

Progression in Science from KS1- KS3

The science curriculum is split into several key areas including working scientifically, biology, physics and chemistry. Within the Key stage 1 and Key stage 2 curriculum the areas of biology, physics and chemistry are broken down further into the following areas:

- Plants
- Animals, including humans
- Everyday materials
- Seasonal changes
- Living things and their habitats
- Rocks
- Light
- Forces and magnets
- States of matter
- Sound
- Electricity
- Properties and changes of materials
- Earth and space
- Forces
- Evolution and inheritance

The following document includes details as to how these areas of study progress from Key Stage one into Key Stage two and then onto Key Stage three.

Sc1: Working scientifically			
KS1	Lower KS2	Upper KS2	KS3
During Years 1 and 2 , pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:	During Years 3 and 4 , pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:	During Years 5 and 6 , pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:	During KS3 , through the content across all three disciplines, pupils should be taught to:
			Scientific attitudes:
			Pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
			Understand that scientific methods and theories develop as scientists modify earlier explanations to take account of new evidence and ideas, together with the importance of publishing results and peer review
			Evaluate risks
			Experimental skills and investigations:
Asking simple questions and recognising that they can be answered in different ways.	Asking relevant questions and using different types of scientific enquiries to answer them.		Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
Performing simple tests	Setting up simple practical enquiries, comparative and fair tests	Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary	Select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate
Observing closely, using simple equipment	Making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers	Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.	Make and record observations and measurements using a range of methods for different investigations;
			Evaluate the reliability of methods and suggest possible improvements.
			Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety.

Sc1: Working scientifically			
KS1	Lower KS2	Upper KS2	KS3
			Apply sampling techniques.
			Make predictions using scientific knowledge and understanding.
			Analysis and Evaluation:
Gathering and recording data to help in answering questions	Gathering, recording, classifying and presenting data in a variety of ways to help in answering questions Recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables	Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.	Present observations and data using appropriate methods, including tables and graphs Apply mathematical concepts and calculate results Evaluate data, showing awareness of potential sources of random and systematic error
Identifying and classifying	Identifying differences, similarities or changes related to simple scientific ideas and processes	Identifying scientific evidence that has been used to support or refute ideas or arguments	Identify further questions arising from their results
Using their observations and ideas to suggest answers to questions	Using straightforward scientific evidence to answer questions or to support their findings. Using results to draw simple conclusions, make predictions for new values and suggest improvements and raise further questions.	Using test results to make predictions to set up further comparative and fair tests Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations	Present reasoned explanations, including explaining data in relation to predictions and hypotheses Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions.
	Reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions	Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations	
			Measurement: Understand and use SI units and IUPACC chemical vocabulary. Use and derive simple equations and carry out appropriate calculations Undertake basic data analysis including simple statistical techniques

Sc2: Biology: Plants

KS1	Lower KS2	Upper KS2	KS3
Identify and name a variety of common wild and garden plants, including deciduous and evergreen trees.	Identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers		The importance of plant reproduction through insect pollination in human food security
Identify and describe the basic structure of a variety of common flowering plants, including trees.	Explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant		<p>Nutrition & Digestion: Plants making carbohydrates in their leaves by photosynthesis and gaining mineral nutrients and water from the soil via their roots</p>
Find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.	Investigate the way in which water is transported within plants.		<p>Photosynthesis:</p> <ul style="list-style-type: none"> • Dependence of almost all life on the ability of photosynthetic organisms such as plants and algae to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain levels of oxygen and CO₂ in the atmosphere • Adaptation of leaves for P • Word summary for photosynthesis – reactants/products
			<p>Gas exchange systems: The role of leaf stomata in gas exchange in plants</p>
Observe and describe how seeds and bulbs grow into mature plants.	Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal.	Describe the life process of reproduction in some plants (and Animals, including humans)	<p>Reproduction: Reproduction in plants, including flower structure, wind and insect pollination, fertilisation, seed and fruit formation and dispersal, including quantitative investigation of dispersal mechanisms</p>

Sc2: Biology Living Things and their habitats:

KS1	Lower KS2	Upper KS2	KS3
Explore and compare the differences between things that are living, dead, and things that have never been alive.	Recognise that living things can be grouped in a variety of ways. Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment	Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including microorganisms, plants, and animals	
Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other.	Recognise that environments can change and that this can sometimes pose dangers to living things.	Give reasons for classifying plants and animals based on special characteristics.	Interactions and interdependencies Relationships in an ecosystem: How organisms affect, and are affected by, their environment, including the accumulation of toxic materials.
Identify and name a variety of plants and animals in their habitats, including micro-habitats.		Describe the life process of reproduction in some plants and animals.	The role of variation in enabling living things to survive in the same ecosystem.
Describe how animals obtain their food from plants and other animals, using the idea of a simple food chain , and identify and name different sources of food.	Construct and interpret a variety of food chains , identifying producers, predators and prey.		The interdependence of organisms in an ecosystem, including food webs and insect pollinated crops as examples.
			Cells and organisation: Cells as the fundamental unit of living organisms, including how to observe, interpret and record cell structure using a light microscope.
			The functions of the cell wall, cell membrane, cytoplasm, nucleus, vacuole, mitochondria and chloroplasts.
			Similarities and differences between plant and animal cells
			The role of diffusion in the movement of materials between cells
			The structural adaptations of some unicellular organisms

The hierarchical organisation of multicellular organisms: from cells to tissues to organs to systems to organisms

Cellular respiration
Aerobic and anaerobic respiration in living organisms, including the breakdown of organic molecules to enable all the other chemical processes necessary for life.
A word summary for aerobic respiration
The process of anaerobic respiration in humans and micro-organisms, including fermentation, and a word summary for anaerobic respiration.
The differences between aerobic and anaerobic respiration in terms of the reactants, the products formed and the implications for the organism.

Sc2: Biology Animals, including humans			
KS1	Lower KS2	Upper KS2	KS3
Identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals.			
Describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets)			
Identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense.	Identify that humans and some other animals have skeletons and muscles for support, protection and movement.		<p>The skeletal and muscular systems: The structure and functions of the human skeleton, to include support, protection, movement and making blood cells. Biomechanics – the interaction between skeleton and muscles, including the measurement of force exerted by different muscles. The function of muscles and examples of antagonistic muscles.</p>
Find out about and describe the basic needs of Animals, including humans, including humans, for survival (water, food and air)		Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.	<p>Health: The effects of recreational drugs (including substance misuse) on behaviour, health and life processes.</p>

Sc2: Biology Animals, including humans			
KS1	Lower KS2	Upper KS2	KS3
Identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense.		Describe the ways in which nutrients and water are transported within Animals, including humans, Identify and name the main parts of the circulatory system , and explain the functions of the heart, blood vessels and blood .	Gas exchange systems: Structure and functions of the gas exchange system in humans, including adaptations to function. Mechanism for breathing to move air in and out of the lungs, using a pressure model to explain the movement of gases, including simple measurements of lung volume. The impact of exercise, asthma and smoking on the human gas exchange system.
Notice that animals, including humans, including humans, have offspring which grow into adults.		Describe the life processes of reproduction in some Animals, including humans . Describe the changes as humans develop from birth to old age Describe the differences in the life cycles of mammal, amphibian, insect & bird.	Reproduction in humans (as an example of a mammal) including structure and function of male and female reproductive systems, menstrual cycle (without details of hormones), gametes, fertilisation, gestation and birth, to include effect of maternal lifestyle on the foetus through the placenta.
Describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene.	Describe the simple functions of the basic parts of the digestive system in humans.		Nutrition and digestion: Content of a healthy diet: carbohydrates, lipids (fats & oils), proteins, vitamins, minerals, dietary fibre and water, and why each is needed.
Identify and name a variety of common animals that are carnivores, herbivores and omnivores .	Identify that Animals, including humans, including humans, need the right types and amount of nutrition , and that they cannot make their own food; they get nutrition from what they eat.		Calculations of energy requirements in a healthy diet Consequences of imbalances in the diet, including obesity, starvation and deficiency diseases.
	Describe the simple functions of the basic parts of the digestive system in humans.		The tissues and organs of the human digestive system, including adaptations to function and how the digestive system digests food (enzymes simply as biological catalysts)
	Identify the different types of teeth in humans and their simple functions.		The importance of bacteria in the human digestive system

Sc2: Biology		Evolution & Inheritance	
KS1	Lower KS2	Upper KS2	KS3
		Evolution and inheritance Pupils should be taught to:	Genetics and evolution:
			The variation between individuals of different species
		Recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents.	The variation between individuals within a species being continuous or discontinuous, to include measurements and graphical representation of variation.
		Identify how Animals, including humans and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution	Variation between species and between individuals of the same species leading to competition which can drive natural selection
	From 'The Earth (Rocks, Atmosphere): Describe in simple terms how fossils are formed when things that have lived are trapped within rock.	Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago.	Changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction .
		Recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents.	Heredity as the process by which genetic information is transmitted from one generation to the next
			The importance of maintaining biodiversity and use of gene banks to preserve heredity material
			a simple model of chromosomes, genes and DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model

Sc3: Chemistry: Materials

KS1	Lower KS2	Upper KS2	KS3
Distinguish between an object and the material from which it is made.	Compare and group materials together, according to whether they are solids, liquids or gases.	Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets.	
<p>Describe the simple physical properties of a variety of everyday materials.</p> <p>Identify and name a variety of everyday materials, including wood, metal, plastic, glass, metal, water and rock.</p>	Observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C),		<p>The particulate nature of matter</p> <p>The properties of the different states of matter (solid, liquid and gas) in terms of the particle model, including gas pressure</p> <p>Changes of state in terms of the particle model.</p> <p>Energetics</p> <p>Energy changes on changes of state (qualitative)</p> <p>Exothermic and endothermic chemical reactions (qualitative).</p>
<p>Compare and group together a variety of everyday materials on the basis of their simple physical properties.</p> <p>Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses.</p>		<p>Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.</p>	<p>Materials</p> <p>The order of metals and carbon in the reactivity series</p> <p>The use of carbon in obtaining metals from metal oxides</p> <p>Properties of ceramics, polymers and composites (qualitative).</p>

Sc3: Chemistry: Materials

KS1	Lower KS2	Upper KS2	KS3
Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.	Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.	Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution. Demonstrate that dissolving , mixing and changes of state are reversible changes .	Pure and impure substances The concept of a pure substance Mixtures, including dissolving Diffusion in terms of the particle model The identification of pure substances.
		Use knowledge of solids, liquids and gases to decide how mixtures might be separated , including through filtering, sieving and evaporating.	Pure and impure substances Simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography.
			Atoms, Elements, Compounds A simple (Dalton) atomic model Differences between atoms, elements and compounds Chemical symbols and formulae for elements and compounds Conservation of mass in changes of state and chemical reactions
			Periodic table: The varying physical and chemical properties of different elements The principles underpinning the Mendeleev Periodic Table The Periodic Table: periods and groups; metals and non-metals. How patterns in reactions can be predicted with reference to the Periodic Table. The chemical properties of metal and non-metal oxides with respect to acidity.

Sc3: Chemistry	Materials:		
KS1	Lower KS2	Upper KS2	KS3
		<p>Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.</p>	<p>Chemical reactions as the rearrangement of atoms. Representing chemical reactions using formulae and equations. Combustion, thermal decomposition, oxidation and displacement reactions. The pH scale for measuring acidity/alkalinity, and indicators. Reactions of acids with metals to produce a salt plus hydrogen. Reactions of acids with alkalis to produce a salt plus water. What catalysts do.</p>
			<p>PHYSICS: Matter: Physical changes Conservation of material and of mass, and reversibility, in melting, freezing, evaporation, sublimation, condensation, dissolving Similarities and differences, including density differences, between solids, liquids and gases Brownian motion in gases Diffusion in liquids and gases driven by differences in concentration The difference between chemical and physical changes.</p>
			<p>PHYSICS: Matter: Particle model The differences in arrangements, in motion and in closeness of particles explaining changes of state, shape and density, the anomaly of ice-water transition Atoms and molecules as particles. PHYSICS: Energy in matter Changes with temperature in motion and spacing of particles Internal energy stored in materials.</p>

Sc3: Chemistry: Rocks

KS1	Lower KS2	Upper KS2	KS3
	Recognise that that soils are made from rocks and organic matter		Earth and Atmosphere The composition of the Earth The structure of the Earth The rock cycle and the formation of igneous , sedimentary and metamorphic rocks
	Describe in simple terms how fossils are formed when things that have lived are trapped within rock.		Earth as a source of limited resources and the efficacy of recycling The carbon cycle The composition of the atmosphere The production of carbon dioxide by human activity and the impact on climate.
	Compare and group together different kinds of rocks on the basis of their simple physical properties		

Sc4: Physics: Forces

KS1	Lower KS2	Upper KS2	KS3
<p>Materials: Find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching.</p>		<p>Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object.</p>	<p>Energy: simple machines give bigger force but at the expense of smaller movement (and vice versa): product of force and displacement unchanged</p> <p>Forces: Forces as pushes and pulls, arising from the interaction between two objects Using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces Moment as the turning effect of a force Forces: associated with deforming objects, stretching and squashing – springs. Forces measured in newtons, measurements of stretch or compression as force is changed Forces: associated with rubbing and friction between surfaces, with pushing things out of the way, resistance to motion of air and water. Force-extension linear reaction: Hooke's Law as a special case. Work done and energy changes on deformation Non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets and forces due to static electricity. Balanced forces: Opposing forces and equilibrium: weight held by a stretched spring or supported on a compressed surface</p>
	<p>Notice that some forces need contact between two objects, but magnetic forces can act at a distance.</p>	<p>Identify the effects of air resistance, water resistance and friction, that act between moving surfaces</p> <p>Recognise that some mechanisms, including gears, pulleys, levers and springs, allow a smaller force to have a greater effect.</p>	
	<p>Compare how things move on different surfaces.</p>		<p>Describing motion: Speed and the quantitative relationship between average speed, distance and time (speed = distance /time) The representation of a journey on a distance-time graph Relative motion: trains and cars passing one another. Forces and motion: Forces being needed to cause objects to stop or start objects moving, or to change their speed or direction of motion Change depending on direction of force and its size</p>
			<p>Pressure in fluids: Atmospheric pressure decreases with increase of height as weight of air above decreases with height Pressure in liquids increases with depth, upthrust effects, floating and density Pressure measured by ratio of force over area – acting normal to any surface</p>

Sc4: Physics : Light

KS1	Lower KS2	Upper KS2	KS3
	Notice that light is reflected from surfaces	Recognise that light appears to travel in straight lines	The similarities and differences between light waves and waves in matter. Light waves travelling through a vacuum; speed of light.
	Recognise that light from the sun can be dangerous and that there are ways to protect their eyes	use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye	The transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface.
	Recognise that they need light in order to see things and that dark is the absence of light	Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes.	Use of ray model to explain imaging in mirrors, the pinhole camera, the refraction of light and action of convex lens in focusing (qualitative); the human eye . Light transferring energy from source to absorber leading to chemical and electrical effects; photo-sensitive material in the retina and in cameras.
	Recognise that shadows are formed when the light from a light source is blocked by a solid object Find patterns that determine the size of shadows.	Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.	
			Colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection.

Sc4: Physics: Sound

KS1	Lower KS2	Upper KS2	KS3
	<p>Sound: Identify how sounds are made, associating some of them with something vibrating</p> <p>Recognise that vibrations from sounds travel through a medium to the ear</p>		<p>Observed waves: Waves on water as undulations which travel through water with transverse motion; these waves can be reflected, and add or cancel - superposition</p>
	<p>Find patterns between the pitch of a sound and features of the object that produced it</p> <p>Find patterns between the volume of a sound and the strength of the vibrations that produced it.</p> <p>Recognise that sounds get fainter as the distance from the sound source increases.</p>		<p>Sound waves: Frequencies of sound waves, measured in Hertz (Hz), echoes, reflection and absorption of sound Sound needs a medium to travel, the speed of sound in air, water and solids Sound produced by vibrations of objects, in loud speakers, detected by their effects on microphone diaphragm and the ear drum, sound waves are longitudinal Auditory range of humans and animals</p>
			<p>Energy and waves: Pressure waves transferring energy; use for cleaning and physiotherapy by ultra-sound; waves transferring information for conversion to electrical signals by microphone.</p>

Sc4: Physics: Magnets

KS1	Lower KS2	Upper KS2	KS3
	Notice that some forces need contact between two objects and some forces act at a distance.		
	Compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials.		
	Observe how magnets attract or repel each other and attract some materials and not others		
	Describe magnets as having two poles		
	Predict whether two magnets will attract or repel each other, depending on which poles are facing		Magnetic poles: attraction and repulsion Magnetic fields by plotting with compass, representation by field lines Earth's magnetism, compass and navigation The magnetic effect of a current, electromagnets, D.C. Motors (principles only)

Sc4: Physics: Electricity

KS1	Lower KS2	Upper KS2	KS3
	Identify common appliances that run on electricity.		Static electricity: Separation of positive or negative charges when objects are rubbed together; transfer of electrons, forces between charged particles The idea of electric field, forces acting across the space between objects not in contact.
	Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.	Use recognised symbols when representing a simple circuit in a diagram.	Current electricity: Electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current flow as charge
	Identify whether or not a lamp will light in a simple series circuit based on whether or not the lamp is part of a complete loop with a battery.	Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.	Potential difference, measured in volts, battery and bulb ratings, resistance measured in ohms, as the ratio of p.d. to current
	Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit.	Compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches.	From energy section: Comparing power ratings of appliances in watts (W, kW) Comparing amounts of energy transferred (J, kJ, kW hour) domestic fuel bills, fuel use and costs
	Recognise some common conductors and insulators, and associate metals with being good conductors.		Differences in resistance between conducting and insulating components (quantitative)

Sc4: Physics: Earth & Space

KS1	Lower KS2	Upper KS2	KS3
<p>Seasonal changes:</p> <p>Observe changes across the four seasons.</p>		Describe the movement of the Earth and other planets relative to the Sun in the solar system.	
Observe and describe weather associated with the seasons and how day length varies.		Describe the movement of the Moon relative to the Earth.	
		Describe the Sun, Earth and Moon as approximately spherical bodies.	Our sun as a star, other stars in our galaxy, other galaxies.
		Use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.	The seasons and the Earth's tilt, day length at different times of year, in different hemispheres.
			The light year as a unit of astronomical distance.
			Gravity force, weight = mass x gravitational field strength (g), on earth $g=10 \text{ N/kg}$, different on other planets and stars; gravity forces between earth and moon, and between earth and sun (qualitative only)

Sc4: Physics: Energy

KS1	Lower KS2	Upper KS2	KS3
		Understand that force and motion can be transferred through mechanical devices such as gears, pulleys, levers and springs.	<p>Energy changes and transfers Simple machines give bigger force but at the expense of smaller movement (and vice versa): product of force and displacement unchanged Heating and thermal equilibrium: Temperature difference between two objects leading to energy transfer from the hotter to the cooler one, through contact (conduction) or radiation; such transfers tending to reduce the temperature difference: Use of insulators Other processes that involve energy transfer: changing motion, dropping an object, completing an electrical circuit, stretching a spring, metabolism of food, burning fuels.</p>
			<p>Calculation of fuel uses and costs in the domestic context Comparing energy values of different foods (from labels) (kJ) Comparing power ratings of appliances in watts (W, kW) comparing amounts of energy transferred (J, kJ, kW hour) Domestic fuel bills, fuel use and costs Fuels and energy resources.</p>
			<p>Changes in systems Energy as a quantity that can be quantified and calculated; the total energy has the same value before and after a change Comparing the starting with the final conditions of a system and describing increases and decreases in the amounts of energy associated with movements, temperatures, changes in positions in a field, in elastic distortions and in chemical compositions Using physical processes and mechanisms, rather than energy, to explain the intermediate steps that bring about such changes.</p>