

Science

THE LEVEL DESCRIPTIONS

In science, the level descriptions indicate the progression in the knowledge, understanding and skills set out in the four sections of the programme of study: scientific enquiry, life processes and living things, materials and their properties and physical processes.

These make up the four attainment targets in science:

1. Sc1 Scientific enquiry
2. Sc2 Life processes and living things
3. Sc3 Materials and their properties
4. Sc4 Physical processes.

The examples given in each level description are intended to indicate pitch and are not statutory. At levels 4 and 5, similar examples may be drawn from either the key stage 2 or 3 programmes of study.

Attainment target 1: Scientific enquiry

There are five aspects of attainment in this attainment target:

1. Ideas and evidence
2. Planning
3. Carrying out
4. Interpreting and evaluating
5. Recording and presenting data

The numbers in brackets within the level descriptions identify these aspects. If you select one you will trigger a search for pupils' work that illustrates that aspect.

Level 1

Pupils describe or respond appropriately to simple features of objects, living things and events they observe, communicating their findings in simple ways *for example, talking about their work, through drawings, simple charts.* (3; 5)

Level 2

Pupils respond to suggestions about how to find things out and, with help, make their own suggestions about how to collect data to answer questions. They use simple texts, with help, to find information. (2) They use simple equipment provided and make observations related to their task. They observe and compare objects, living things and events. (3) They describe their observations using scientific vocabulary and record them, using simple tables when appropriate. (5) They say whether what happened was what they expected. (4)

Level 3

Pupils respond to suggestions and put forward their own ideas about how to find the answer to a question. (2) They recognise why it is important to collect data to answer questions. (1) They use simple texts to find information. (2) They make relevant observations and measure quantities, such as length or mass, using a range of

simple equipment. (3) Where appropriate, they carry out a fair test with some help, recognising and explaining why it is fair. (2) They record their observations in a variety of ways. (5) They provide explanations for observations and for simple patterns in recorded measurements. (4) They communicate in a scientific way what they have found out and suggest improvements in their work. (4; 5)

Level 4

Pupils recognise that scientific ideas are based on evidence. (1) In their own investigative work, they decide on an appropriate approach *for example, using a fair test* to answer a question. (2) Where appropriate, they describe, or show in the way they perform their task, how to vary one factor while keeping others the same. (2) Where appropriate, they make predictions. (2) They select information from sources provided for them. (2) They select suitable equipment and make a series of observations and measurements that are adequate for the task. (3) They record their observations, comparisons and measurements using tables and bar charts. (5) They begin to plot points to form simple graphs, and use these graphs to point out and interpret patterns in their data. (4; 5) They begin to relate their conclusions to these patterns and to scientific knowledge and understanding, and to communicate them with appropriate scientific language. (5) They suggest improvements in their work, giving reasons. (4)

Level 5

Pupils describe how experimental evidence and creative thinking have been combined to provide a scientific explanation *for example, Jenner's work on vaccination at key stage 2, Lavoisier's work on burning at key stage 3*. (1) When they try to answer a scientific question, they identify an appropriate approach. (2) They select from a range of sources of information. (2) When the investigation involves a fair test, they identify key factors to be considered. (2) Where appropriate, they make predictions based on their scientific knowledge and understanding. (2) They select apparatus for a range of tasks and plan to use it effectively. (3) They make a series of observations, comparisons or measurements with precision appropriate to the task. (3) They begin to repeat observations and measurements and to offer simple explanations for any differences they encounter. (3; 4) They record observations and measurements systematically and, where appropriate, present data as line graphs. (5) They draw conclusions that are consistent with the evidence and begin to relate these to scientific knowledge and understanding. (4) They make practical suggestions about how their working methods could be improved. (4) They use appropriate scientific language and conventions to communicate quantitative and qualitative data. (5)

Level 6

Pupils describe evidence for some accepted scientific ideas and explain how the interpretation of evidence by scientists leads to the development and acceptance of new ideas. (1) In their own investigative work, they use scientific knowledge and understanding to identify an appropriate approach. (2) They select and use sources of information effectively. (2) They make enough measurements, comparisons and observations for the task. (3) They measure a variety of quantities with precision, using instruments with fine-scale divisions. (3) They choose scales for graphs and diagrams that enable them to show data and features effectively. (5) They identify measurements and observations that do not fit the main pattern shown. (4) They draw conclusions that are consistent with the evidence and use scientific knowledge and understanding to explain them. (4) They make reasoned suggestions about how their working methods could be improved. (4) They select and use appropriate methods for communicating qualitative and quantitative data using scientific language and conventions. (5)

Level 7

Pupils describe some predictions based on scientific theories and give examples of the evidence collected to test these predictions. (1) In their own work, they use

scientific knowledge and understanding to decide on appropriate approaches to questions. (2) They identify the key factors in complex contexts and in contexts in which variables cannot readily be controlled, and plan appropriate procedures. (2) They synthesise information from a range of sources, and identify possible limitations in secondary data. (2) They make systematic observations and measurements with precision, using a wide range of apparatus. (3) They identify when they need to repeat measurements, comparisons and observations in order to obtain reliable data. (3) Where appropriate, they represent data in graphs, using lines of best fit. (4) They draw conclusions that are consistent with the evidence and explain these using scientific knowledge and understanding. (4) They begin to consider whether the data they have collected are sufficient for the conclusions they have drawn. (4) They communicate what they have done using a wide range of scientific and technical language and conventions, including symbols and flow diagrams. (5)

Level 8

Pupils give examples of scientific explanations or models that have had to be changed in the light of additional scientific evidence. (1) They evaluate and synthesise data from a range of sources. (2) They recognise that investigating different kinds of scientific questions requires different strategies, and use scientific knowledge and understanding to select an appropriate strategy in their own work. (2) They decide which observations are relevant in qualitative work and include suitable detail in their records. (5) They decide the level of precision needed in comparisons or measurements, and collect data enabling them to test relationships between variables. (3) They identify and begin to explain anomalous observations and measurements and allow for these when they draw graphs. (4) They use scientific knowledge and understanding to draw conclusions from their evidence. (4) They consider graphs and tables of results critically. (4) They communicate findings and arguments using appropriate scientific language and conventions, showing awareness of a range of views. (5)

Exceptional performance

Pupils give examples of scientific explanations and models that have been challenged by subsequent experiments and explain the significance of the evidence in modifying scientific theories. (1) They evaluate and synthesise data from a range of sources. (2) They recognise that investigating different kinds of scientific questions requires different strategies, and use scientific knowledge and understanding to select an appropriate strategy in their own work. (2) They make records of relevant observations and comparisons, clearly identifying points of particular significance. (5) They decide the level of precision needed in measurements and collect data that satisfy these requirements. (3) They use their data to test relationships between variables. (2) They identify and explain anomalous observations and measurements, allowing for these when they draw graphs. (4) They use scientific knowledge and understanding to interpret trends and patterns and to draw conclusions from their evidence. (4) They consider graphs and tables of results critically and give reasoned accounts of how they could collect additional evidence. (4) They communicate findings and arguments using appropriate scientific language and conventions, showing their awareness of the degree of uncertainty and a range of alternative views. (5)

Attainment target 2: Life processes and living things

Select a level to trigger a search for pupils' work that illustrates the level.

Level 1

Pupils recognise and name external parts of the body *for example, head, arm* and of plants *for example, leaf, flower*. They communicate observations of a range of animals and plants in terms of features *for example, colour of coat, size of leaf*. They

recognise and identify a range of common animals *for example, fly, goldfish, robin.*

Level 2

Pupils use their knowledge about living things to describe the basic conditions *for example, a supply of food, water, air, light* that animals and plants need in order to survive. They recognise that living things grow and reproduce. They sort living things into groups, using simple features. They describe the basis for their groupings *for example, number of legs, shape of leaf.* They recognise that different living things are found in different places *for example, ponds, woods.*

Level 3

Pupils use their knowledge and understanding of basic life processes *for example, growth, reproduction* when they describe differences between living and non-living things. They provide simple explanations for changes in living things *for example, diet affecting the health of humans or other animals, lack of light or water altering plant growth.* They identify ways in which an animal is suited to its environment *for example, a fish having fins to help it swim.*

Level 4

Pupils demonstrate knowledge and understanding of life processes and living things drawn from the key stage 2 or key stage 3 programme of study. They use scientific names for some major organs of body systems *for example, the heart at key stage 2, the stomach at key stage 3* and identify the position of these organs in the human body. They identify organs *for example, stamen at key stage 2, stigma, root hairs at key stage 3* of different plants they observe. They use keys based on observable external features to help them to identify and group living things systematically. They recognise that feeding relationships exist between plants and animals in a habitat, and describe these relationships using food chains and terms *for example, predator and prey.*

Level 5

Pupils demonstrate an increasing knowledge and understanding of life processes and living things drawn from the key stage 2 or key stage 3 programme of study. They describe the main functions of organs of the human body *for example, the heart at key stage 2, stomach at key stage 3,* and of the plant *for example, the stamen at key stage 2, root hairs at key stage 3.* They explain how these functions are essential to the organism. They describe the main stages of the life cycles of humans and flowering plants and point out similarities. They recognise that there is a great variety of living things and understand the importance of classification. They explain that different organisms are found in different habitats because of differences in environmental factors *for example, the availability of light or water.*

Level 6

Pupils use knowledge and understanding drawn from the key stage 3 programme of study to describe and explain life processes and features of living things. They use appropriate scientific terminology when they describe life processes *for example, respiration, photosynthesis* in animals and plants. They distinguish between related processes *for example, pollination, fertilisation.* They describe simple cell structure and identify differences between simple animal and plant cells. They describe some of the causes of variation between living things. They explain that the distribution and abundance of organisms in habitats are affected by environmental factors *for example, the availability of light or water.*

Level 7

Pupils use knowledge and understanding of life processes and living things drawn from the key stage 3 programme of study to make links between life processes in animals and plants and the organ systems involved. They explain the processes of respiration and photosynthesis in terms of the main underlying chemical change.

They use their knowledge of cell structure to explain how cells *for example, ovum, sperm, root hair* are adapted to their functions. They identify common variations between individuals, including some features *for example, eye colour* that are inherited and others *for example, height* that can also be affected by environmental factors. They construct models *for example, food webs, pyramids of numbers* to show feeding relationships, and explain how these relationships affect population size.

Level 8

Pupils demonstrate an extensive knowledge and understanding of life processes and living things drawn from the key stage 3 programme of study by describing and explaining how biological systems function. They relate the cellular structure of organs to the associated life processes *for example, the absorption of food in the digestive system, gas exchange in the lungs*. They recognise, predict and explain changes in biological systems *for example, the effect of increased carbon dioxide concentration on the growth of greenhouse crops, the consequences of smoking for organ systems*. They explain how characteristics can be inherited by individuals and apply their knowledge *for example, in relation to selective breeding*. 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.

Exceptional performance

Pupils demonstrate both breadth and depth of knowledge and understanding drawn from the key stage 3 programme of study when they describe and explain how biological systems function. They recognise that organisms respond to change, and describe ways in which this is achieved. They relate their understanding of internal and external cellular structures to life processes *for example, the increased surface areas of cells in the digestive system*. They relate their understanding of cellular structure to inheritance and variation and explain how this leads to new varieties *for example, how genetic engineering is a modern form of selective breeding*. They recognise the importance of quantitative data *for example, related to populations in an environment* when they describe and explain patterns of change within an ecosystem.

Attainment target 3: Materials and their properties

Select a level to trigger a search for pupils' work that illustrates the level.

Level 1

Pupils know about a range of properties *for example, texture, appearance* and communicate observations of materials in terms of these properties.

Level 2

Pupils identify a range of common materials and know about some of their properties. They describe similarities and differences between materials. They sort materials into groups and describe the basis for their groupings in everyday terms *for example, shininess, hardness, smoothness*. They describe ways in which some materials are changed by heating or cooling or by processes such as bending or stretching.

Level 3

Pupils use their knowledge and understanding of materials when they describe a variety of ways of sorting them into groups according to their properties. They explain simply why some materials are particularly suitable for specific purposes *for example, glass for windows, copper for electrical cables*. They recognise that some changes *for example, the freezing of water* can be reversed and some *for example, the baking of clay* cannot, and they classify changes in this way.

Level 4

Pupils demonstrate knowledge and understanding of materials and their properties drawn from the key stage 2 or key stage 3 programme of study. They describe differences between the properties of different materials and explain how these differences are used to classify substances *for example, as solids, liquids, gases at key stage 2, as acids, alkalis at key stage 3*. They describe some methods *for example, filtration, distillation* that are used to separate simple mixtures. They use scientific terms *for example, evaporation, condensation* to describe changes. They use knowledge about some reversible and irreversible changes to make simple predictions about whether other changes are reversible or not.

Level 5

Pupils demonstrate an increasing knowledge and understanding of materials and their properties drawn from the key stage 2 or key stage 3 programme of study. They describe some metallic properties *for example, good electrical conductivity* and use these properties to distinguish metals from other solids. They identify a range of contexts in which changes *for example, evaporation, condensation* take place. They use knowledge about how a specific mixture *for example, salt and water, sand and water* can be separated to suggest ways in which other similar mixtures might be separated.

Level 6

Pupils use knowledge and understanding of the nature and behaviour of materials drawn from the key stage 3 programme of study to describe chemical and physical changes, and how new materials can be made. They recognise that matter is made up of particles, and describe differences between the arrangement and movement of particles in solids, liquids and gases. They identify and describe similarities between some chemical reactions *for example, the reactions of acids with metals, the reactions of a variety of substances with oxygen*. They use word equations to summarise simple reactions. They relate changes of state to energy transfers in a range of contexts *for example, the formation of igneous rocks*.

Level 7

Pupils use knowledge and understanding drawn from the key stage 3 programme of study to make links between the nature and behaviour of materials and the particles of which they are composed. They use the particle model of matter in explanations of phenomena *for example, changes of state*. They explain differences between elements, compounds and mixtures in terms of their constituent particles. They recognise that elements and compounds can be represented by symbols and formulae. They apply their knowledge of physical and chemical processes to explain the behaviour of materials in a variety of contexts *for example, the way in which natural limestone is changed through the action of rainwater, ways in which rocks are weathered*. They use patterns of reactivity *for example, those associated with a reactivity series of metals* to make predictions about other chemical reactions.

Level 8

Pupils demonstrate an extensive knowledge and understanding drawn from the key stage 3 programme of study, which they use to describe and explain the behaviour of, and changes to, materials. They use the particle model in a wide range of contexts. They describe what happens in a range of chemical reactions and classify some *for example, oxidation, neutralisation*. They represent common compounds by chemical formulae and use these formulae to form balanced symbol equations for reactions *for example, those of acids with metals, carbonates or oxides*. They apply their knowledge of patterns in chemical reactions to suggest how substances *for example, salts* could be made.

Exceptional Performance

Pupils demonstrate both breadth and depth of knowledge and understanding drawn from the key stage 3 programme of study when they describe and explain the nature

and behaviour of materials. They use particle theory in a wider range of contexts, recognising that differences in the properties of materials relate to the nature of the particles within them. They recognise, and give explanations for, examples of chemical behaviour that do not fit expected patterns. They routinely use balanced symbol equations for reactions. They interpret quantitative data about chemical reactions, suggesting explanations for patterns identified.

Attainment target 4: Physical processes

Select a level to trigger a search for pupils' work that illustrates the level.

Level 1

Pupils communicate observations of changes in light, sound or movement that result from actions *for example, switching on a simple electrical circuit, pushing and pulling objects*. They recognise that sound and light come from a variety of sources and name some of these.

Level 2

Pupils know about a range of physical phenomena and recognise and describe similarities and differences associated with them. They compare the way in which devices *for example, bulbs* work in different electrical circuits. They compare the brightness or colour of lights, and the loudness or pitch of sounds. They compare the movement of different objects in terms of speed or direction.

Level 3

Pupils use their knowledge and understanding of physical phenomena to link cause and effect in simple explanations *for example, a bulb failing to light because of a break in an electrical circuit, the direction or speed of movement of an object changing because of a push or a pull*. They begin to make simple generalisations about physical phenomena *for example, explaining that sounds they hear become fainter the further they are from the source*.

Level 4

Pupils demonstrate knowledge and understanding of physical processes drawn from the key stage 2 or key stage 3 programme of study. They describe and explain physical phenomena *for example, how a particular device may be connected to work in an electrical circuit, how the apparent position of the Sun changes over the course of a day*. They make generalisations about physical phenomena *for example, motion is affected by forces, including gravitational attraction, magnetic attraction and friction*. They use physical ideas to explain simple phenomena *for example, the formation of shadows, sounds being heard through a variety of materials*.

Level 5

Pupils demonstrate knowledge and understanding of physical processes drawn from the key stage 2 or key stage 3 programme of study. They use ideas to explain how to make a range of changes *for example, altering the current in a circuit, altering the pitch or loudness of a sound*. They use some abstract ideas in descriptions of familiar phenomena *for example, objects are seen when light from them enters the eye at key stage 2, forces are balanced when an object is stationary at key stage 3*. They use simple models to explain effects that are caused by the movement of the Earth *for example, the length of a day or year*.

Level 6

Pupils use and apply knowledge and understanding of physical processes drawn from the key stage 3 programme of study. They use abstract ideas in some descriptions and explanations *for example, electric current as a way of transferring energy, the sum of several forces determining changes in the direction or the speed of movement of an object, wind and waves as energy resources available for use*. They

recognise, and can give examples of, the wide application of many physical concepts *for example, the transfer of energy by light, sound or electricity, the refraction and dispersion of light*. They give explanations of phenomena in which a number of factors have to be considered *for example, the relative brightness of planets and stars*.

Level 7

Pupils use knowledge and understanding of physical processes drawn from the key stage 3 programme of study to make links between different phenomena. They make connections between electricity and magnetism when explaining phenomena *for example, the strength of electromagnets*. They use some quantitative definitions *for example, speed, pressure* and perform calculations, using the correct units. They apply abstract ideas 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*.

Level 8

Pupils demonstrate an extensive knowledge and understanding of the physical processes in the key stage 3 programme of study. They use models to describe and explain phenomena *for example, the magnetic field of an electromagnet, the passage of sound waves through a medium*. They use quantitative relationships between physical quantities in calculations that may involve more than one step. They offer detailed and sometimes quantitative interpretations of graphs *for example, speed-time graphs*. 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. They consider physical phenomena from different perspectives *for example, 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 the physical processes in the key stage 3 programme of study when they describe and explain physical phenomena. They make effective use of a range of quantitative relationships between physical quantities. They understand how models *for example, the particle model* are useful in explaining physical phenomena *for example, how sweating causes cooling*. They apply their understanding of physical phenomena to a wide range of systems *for example, recognising the role of gravitational attraction in determining the movement of satellites, planets and stars*. They recognise the importance of quantitative data and make effective use of this when they consider questions such as energy efficiency.

