The Lionheart Five Year Science Curriculum

Our rationale is to provide a fluid and dynamic knowledge rich KS3 to KS4 curriculum. This will be achieved through a comprehensive 5 year curriculum model where we will be establishing key knowledge and skills that include effective practical and analytical approaches with Literacy and numeracy embedded throughout. This curriculum model will enable learners to gain access to higher GCSE content in earlier years to support accelerated learning and the transition between the two key stages will be bridged effectively. The scientific knowledge and skills developed by learners will provide them with a secure foundation to access sciences at post 16 and consequently STEM related career aspirations.

This curriculum is specified in detail to ensure that knowledge is remembered (not merely encountered) that enables cognitive retrieval through sequential mapping of key concepts and interleaving. Evidence has shown that treating thinking skills as abstract from content leads to students writing surface knowledge responses. By grounding skills in relevant and enriching knowledge, students become scholarly and confident demonstrating deeper understanding. Our knowledge rich curriculum reflects this approach to science education that will lead to automaticity in our students.

Five year curriculum plan (KS3 and 4)

At KS3 we have chosen a curriculum (Activate) that has embedded and consolidated topics that would have been visited at KS2 and these are the key principles that are developed across the key stages. This builds on these foundations in terms of level of content and challenge. The KS3 curriculum interleaves on topics that will be taught at KS4 as it follows the AQA syllabus. Learners will be exposed to key concepts at KS3 that will prepare them for the challenges at KS4. At KS4 we follow the AQA Trilogy and Separate Sciences (Biology, Chemistry and Physics). The learners will be developing practical skills and the components of 'how science works' throughout KS3 and KS4, with a greater emphasis on the required practical's at GCSE.

Our topics taught at KS4 will have concepts that will ensure that learners have secured the necessary foundations for moving onto science courses at KS5.

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Trilogy (combined) 5 year plan

The topics that are linked together across KS3 and KS4 have been colour coded and can be mapped across this cyclic curriculum.

	KS3			
Forces	1.1 Speed	1.2 Gravity	1.3 Contact forces	1.4 Pressure
Electro-magnets	2.1 Potential difference and resistance	2.2 Current	2.3 Magnetism	2.4 Electro-magnets
Energy	3.1 Energy costs	3.2 Energy transfer	3.3 Work	3.4 Heating and cooling
Waves	4.1 Sound	4.2 Light	4.3 Wave effects	4.4 Wave properties
Matter	5.1 Particle model	5.2 Separating mixtures	5.3 Elements	5.4 Periodic Table
Reactions	6.1 Acids and alkalis	6.2 Metals and non-metals	6.3 Types of reaction	6.4 Chemical energy
Earth	7.1 Earth Structure	7.2 Universe	7.3 Climate	7.4 Earth resources
Organisms	8.1 Movement	8.2 Cells	8.3 Breathing	8.4 Digestion
Ecosystem	9.1 Inter-dependence	9.2 Plant reproduction	9.3 Respiration	9.4 Photo-synthesis
Genes	10.1 Variation	10.2 Human reproduction	10.3 Evolution	10.4 Inheritance

KS4 Paper 1 Biology	
1 Cells and organisation	2 Disease and bioenergetics
B1 Cell structure and transport	B5 Communicable diseases
B2 Cell division	B6 Preventing and treating disease
B3 Organisation and the digestive system	B7 Non-communicable diseases
B4 Organising animals and plants	B8 Photosynthesis
	B9 Respiration

KS4 Paper 2 Biology		
3 Biological responses	4 Genetics and reproduction	B5 Ecology
B10 The human nervous system	B12 Reproduction	B15 Adaptations, interdependence, and competition
	B13 Variation and evolution	B16 Organising and ecosystem
B11 Hormonal coordination		
	B14 Genetics and evolution	B17 Biodiversity and ecosystems

KS4 Paper 1 Chemistry	
1 Atoms, bonding, and moles	2 Chemical reactions and energy changes
C1 Atomic structure	C5 Chemical changes
C2 The periodic table	C6 Electrolysis
C3 Structure and bonding	C7 Energy changes
C4 Chemical calculations	

KS4 Paper 2 Chemistry	
3 Rates, equilibrium and organic chemistry	4 Analysis and the Earth's resources
C8 Rates and equilibrium	C10 Chemical analysis
	C11 The Earth's atmosphere
C9 Crude oil and fuels	C12 The Earth's resources

KS4 Paper 1 Physics	
1 Energy and energy resources	2 Particles at work
P1 Conservation and dissipation of energy	P4 Electric circuits
	P5 Electricity in the home
P2 Energy transfer by heating	P6 Molecules and matter
P3 Energy resources	P7 Radioactivity

KS4 Paper 2 Physics	
3 Forces in action	4 Waves, electromagnetism, and space
P8 Forces in balance	P11 Wave properties
P9 Motion	P12 Electromagnetic waves
P10 Force and motion	P13 Electromagnetism

Separate Sciences 5 year plan

The topics that are linked together across KS3 and KS4 have been colour coded and can be mapped across this cyclic curriculum.

	KS3			
Forces	1.1 Speed	1.2 Gravity	1.3 Contact forces	1.4 Pressure
Electro-magnets	2.1 Potential difference and resistance	2.2 Current	2.3 Magnetism	2.4 Electro-magnets
Energy	3.1 Energy costs	3.2 Energy transfer	3.3 Work	3.4 Heating and cooling
Waves	4.1 Sound	4.2 Light	4.3 Wave effects	4.4 Wave properties
Matter	5.1 Particle model	5.2 Separating mixtures	5.3 Elements	5.4 Periodic Table
Reactions	6.1 Acids and alkalis	6.2 Metals and non-metals	6.3 Types of reaction	6.4 Chemical energy
Earth	7.1 Earth Structure	7.2 Universe	7.3 Climate	7.4 Earth resources
Organisms	8.1 Movement	8.2 Cells	8.3 Breathing	8.4 Digestion
Ecosystem	9.1 Inter-dependence	9.2 Plant reproduction	9.3 Respiration	9.4 Photo-synthesis
Genes	10.1 Variation	10.2 Human reproduction	10.3 Evolution	10.4 Inheritance

KS4 Paper 1 Biology	
1 Cells and organisation	2 Disease and bioenergetics
B1 Cell structure and transport	B5 Communicable diseases
B2 Cell division	B6 Preventing and treating disease
B3 Organisation and the digestive system	B7 Non-communicable diseases
B4 Organising animals and plants	B8 Photosynthesis
	B9 Respiration

KS4 Paper 2 Biology		
3 Biological responses	4 Genetics and reproduction	B5 Ecology
B10 The human nervous system	B13 Reproduction	B16 Adaptations, interdependence, and competition
B11 Hormonal coordination	B14 Variation and evolution	B17 Organising and ecosystem
B12 Homeostasis in action	B15 Genetics and evolution	B18 Biodiversity and ecosystems

KS4 Paper 1 Chemistry	
1 Atoms, bonding, and moles	2 Chemical reactions and energy changes
C1 Atomic structure	C5 Chemical changes
C2 The periodic table	C6 Electrolysis
C3 Structure and bonding	C7 Energy changes
C4 Chemical calculations	

KS4 Paper 2 Chemistry	
3 Rates, equilibrium and organic chemistry	4 Analysis and the Earth's resources
C8 Rates and equilibrium	C12 Chemical analysis
C9 Crude oil and fuels	C13 The Earth's atmosphere
C10 Organic reaction	C14 The Earth's resources
C11 Polymers	C15 Using our resources

KS4 Paper 1 Physics	
1 Energy and energy resources	2 Particles at work
P1 Conservation and dissipation of energy	P4 Electric circuits
	P5 Electricity in the home
P2 Energy transfer by heating	P6 Molecules and matter
P3 Energy resources	P7 Radioactivity

KS4 Paper 2 Physics	
3 Forces in action	4 Waves, electromagnetism, and space
P8 Forces in balance	P12 Wave properties
P9 Motion	P13 Electromagnetic waves
P10 Force and motion	P14 Light
	P15 Electromagnetism
P11 Force and pressure	P16 Space

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Timetabling

On average each week our KS4 learners access 5 hours of curriculum time and KS3 subsequently have 4 hours. During their experience in Science lessons they will be developing practical skills, understanding the key drivers of how Science works including consolidation of key concepts and knowledge.

Vocabulary

Vocabulary is at the heart of our curriculum and endeavours to narrow the gap between advantaged and disadvantaged learners, addressing the key issue of social mobility. Knowing about how vocabulary can impact on student outcomes is the responsibility of every teacher and an entitlement of every learner. Our curriculum will empower teachers to become more astute and confident in the use of explicit vocabulary that will enable our learners to analyse data and texts with confidence. This will in turn initiate learners to write in a conceptualised and evaluative manner.

Our units align and encourage a structured approach interleaving and revisiting content and vocabulary from previous topics. The impact will be assessed through low stakes knowledge tests, end of topic assessments and written responses to long answer questions. Our vision is that our students will use explicit vocabulary through explanations orally as well. Each unit has its own key knowledge organiser with the relevant vocabulary highlighted. The vocabulary will be relevant to the subject content of the unit. It will feature as part of the resources for the unit and modelled by teachers within daily diet of a lesson, tested weekly in vocabulary tests and integration in the scheme of work.

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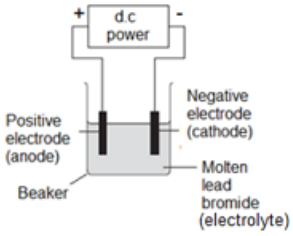
KNOWLEDGE ORGANISER

Chemistry Topic 6 Electrolysis

Section 1 Electrolysis key terms

Electrolysis	The process of **splitting an ionic compound** by passing **electricity** through it.
Electrolyte	An **ionic compound** that is **molten** (melted) or **dissolved in water.** The electrolyte is broken down by electricity enabling its **ions** to and hence carry a charge. **move freely**
Electrode	An **electrical conductor** that is placed in the **electrolyte** and connected to the **power supply.**
Cathode	The **negative electrode.** The electrode attached to the negative terminal of the power supply.
Anode	The **positive electrode.** The electrode attached to the positive terminal of the power supply.
Oxidation	Loss of electrons
Reduction	Gain of electrons



Positive
Anode
Negative
Is
Cathode

Section 2a: Changes at the electrodes – Pure ionic compounds

Electrolyte	Cathode	Anode
Molten Compound	Metal	Non-metal produced.
Molten lead bromide (diagram above)	**Lead metal** is produced $Pb^{2+} + 2e^- \rightarrow Pb$	**Bromine** is produced $2Br^- \rightarrow Br_2 + 2e^-$

Section 2b: Changes at the electrodes – Aqueous solutions

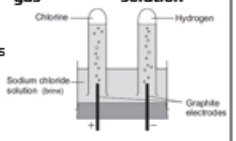
Electrolyte	Cathode	Anode
Dissolved compound (aqueous solution)	The **metal** if the metal is **less reactive than hydrogen.** **Hydrogen** is produced if the **metal is more reactive than hydrogen.**	**Oxygen** is produced **unless the solution contains halide ions** (chloride, bromide, iodide) when the **halogen** (chlorine, bromine, iodine) is produced.

Electrolyte	Cathode	Anode
$CuBr_{2(aq)}$	Copper	Bromine
$NaCl_{(aq)}$	Hydrogen	Chlorine
$KI_{(aq)}$	Hydrogen	Iodine
$Na_2SO_{4(aq)}$	Hydrogen	Oxygen

Electrolysis of Brine (concentrated sodium chloride solution)

In the electrolysis of brine, **three products** are formed, **hydrogen, chlorine** and **sodium hydroxide.**

Sodium chloride solution → hydrogen gas + chlorine gas + sodium hydroxide solution



At the **cathode hydrogen** gas forms
$2H^+ + 2e^- \rightarrow H_2$ **(reduction)**

At the **anode, chlorine** gas forms
$2Cl^- \rightarrow Cl_2 + 2e^-$ **(Oxidation)**

Sodium ions stay in solution (as sodium is more reactive than hydrogen) and **combine with hydroxide ions** to form sodium hydroxide.
$Na^+ + OH^- \rightarrow NaOH$

[3] An example of a knowledge organiser for the KS4 Chemistry topic Electrolysis. The keywords for each topic are highlighted in section 1. This is consistent through all of the knowledge organisers.

Science vocabulary				
Accuracy	Random error	Interval	Resolution	Variables
Calibration	Systematic error	Precision	Sketch graph	Categoric
Data	Zero error	Prediction	True value	Continuous
Error	Evidence	Range	Uncertainty	Control
Measurement error	Fair test	Repeatable	Validity	Dependent
Anomalies	Hypothesis	Reproducible	Valid conclusion	Independent

[4] The Science vocabulary list for KS4 Science that link to the concepts of experimentation and analysis

Science command words			
Calculate	Determine	Justify	Show
Choose	Draw	Label	Sketch
Compare	Estimate	Measure	Suggest
Complete	Evaluate	Name	Use
Define	Explain	Plan	Work out
Describe	Give	Plot	Write
Design	Identify	Predict	

[5] The Science command words for KS4 to enable students to answer exam based questions and levels of complexity in questioning

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Assessment

In terms of assessment each topic will be tested at the end via a low stakes knowledge based assessment that incorporate prior learning through interleaving key concepts and this will be a cumulative process. There will also be opportunities for extended writing (6 mark long answer questions) that will emulate exam style questions. We have planned for common assessment points across KS3 and KS4 including baseline tests and end of year/trial exams. The marks for the student assessments will be stored in a common database within each school and results will be made available where appropriate with parents. The continued assessments at KS4 will ensure that there is a focus on the required practical components for the sciences that will be examined across Paper 1 and Paper 2 in the GCSE end of year exams.

Schemes of Learning

Our schemes of learning across the key stages will be readily available electronically through OneDrive. All schools across the LAT will have access to the schemes and a common set of core resources that will enable them to use and adapt. The intention is that we would like teachers to preserve their creativity and innovation in designing lessons that would engage and improve outcomes of the learners in their lessons. Where there is demonstrable good practice, teachers across the LAT will be encouraged to share and develop pedagogy and distribute via the OneDrive portal.

Collaboration and Enrichment

In order for our schools across the LAT to work collaboratively and as an interdisciplinary team we will be organising several challenge days, masterclasses and other events to encourage enrichment and inclusion of our learners. As such, we have arranges a CSI Challenge Day at KS3 and a Science Masterclass for HAP Girls at KS4. We will endeavour to hold regular events at all the different locations across the LAT. The aims of such events are to extend the learners and for them to develop both analytical and problem solving skills.

Science at KS5

There is an effective transition from KS3/KS4 science to KS5 for schools that follow a 7 year curriculum plan. The GCSE topics at KS4 successfully interleave into the more challenging concepts at KS5 in biology, chemistry and physics. This demonstrates a cyclic curricular approach. Our learners will be provided with essential transition work that builds on the foundations for KS5. There will be an exposure to A-level exam questions at GCSE that would link into KS5 preparing our learners for the transition into A-level sciences. The delivery of required practical's is paramount because the learners will achieve endorsement as well as be assessed through examinations. Where required, we will be sharing practice around this area.

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Our students will be developing independent learning skills through 'Prep Learning' to enable them to apply their knowledge in sequential lessons. These attributes will help them prepare for University as it will develop transferable skills. A strong focus at KS5 will be 'Learning how to learn' that will encompass revision skills and reading subject material beyond the specification that will embed scientific vocabulary and enrichment. A key skill we would like our KS5 students to develop is reflection through peer and self-assessment that will enable them to improve their learning through understanding of meta-cognatic methodology.

To raise aspirations and career opportunities we will be encouraging outside speakers from industry, academia and the local community to deliver informative sessions to our learners across all key stages.

Overall our KS5 curriculum will ensure that our learners will have a good grounding in scientific knowledge and they will become both scholarly and confident in their science studies at KS5 and beyond.

CPD

A major focus is action research, where groups within science departments have focussed on developing subject specific and pedagogical approaches. We will also develop a CPD delivery programme following regular observations and analysis of reviews to suit the needs of the departments across the LAT.