pupils demonstrate extensive knowledge and understanding related to energy, forces and space, for example the passage of sound waves through a medium. They use and apply this effectively in their descriptions and explanations, identifying links between topics. They interpret, evaluate and synthesise data from a range of sources and in a range of contexts. They show they understand the relationship between evidence and scientific ideas, and why scientific ideas may need to be changed, such as the developing understanding of the structure of the solar system. They describe and explain the importance of a wide range of applications and implications of science, such as relating the dissipation of energy during energy transfer to the need to conserve limited energy resources.

Exceptional Performance

Pupils demonstrate both breadth and depth of knowledge and understanding of energy, forces and space. They apply this effectively in their descriptions and explanations, identifying links and patterns within and between topics, for example understanding how models like the particle model are useful in explaining physical phenomena, such as how sweating causes cooling. They interpret, evaluate and synthesise data from a range of sources in a range of contexts and apply their understanding to a wide range of data on energy efficient physical systems. They demonstrate an understanding of how scientific knowledge and understanding changes, building on processes such as questioning, investigating and evidence gathering, for example through the role of artificial satellites and probes in communications and space exploration. They describe and explain the importance of a wide range of applications and implications of science in familiar and unfamiliar contexts, such as alternative methods of electricity generation.