L.E.A.D. Academy Trust

Lead • Empower • Achieve • Drive

Secondary Curriculum

Science

Contents

L.E.A.D. Academy Trust

Our vision

Through outstanding leadership we, at the L.E.A.D. Academy Trust, will provide the highest quality education to enable every pupil to realise their full potential.

Our principles

To achieve our vision we prioritise the four core principles for which our name stands:

Lead - *to show the way; to be first or foremost*

In every aspect of life the ability to lead is essential. Strong leadership is the key to the success of our schools. We will develop leadership skills in everyone who attends one of them, ensuring the development of pupils as leaders of their own learning.

Empower - *to give power to; to enable*

At L.E.A.D. Academy schools pupils are empowered to have high aspirations for their futures. We nurture and challenge pupils to take responsibility, make decisions and work together so they grow into confident and resilient young people.

Achieve - *to accomplish; to get or attain by effort*

We believe in achievement in its broadest sense and that enjoyment of learning is crucial to success. We continually look for and reward achievement in every individual in our schools. We also know that a strong command of English and maths is vital as a foundation for the whole curriculum and prioritise learning in these core subjects.

Drive - *to cause and guide progress; to impel forward*

We will provide the very best education and training for every individual in our schools and will ensure that this is delivered. We value excellent teaching, underpinned by high quality professional development and will constantly move forwards, using and instigating the best ideas and practice.

We also understand that children need to be motivated if they are to succeed in life and we will provide a stimulating curriculum and environment which will prepare them for their futures with confidence and determination.

Glossary of key terms

Word	Meaning
Learning	A lasting change in long-term memory
Substantive knowledge	Established facts (content)
Disciplinary knowledge	Methods that establish the substantive facts (skills)
Conceptual knowledge	Knowledge of concepts, theories, principles, models etc. “Know that…”
Procedural knowledge	Knowledge of how to perform specific tasks “Know how to…”
Conditional knowledge	Knowing when and why to use conceptual and/or procedural knowledge
Discipline (Disciplinary)	A branch of knowledge e.g. Mathematics, Geography, Drama etc
Sequenced	Arranged in a particular order to aid learning
Spaced	Knowledge repeated at certain intervals to aid learning
Misconceptions	A view or opinion that is incorrect based on faulty understanding
Modelling	The process of learning by copying the behavior of an expert
Literacy	The ability to read or write effectively within a specific discipline
Oracy	The ability to express oneself effectively within a specific discipline
Pedagogy	The method and practice of teaching. The ‘how’ of the classroom
Schema	A cognitive framework of knowledge that helps us interpret new information

Science curriculum vision

Science at The Birley Academy is more than just a core subject. The curriculum has been planned with the aim of making the learning of science easier. It is designed to engage students so they have an appreciation and curiosity for the subject and be excited to study science at a greater depth and feel it is a subject they can achieve in, whatever their background.

Science relies on content (substantive knowledge) as well as skills (disciplinary knowledge) and this is woven into the fabric of our curriculum over five years. Pupils build upon their science education from primary school and cover, in depth, the most fundamental concepts in Year 7 – Atoms, Cells, Energy. This knowledge then increases in complexity as pupils build upon this knowledge through the disciplines of Biology, Chemistry and Physics.

"Somewhere, something incredible is waiting to be known." – Carl Sagan

Design of the science curriculum

We strive to constantly evaluate and evolve our curriculum to ensure that students' knowledge is built up in a logical way which is vital for a thorough understanding of complex scientific concepts.

We have recently refined our curriculum in order to include the following aims:

- To learn content that is sequenced in a logical order.
- To build on what pupils learned in primary school.
- To clearly and explicitly identify misconceptions.
- To revisit ideas and be shown different examples to develop their thinking.
- To consolidating learning before moving on.
- To help pupils see how knowledge connects with what they already know about science, so that they build connected knowledge.
- To embed disciplinary knowledge within the most appropriate substantive content so practical experiments have a clear purpose.
- To ensure a provision of stretch and challenge for all pupils.

The curriculum is research informed and considers what a successful scientist looks like at A Level and beyond with concepts sequenced back through each year. The curriculum covers nationally and internationally accepted core concepts in science but also goes beyond the national curriculum and examination specifications to include the knowledge considered important to attain a deep understanding of scientific ideas. The fact that we include ambitious content in key stage 3 means that every child has the option of taking separate sciences for GCSE when they pick options at the end of Year 9.

Delivery of the science curriculum

At KS3, students are introduced to the fundamentals in Biology, Chemistry & Physics which form the building blocks for all other knowledge. Learners are also taught the 'vocabulary' of Science which are the skills that will underpin all aspects of Science up to GCSE and beyond.

Scientific literacy is developed through chosen tasks and explicit teaching of key vocabulary. There is a requirement for pupils to express themselves with increasing sophistication and accuracy through different means.

At GCSE, students follow the AQA exam board. They are taught by skilled subject specialists who are keen to pass on the mastery of their own discipline. AQA is the most widely taken exam board, it facilitates opportunities for data analysis and collaboration that we would not have otherwise.

Practical skills are an integral part of the Science curriculum and due to the longer lessons are seamlessly embedded in the day-to-day teaching. Disciplinary procedural knowledge includes how to work safely as a scientist including the use of a range of apparatus and techniques.

Common misconceptions are identified and built into curriculum planning so that potential barriers to learning can be pre-empted and overcome

Development of examination technique focusses on identification of command words, the need to thoroughly process all information and the accurate use of subject specific vocabulary.

One of the most important features of the Science curriculum at The Birley Academy is that it is fluid in nature. The curriculum is regularly adapted and updated to make sure that it always meets the needs of the learners at the time. This combined with high quality teaching and learning experiences help us to implement our vision of a successful knowledge-engaged curriculum.

Adapting the curriculum for SEND

We aim to ensure that all our pupils who are disadvantaged or have any special educational needs and/or disabilities (SEND) have access to the same carefully planned curriculum as their peers. Our curriculum aims to provide pupils with SEND with explicit systematic teaching and rehearsal of knowledge. We also ensure that these pupils have the time they need to study important subject content in science.

We know that successful teaching is successful for all pupils regardless of background or prior attainment. To that end the curriculum is adapted to suit all learners in the following ways:

- Learner confidence is built by making lessons accessible and offering all pupils the opportunity for success. The curriculum creates opportunities for learners to feel 'like a scientist'
- Lessons begin with specific knowledge retrieval activities to return to and embed fundamental ideas
- Complex concepts and abstract ideas are organised through easy to follow diagrams and flow charts that can be referenced to support successful application
- Live modelling is used often to explicitly narrate expert thought that pupils can replicate
- Links between ideas are made explicit so that learners can build and strengthen their schema
- Practical work is not completed without a solid grounding in theory and/or demonstration by an expert
- Scaffolds are provided to support oracy and literacy activities with a plan in place to reduce reliance on these scaffolds over time
- Further activities that aid retention and quick recall of spaced content are embedded within every lesson

Legacy curriculum

In 2024-25 at The Birley Academy, Year 7, year 8 and year 9 students will follow the L.E.A.D. Science curriculum. This is because students in Year 10-11 have followed a legacy curriculum route as detailed below. However, knowledge checks will be used at the start of each unit taught to identify specific knowledge gaps so that these can be addressed before the unit is taught.

		23-24	24-25	25-26	26-27
Year Group in 24/25	Year 7	New	New	New	New
	Year 8	Legacy	New	New	New
	Year 9	Legacy	New	New	New
	Year 10	Legacy	Legacy	New	New
	Year 11	Legacy	Legacy	Legacy	New

Curriculum intent map

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Theme/Concept	(KS2)	Year 7	Year 8	Year 9	Year 10	Year 11	(Post-16)
Biology: The cellular basis of life		**Cells and Microscopes** Animal & plant cell structure Microscopy Specialised animal & plant cells Introduction to stem cells Organisation & unicellular organisms Diffusion Osmosis	**Respiration** Aerobic and anaerobic respiration Word equations Breathing rate and heart rate	**Cells & Cell Transport** Prokaryotic & eukaryotic cells Specialised cells Microscopes & magnification Osmosis Diffusion Active Transport	**Cell division** (cells recap) Chromosomes The cell cycle Mitosis Stem cells	*(Application)*	*Biological molecules* *Cells* *Organisms exchange substances with their environment*
			(photosynthesis taught in plant biology)		**Bioenergetics** Photosynthesis & limiting factors Using glucose from photosynthesis Aerobic and anaerobic Respiration metabolism		
Biology: DNA as the molecule of inheritance	*Animals including humans* *Evolution & Inheritance*	*(Cells)*	**Reproduction** Human reproductive systems Sexual and asexual reproduction Fertilisation Pregnancy and birth The menstrual cycle Contraception	*(cells and cell transport)*	**Inheritance** Sexual & asexual reproduction meiosis Genetic inheritance Genotype & phenotype Inherited disorders Sex determination Variation Understanding of genetics DNA and the genome TRIPLE CONTENT *Advantages & disadvantages of sexual & asexual reproduction* *DNA structure* *Protein synthesis*	**Variation & evolution** Selective breeding Evolution & natural selection Evidence for evolution Antibiotic resistance Genetic engineering Cloning Fossils Classification TRIPLE CONTENT *Cloning* *Theory of evolution* *Speciation* *The understanding of genetics*	*Genetic information, variation* *Genetics* *The control of gene expression*
Biology: Human Biology		**Health** Biomechanics - skeleton, muscles & exercise Basic digestion & nutrition Nervous system Simple endocrine systems Substance misuse	**Breathing & Circulation** The Lungs Diffusion Asthma & smoking Lung disease The heart - basics Exercise Smoking	**The digestive system** Human digestive system Food tests Digestive enzymes **The heart & circulation** Blood The heart Blood & blood vessels Health issues Non-communicable diseases Heart disease The lungs	**Defence and immunity** Pathogens & microbes Communicable diseases Human defense systems Discovery and development of drugs Reducing the spread of infection Vaccination Antibiotics & painkillers Culturing microorganisms TRIPLE CONTENT *Monoclonal antibodies & their uses.* *Plant diseases & plant defence response.*	**Homeostasis & response** Human nervous system Human endocrine system Control of blood glucose TRIPLE CONTENT Maintaining water & nitrogen *balance* *The Brain* *The Eye* *Control of body temperature* *Plant hormones & uses of plant hormones*	*Organisms exchange substances with their environment* *Energy transfers* *Organism response to environment*
Biology: Ecosystems	*Living things and their habitats*	**Ecology** Habitats & communities Variation Continuous & discontinuous variation Biodiversity Biotic and abiotic factors Adaptation & variation Charles Darwin Natural selection Sampling	**Plant Biology** Plant structure Leaf structure & adaptations (basic) Photosynthesis word equation Structure of the flower Reproduction in plants seed dispersal	**Plant organisation** Leaf structure Stomata Transport in plants (transpiration and translocation)	**Adaptations & competition** Interdependence biotic & abiotic factors Sampling Adaptations & competition Extremophiles Feeding relationships TRIPLE CONTENT Trophic levels Interdependence Pyramids of biomass Transfer of biomass Pollution Nutrient cycles Food security Food production Decoposition The impact of environmental change	**Human effects on ecosystems** Biodiversity Deforestation & peat bogs The carbon cycle The water cycle Global warming	*Relationships between organisms* *Energy transfers* *Populations, evolution and ecosystems*

Chemistry: Structure, Properties, Bonding & Analysis		*(Substances & Properties)*	**Elements, mixtures and compounds** Particulate nature of matter Elements, compounds Symbols & formulae Mixtures Introduction to the Periodic Table	**Atomic structure** Atomic structure Subatomic particles Charge Size & mass Relative atomic mass Isotopes Electronic structure Balancing equations	**Bonding** Chemical bonds Ionic bonding Properties of ionic compounds Covalent bonding Properties of small molecules Giant covalent structures Structure and bonding of carbon Comparison to ionic bonding Metallic bonding Properties of metals and alloys including conductors Polymers.	**Crude Oil Hydrocarbons / organic chemistry** Hydrocarbon molecules Cracking Fractional distillation TRIPLE CONTENT Reactions of organic compounds (triple only) Synthetic & naturally occurring polymers (triple only)	*Atomic structure, amount of substance, bonding*
	Rocks	*(Substances & Properties)*	**Chemical analysis** Pure & impure substances Solutions & salts Chromatography Filtering & evaporation Simple distillation	**Periodic Table** Elements Metals & non-metals Atomic structure & periodic patterns History of the Periodic Table Group 0 Group 1 Group 7 TRIPLE CONTENT Properties of transition metals	**Electrolysis** Electrolysis of molten compounds & solutions Balanced equations Extracting aluminium		*Energetics, kinetics, thermodynamics, rate equations, acids & bases, periodicity*
					Chemical Analysis Purity Formulations Chromatography Identification of common gases TRIPLE CONTENT Identification of ions by chemical and spectroscopic means (triple only)		
Chemistry: Chemical Reactions	*Properties and changes of materials*	**Substances & properties** Composites, ceramics and polymers Acids & alkalis Concentration & dilution pH scales Neutralisation Simple titrations Reactions of acids including: making a salt Testing for hydrogen and carbon dioxide Representing reactions using word equations	**Chemical Reactions** Reactants & products Conservation of mass Representing reactions using: Word equations Symbol equations (simple balanced) Combustion, thermal decomposition, oxidation, reduction and displacement Endothermic & exothermic reactions	**Energy changes** Exothermic & endothermic Reaction profiles including use of catalysts Energy change of reactions TRIPLE CONTENT Chemical cells & fuel cells	**Quantitative Chemistry** Relative atomic and relative formula mass Balancing equations Moles Moles in gases & moles in solution Amounts of substances in equations Using moles to balance equations Limiting reactions TRIPLE CONTENT Yield & atom economy Titration Amount of gases	**Rates** Rate of reaction Collision frequency Reversible reactions Catalysis Reversible reactions Dynamic equilibrium TRIPLE CONTENT Haber process	*Redox, chemical equilibria*
				Chemical changes Strong and weak acids Concentration of solutions & pH Neutralisation Metal acid reactions Filtration and evaporation Oxidation & reduction Redox			
Chemistry: Earth & Resources		**Earth & Recycling** Rocks & the Earth Earthquakes & waves Atmosphere, air quality & pollution inc. acid rain Chemical & physical weathering	*(Atoms & Periodic Table)*	**Chemical changes** Reactivity Extraction of metals Extracting metals from low grade ore		**Atmosphere & Resources** Composition and evolution of the Earth's atmosphere Greenhouse effect and climate change Making rocks Making fossil fuels Atmospheric pollution Using resources and potable water Water cycle Recycling TRIPLE CONTENT NPK fertilisers Alloys Corrosion Glass, ceramic, polymer, composites.	*Organic chemistry*

Physics: Energy	*Light* *Straight lines* *Reflection to see objects* *Shadows*	**Energy** Energy stores Energy transfers Heat transfer by particles Heat transfer by radiation Energy from food Work done Power	**Waves - Sound** Transverse and longitudinal Properties of waves superposition Sound waves Sound and the oscilloscope The ear Hearing damage Echo and ultrasound Microphone and speaker	**Energy Stores** Energy stores & systems Conservation of energy Work done GPE KE EPE Efficiency Power	**Nuclear Radiation / atomic structure** History of the atom Atoms & isotopes Radioactive decay Nuclear radiation Half-life Hazards & uses of radioactive emissions and background radiation TRIPLE CONTENT Nuclear fission & fusion	**Waves** Transverse & longitudinal Properties of waves Wave speed calculations Ripple tank RP Speed of sound Reflection and diffuse vs specular waves and surfaces (reflected, transmitted absorbed and transparent, translucent and opaque) TRIPLE CONTENT Refraction Reflection Refraction RP Lenses	*Waves* *Thermal* *Radioactivity*
		Resources Structure of the earth Earthquakes Fuels and power stations Renewable and non renewable The cost of electricity	**Waves - Light** Light sources Light and surfaces How we see The law of reflection Refraction Lenses and the eye Camera obscura practical lesson Light and colour	**Energy resources** Comparing conventional power stations Wind and wave energy Tidal and hydro electric Solar Geothermal and data analysis Big energy issues (meeting changing demand)		**Electromagnetism** Communications (radio, microwave and optic fibre) Leslie cube RP UV, Xrays and gamma TRIPLE CONTENT Sound waves Waves for scanning Light colour and filters	
	Electricity *Brightness & voltage* *Components* *Symbols*		**Electricity & Magnetism** Static electricity and fields Potential difference, current and resistance Series circuits Parallel circuits Magnets Magnetic fields Electromagnets Using electromagnets	**Electricity in circuits** Current and charge Ohms law Resistance in a wire (RP) Series circuits Parallel circuits Resistors in series and parallel (RP) Component graphs Components RP Charge and energy TRIPLE CONTENT	**Domestic electricity** AC and DC Plugs and cables Fuses Power calculations The national grid	**Electromagnetism** Magnetic fields Fields and current The motor effect TRIPLE CONTENT Em devices Generator effect Alternator and dynamo Transformers Transformer calculations	*Electricity* *Electric &* *Magnetic Fields*
Physics: Forces	*Forces* *Gravity* *Types of force* *Transferring force*	**Forces** Introduction to forces Squashing and stretching Drag forces Friction Balanced forces Unbalanced forces Speed Fields Weight, mass and Gravity	*(forces)*	**Motion** Distance time graphs Velocity time Graphs More complex graphs of motion	**Forces and motion** Force and Motion Force and acceleration Weight and terminal velocity Forces and braking Momentum Force and elasticity (TRIPLE CONTENT) Conservation of momentum Impact forces	**Force and pressure** (TRIPLE CONTENT) Pressure and surfaces Pressure in a liquid Atmospheric pressure Upthrust and floating	*Mechanics*
					Forces in balance Vectors and scalars Forces between objects Balanced and unbalanced forces Centre of mass Parallelogram of forces Resolving Forces Newtons laws (TRIPLE CONTENT) Moments Gears		
	Earth & Space *Solar System* *Moon* *Day & Night*	*(Forces)*	**Space** The night sky The universe The solar system Days, months, years, and seasons Changing ideas	*(Motion)*		**Space** (TRIPLE CONTENT) Solar system & the universe Stellar evolution The Big Bang Theory Red shift The cosmic microwave background Orbits	*Circular and SHM* *Gravitational Fields*
Physics: Matter	*Properties of Materials* *Classify* *Dissolving* *States of matter*	**Particle Model** Changes of state and particle model melting and freezing Boiling and evaporation Brownian motion and diffusion Gas Pressure		**Energy transfer by heating** HEATING Conduction Specific heat capacity Insulation TRIPLE CONTENT Infra red Leslie cube practical	**Molecules & matter** Density Density RP States of matter Internal energy Heating and cooling Specific latent heat Gas pressure (Triple content) Gas pressure and volume	*(Application)*	*Particle Physics* *Materials*

Curriculum timeline 2024-25

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Time of Year	Year 7	Year 8	Year 9	Year 10	Year 11
Autumn 1	Particle model	Elements, mixtures & compounds	Cells and cell transport	Cell division	Homeostasis & response
	Cells & microscopes	Reproduction	Energy stores	Domestic electricity	Rates
					Electromagnetic waves
				Molecules and matter	Light (T)
				Bonding	Atmosphere & resources
Autumn 2	Substances & properties	Waves - sound and light	Atomic structure	Inheritance	Organic chemistry
	Energy		The digestive system	Radioactivity	*Mock Exams*
					Variation & evolution
Spring 1	Health	Breathing & Circulation	The heart & circulation	Defence & immunity	Electromagnetism
	Resources	Chemical analysis	Energy transfer by heating	Chemical analysis	Human Effects on Ecosystem
Spring 2	Forces	Chemical reactions	The periodic table	Forces in balance	Space (T)
					Mock Exams
		Electricity & Magnetism	The heart & circulation	Electrolysis	
Summer 1	Earth & recycling	Respiration	Energy resources	Bioenergetics	Revision
			Chemical changes	Forces & motion (inc graphs of motion)	
				Force and pressure (T)	
	Ecology	Space		Quantitative Chemistry	*External Examination*
Summer 2	Ecology cont.	Plant biology	Organising plants	Wave properties	*External Examination*
			Electricity in circuits	Adaptations	
	Summer Examination	*Summer Examination*	*Summer Examination*	*Summer Examination*	
	Application	cont.	Energy changes	Application	---
		Application	Application		

Sequences of learning

Biology

Year 7 Cells & microscopes
Year 7 Health
Year 7 Ecology

Year 8 Reproduction (in progress)
Year 8 Breathing and circulation (in progress)
Year 8 Respiration (in progress)
Year 8 Plant biology (in progress)

Year 9 Cells and cell transport (in progress)
Year 9 The digestive system (in progress)
Year 9 The heart and circulation (in progress)
Year 9 Plant organisation (in progress)

Chemistry

Year 7 Earth and recycling
Year 7 Substances & properties

Year 8 Elements, mixtures and compounds (in progress)
Year 8 Chemical analysis (in progress)
Year 8 Chemical reactions (in progress)

Year 9 Atomic structure (in progress)
Year 9 The periodic table (in progress)
Year 9 Chemical changes (in progress)
Year 9 Energy changes (in progress)

Physics

Year 7 Energy Stores
Year 7 Resources
Year 7 Forces
Year 7 Particle

Year 8 Waves - Sounds and light (in progress)
Year 8 Electricity and magnetism (in progress)
Year 8 Space (in progress)

Year 9 Energy stores (in progress)
Year 9 Energy transfer by heating (in progress)
Year 9 Energy resources (in progress)
Year 9 Electricity in circuits (in progress)