

# Discussion 3: meeting the challenge of Combined Science

## What are the issues for the potential 1-3 Foundation learner?

- Accessing content and RPs – progression of content from the ELC outcomes through the Foundation tier.
- Achievable assessments to motivate students – use ELC assessments as part of your formative assessments.
- Using practical lessons efficiently to cover both the required practicals and need to cover the Teacher Devised Assessments.
- Creating engaging lessons – use the working scientifically statements as a starting point and teach topics through these, embedding these important skills.
- Students need to access performance points – make decisions on entry and awarding in March 2018 as students can be entered for both ELC and GCSE

## Planning a bespoke route through for your students

There are a number of questions to consider before you start planning your co-teaching course:

- Are you using ELC as a motivating tool to support Combined (Approach 1), **or** is ELC the main course and you are topping up with Combined (Approach 2)?
- **Approach 1:** how are you organising the teaching order of the Combined Science Trilogy topics?
  - the same order of the specification
  - reordered to match students' ability to deal with abstract ideas
  - bear in mind, some of the ELC learning outcomes appear in different places in the combined course, eg outcomes 4, 7, 8 and 9.
- **Approach 2:** is the order you want to teach the learning outcomes of the ELC course the same as in the ELC specification?

## Steps to follow

1. Look at ELC and Combined together and design your long-term plan.
2. Produce a medium-term plan with the working scientifically, RPs and maths development mapped in along with the content you are focusing on.
3. Plan individual lessons using the schemes of work, our teaching support resources and your own teaching resources.

## Activity 1: long-term plan

- Choose either: **Approach 1 – Combined Science: Trilogy + ELC** or **Approach 2 – ELC with top-up of Combined Science: Trilogy**
- Look at part 1:
  - Do you agree with this?
  - Would you change anything?
  - What is the best order to teach the topics in for your students?
- Then have a look at part 2 – how would you organise this?

### Approach 1 – Combined Science: Trilogy + ELC

#### Part 1

Combined Science: Trilogy		ELC			Order to teach
Spec ref	Title	Spec ref	Learning Outcome	Main content	
5.1.1	A simple model	3.3.1	LO 1 LO 2	Atoms, elements, compounds, periodic table, word equation	
5.1.2	Periodic table	3.3.1	LO 1 LO 2	Atoms, elements, compounds, periodic table, word equation	
5.1.1.2	Mixtures	3.3.3	LO 5	Mixtures and separation techniques	
5.8.1	Purity, formulations and chromatography				
RP 12	Paper chromatography	3.3.3	LO 6	TDA: investigate coloured inks or food dyes using paper chromatography	
5.2.2	Bonding, structure and properties	3.3.2	LO 3	States of matter, melting points	
		3.3.4	LO 8	Bonding and properties of metals	
5.2.3	Structure and bonding of carbon	3.3.2	LO 4	Diamond and graphite – structure and properties	
5.4.1	Reactivity of metals	3.3.4	LO 7 LO 9	Extraction of metals from their ores based on reactivity Alloys – steel ( <b>not covered</b> )	

				<b>in Combined)</b>	
<b>5.10.2</b>	Life cycle assessment and recycling	<b>3.3.4</b>	LO 7	Recycling metals and limiting environmental impact	
<b>5.7.1.4</b>	Cracking and alkenes <b>(part only)</b>	<b>3.3.5</b>	LO 10	Polymers: what they are, properties, not biodegradable Add to teaching on recycling	
<b>ELC Externally Set Assignment Component 3</b>					

**Content not covered**

<b>5.2.1</b>	Chemical bonds
<b>5.3</b>	Quantitative chemistry
<b>5.4.3</b>	Electrolysis
<b>RP9</b>	Electrolysis of an aqueous solution
<b>5.6.2</b>	Reversible reactions

## Part 2

Combined Science: Trilogy		ELC			Order to teach
Spec ref	Title	Spec ref	Learning Outcome	Main content	
<b>5.4.2</b>	Reaction of acids	<b>3.4.1</b>	LO 1	Acids + metals produce salts; hydrochloric and sulfuric acids; word equations	
<b>5.4.2.2</b>	Neutralisation of acids and salt production	<b>3.4.1</b>	LO 2	Neutralisation of acids by alkalis, bases and carbonates; word equations	
<b>5.8.2</b>	Common gases	<b>3.4.1</b>	LO 1	Tests for hydrogen and carbon dioxide	
<b>RP 8</b>	Making a salt	<b>3.4.1</b>	LO 2	TDA: investigate how solid salts can be produced by crystallisation	
<b>5.5.1</b>	Exothermic and endothermic reactions	<b>3.4.2</b>	LO 3	Reactions causing energy transfer out to the surroundings or taking energy in from the surroundings – terms not needed	
<b>RP 10</b>	Temperature change in reacting substances	<b>3.4.2</b>	LO 3	TDA: investigating temperature change in reactions	
<b>5.6.1</b>	Rates of reactions	<b>3.4.2</b>	LO4	Rates of reaction: temperature, concentration, surface area, catalysts, measuring rates	
<b>RP11</b>	Concentration affects rate of a reaction	<b>3.4.3</b>	LO 4	TDA: investigating the effect of concentration on the rate of a reaction	
<b>5.9.1</b>	Composition of Earth's atmosphere	<b>3.4.3</b>	LO 5 LO 6	How Earth's early atmosphere developed and changed to include oxygen and reduce carbon dioxide	
<b>5.9.2</b>	Carbon dioxide and methane	<b>3.4.4</b>	LO 9	Human activities which increase greenhouse gases	

<b>5.9.3</b>	Common atmospheric pollutants	<b>3.4.4</b>	LO 8	Gases released when fuels burn	
<b>5.7.1</b>	Carbon compounds as a fuel	<b>3.4.4</b>	LO 7	Crude oil is a mixture found in underground deposits and can be separated into useful fractions by fractional distillation which can be used as fuels	
<b>5.10.1</b>	Using Earth's resources; potable water	<b>3.4.5</b>	LO 10	How water is made safe to drink	
<b>RP 13</b>	Water samples	<b>3.4.5</b>	LO 10	TDA: investigating how to purify water samples	
<b>ELC Externally Set Assignment Component 4</b>					

**Content not covered**

<b>5.2.1</b>	Chemical bonds
<b>5.3</b>	Quantitative chemistry
<b>5.4.3</b>	Electrolysis
<b>RP9</b>	Electrolysis of an aqueous solution
<b>5.6.2</b>	Reversible reactions

## Approach 2 – ELC with top-up of Combined Science: Trilogy

### Part 1

ELC			Combined Science: Trilogy		Order to teach
Spec ref	Learning Outcome	Main content	Spec ref	Title	
3.3.2	LO 3	States of matter, melting points	5.2.2	How bonding and structure are related	
3.3.3.	LO 5	Mixtures and separation techniques	5.1.1.2	Mixtures	
3.3.3	LO 6	TDA: investigate coloured inks or food dyes using paper chromatography	5.8.1	Purity, formulations and chromatography	
			RP 12	Paper chromatography	
3.3.1	LO 1 LO 2	Atoms, elements, compounds, periodic table, word equations	5.1.1	A simple model	
3.3.1	LO 1 LO 2	Atoms, elements, compounds, periodic table, word equations	5.1.2	Periodic table	
3.3.2	LO 4	Diamond and graphite – structure and properties	5.2.3	Structure and bonding of carbon	
3.3.4	LO 8	Bonding and properties of metals: melting points and uses	5.2.2	How bonding and structure are related	
3.3.4	LO 7	Extraction of metals from their ores based on reactivity	5.4.1	Reactivity of metals	
3.3.4	LO 9	Alloys – steel ( <b>not covered in Combined</b> )			
3.3.4	LO 7	Recycling metals and limiting environmental impact	5.10.2	Life cycle assessment and recycling	
3.3.5	LO 10	Polymers: what they are, properties, not biodegradable	5.7.1.4	Cracking and alkenes ( <b>part only</b> )	
<b>ELC Externally Set Assignment Component 3</b>					

## Part 2

ELC			Combined Science: Trilogy		Order to teach
Spec ref	Learning Outcome	Main content	Spec ref	Title	
<b>3.4.1</b>	LO 1	Acids + metals produce salts; hydrochloric and sulfuric acids; word equations	<b>5.4.2</b>	Reaction of acids	
<b>3.4.1</b>	LO 1	Test for hydrogen	<b>5.8.2</b>	Common gases	
<b>3.4.1</b>	LO 2	Neutralisation of acids by alkalis, bases and carbonates; word equations	<b>5.4.2.2</b>	Neutralisation of acids and salt production	
<b>3.4.1</b>	LO 2	Test for carbon dioxide	<b>5.8.2</b>	Common gases	
<b>3.4.1</b>	LO 2	TDA: Investigate how solid salts can be produced by crystallisation	<b>RP 8</b>	Making a salt	
<b>3.4.2</b>	LO 3	Reactions causing energy transfer out to the surroundings or taking energy in from the surroundings – terms not needed	<b>5.5.1</b>	Exothermic and endothermic reactions	
<b>3.4.2</b>	LO 3	TDA: Investigating temperature change in reactions	<b>RP 10</b>	Temperature change in reactions	
<b>3.4.2</b>	LO 4	Rates of reaction: temperature, concentration, surface area, catalysts; measuring rates	<b>5.6.1</b>	Rates of reactions	
<b>3.4.</b>	LO 4	TDA Investigate how concentration makes a chemical reaction go faster	<b>RP11</b>	Concentration affects rate of a reaction	
<b>3.4.3</b>	LO 5 LO 6	How Earth's early atmosphere developed and changed to include oxygen and reduce carbon dioxide	<b>5.9.1</b>	Composition of Earth's atmosphere	
<b>3.4.4</b>	LO 9	Human activities which	<b>5.9.2</b>	Carbon dioxide and	

		increase greenhouse gases		methane	
	LO 8	Gases released when fuels burn	<b>5.9.3</b>	Common atmospheric pollutants	
<b>3.4.4</b>	LO 7	Crude oil is a mixture found in underground deposits and can be separated into useful fractions by fractional distillation which can be used as fuels	<b>5.7.1</b>	Carbon compounds as a fuel	
<b>3.4.5</b>	LO 10	How water is made safe to drink	<b>5.10.1</b>	Using Earth's resources; potable water	
<b>3.4.5</b>	LO 10	TDA: investigating how to purify water samples	<b>RP 13</b>	Water samples	
<b>ELC Externally Set Assignment Component 4</b>					



## Activity 2: developing the teaching and learning – medium-term

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The co-teaching document shows the progression of ideas covered in the content from each of the ELC outcomes, as they map across to the Combined Foundation Tier content.

The right hand side shows relevant content from the Foundation Tier of that topic, which is not directly related to the ELC outcome.

How far to go with the coverage of the content and the practical skills will be a choice individual teachers will make depending on their students.

As practical skills and working scientifically are so important in the new GCSEs, we have shown how the practical assessments in ELC can be extended into some of the RPs. Where appropriate, content may also be delivered through practical experiences.

- Look at the co-teaching document and your long-term plan.
- Use this to plan the content you would cover with your students, a TDA you would do and where you can focus on Working Scientifically skills.
- You might also want to map opportunities for maths; ELC does not assess maths skills directly but they will be needed for the Combined Science Trilogy specification.
- You might be able to work with the maths department in your school to identify a joint approach for these students. This will maximise your efforts and ensure a consistent approach to teaching maths skills.

Co-teaching document: ELC Science (5960) and Foundation Level GCSE Combined Science: Trilogy (8464)

**Chemistry: Component 3 – Elements, mixtures and compounds**

ELC Outcomes	Summary of content covered in ELC	Same theme covered in Combined but extra content	New content on same topic	Rest of Combined Foundation content
1. Atoms and elements	<p>All substances are made of atoms.</p> <p>An atom is the smallest part of an element.</p> <p>The elements are shown in the periodic table and elements in the same group of the periodic table have similar properties.</p>	<p>5.1.1.1 Extra parts – atomic symbols (first 20, Group 1 and Group 7).</p> <p>5.1.2.1 Arrangement of the periodic table in terms of electronic structure.</p>	<p>5.1.1.3 Development of the model of the atom.</p> <p>5.1.2.2 Development of the periodic table.</p>	<p>5.11 Key ideas.</p> <p>5.1.1.4 Relative electrical charges of subatomic particles.</p> <p>5.1.1.5 Size and mass of atoms.</p> <p>5.1.1.6 Relative atomic mass.</p> <p>5.1.1.7 Electronic structure.</p> <p>5.1.2.4 Group 0.</p> <p>5.1.2.5 Group 1.</p> <p>5.1.2.6 Group 7.</p>

2. Elements and compounds	<p>Atoms combine with different atoms to form a compound.</p> <p>Compounds can be made by metals combining with non-metals or by non-metals combining with other non-metals.</p> <p>Simple reactions can be described as word equations.</p>	<p>5.1.1.1 Extra parts – energy changes; formulae and naming compounds; symbol equations.</p>		<p>5.2.1 Chemical bonds, ionic, covalent and metallic.</p>
Practical development	<p>Investigate the reaction when magnesium burns in oxygen (air) to produce magnesium oxide.</p> <p>Compare the properties of iron and sulfur with those of iron sulphide.</p>			
3. States of matter	<p>The three states of matter are solid, liquid and gas.</p> <p>Definitions of the changes between the three states using the terms melting, boiling, condensing and freezing.</p> <p>Simple particle model to explain the states of matter.</p>	<p>5.2.2.1 Predictions of state based on data; explanations of changes of state based on energy changes.</p> <p>5.2.2.2 State symbols.</p>		<p>5.2.2.3 Properties of ionic compounds.</p> <p>5.2.2.4 Properties of small molecules.</p>

Practical development	Investigate the changes in state from ice to steam.			
4. Forms (allotropes) of carbon	Diamond and graphite are both forms of carbon but with different structures that determine their properties.	5.2.3.1 Diamond.  5.2.3.2 Graphite. Details of bonding.	5.2.3.3 Graphene and fullerenes.	
Practical development	Investigate the properties of graphite as a lubricant and for writing.			
5. Mixtures	Mixtures contain two or more substances which are not chemically combined.  The appropriate method to separate mixtures by filtration, distillation, crystallisation or chromatography.	5.1.1.2 More complex definition of mixture.  Inclusion of fractional distillation.		5.8.1.1 Pure substances.  5.8.1.2 Formulations.

Practical development	<p>Use filtration / distillation / crystallisation to separate substances.</p> <p>Compare the time needed to filter mixtures of water and calcium carbonate that has different particle sizes.</p>			
6. Chromatography	<p>Describe how to separate mixtures by chromatography.</p> <p>Recognise that in paper chromatography, a solvent moves through the paper carrying different compounds different distances.</p>	<p>5.8.1.3 Chromatography – definitions of phases; use of <math>R_f</math> and correct use of significant figures; differences between pure and impure substances.</p>		
Practical development	<p>Investigate the different colours in inks or food colours using paper chromatography.</p>		<p>Required practical 12 (6) – investigate how paper chromatography can be used to separate and tell the difference between coloured substances. Students should calculate <math>R_f</math> values.</p>	

<p>7. Extraction of metals from their ores</p>	<p>Unreactive metals are found in the Earth as metals.</p> <p>Most metals are found as compounds that need chemical reactions to extract the metal.</p> <p>Metals less reactive than carbon can be extracted by heating the metal ore with carbon.</p> <p>An ore is a rock containing enough metal to make it economic to extract it and large amounts of rock have to be quarried or mined to get metal ores.</p> <p>The effects of extracting metals can be reduced by recycling.</p>	<p>5.4.1.3 Extraction of metals and reduction:</p> <p>Definition of reduction and identification of which substances are reduced/oxidised.</p> <p>Interpretation of data relating to metal extraction.</p> <p>5.10.2.2 Ways of reducing the use of resources – part relevant to metals.</p>	<p>5.1.2.3 Metals and non-metals in terms of electronic structure.</p>	<p>5.3 Quantitative chemistry.</p> <p>5.4.1.1 Metal oxides.</p> <p>5.4.3 Electrolysis (including the required practical 9: investigate what happens when aqueous solutions are electrolysed using inert electrodes).</p> <p>5.10.2.1 Life cycle assessment.</p> <p>5.10.2.2 Ways of reducing the use of resources.</p>
<p>Practical development</p>	<p>Model smelting by extracting copper from malachite or lead from galena using carbon.</p>			

8. Properties of metals	<p>Metals have giant structures of atoms with strong bonds between the atoms so most metals have high melting points.</p> <p>Properties of metals.</p> <p>Relate uses of metals to their properties. Eg copper and aluminium.</p>	<p>5.2.2.7 Properties of metals and alloys: arrangement of atoms in layers.</p> <p>5.2.2.8 Metals as conductors – explanation of conductivity in terms of electrons.</p>		
Practical development	Compare the properties such as conductivity or density of some metals.			
9. Alloys	<p>Most metals in everyday use are alloys.</p> <p>An alloy is produced by mixing small amount of other elements with the metal eg steel.</p>	<p>5.2.2.7 Properties of metals and alloys: explanation in terms of the distortion of the layers of atoms.</p>		
Practical development	<p>Investigate the melting points of tin, lead and solder.</p> <p>Investigate the hardness of different alloys or steels.</p>			

10. Polymers	<p>Polymers are made from small molecules called monomers joined together in very long chains.</p> <p>The uses of polymers are related to their properties.</p> <p>Polymers are not biodegradable (not broken down by microbes) and there are problems with the disposal of polymers.</p>	<p>5.2.2.5 Polymers – recognition of polymers from diagrams showing bonding and structure.</p>		<p>5.2.2.6 Giant covalent structures.</p>
Practical development	Compare the biodegradability of different polymers and other materials.			



## Medium-term plan: Approach 1 – Combined Trilogy (8464) and parts of ELC (5960) Component 3

- Step 1 – input the order from your long-term plan into columns 1 (Combined Trilogy) and 2 (ELC) in the template.
- Step 2 – refer to columns 3 and 4 of the co-teaching document and decide on the content you will cover from the Combined Science Trilogy specification. Fill in column 3 (common content to cover) in the template.
- Step 3 – refer to column 5 of the co-teaching document and decide which of the extra content in the Combined Science Trilogy specification you think is appropriate for your students. Use this to fill out column 5 (Extra) in the template.
- Step 4 – note any relevant practical work and what the focus of this might be.
- Step 5 – note any concepts of Working Scientifically you want to draw out and focus on.
- Step 6 – note any maths skills you want to introduce, teach and practice.

### Example

Combined Trilogy	ELC	Common content to cover	✓ x	Extra	✓ x	Practical work	Working Scientifically	Maths
5.1.1 A simple model	LO 1 Atoms, elements and periodic table	5.1.1.1 Extra parts – atomic symbols (first 20, Group 1 and Group 7)	✓	5.1.1.4 Relative electrical charges of subatomic particles	✓	N/A	WS1.1 How ideas develop over time	N/A
5.1.2 Periodic table		5.1.2.1 Arrangement of the periodic table in terms of electronic structure	✓	5.1.1.5 Size and mass of atoms	✓		Development of the periodic table	
		5.1.1.3 Development of the model of the atom	x	5.1.1.6 Relative atomic mass	x		WS1.2 Using models	
		5.1.2.2 Development of the periodic table	✓	5.1.1.7 Electronic structure	✓			
				5.1.2.4 Group 0	✓			
				5.1.2.5 Group 1	✓			
				5.1.2.6 Group 7	✓			

Combined Trilogy	ELC	Common content to cover	✓ ✗	Extra	✓ ✗	Practical work	Working Scientifically	Maths
5.1.1 A simple model	LO 2 Compounds word equation	5.1.1.1 Formulae and naming compounds; symbol equations  5.3.1.2 RFM could be covered here		5.1.1.1 Chemical reactions definition			WS1.2 Using models  WS 4.1 Scientific vocabulary, terminology and definitions	
5.1.1.2 Mixtures	LO 5 Mixtures and separation techniques	5.1.1.2 More complex definition of mixture Leave fractional distillation to do later		5.8.1.1 Pure substances  5.8.1.2 Formulations		Recap separation techniques from KS3  Focus on Scientific language linked to properties: (solution, soluble, solvent, saturated)	WS 2.2 Plan experiments  WS 2.3 Techniques and apparatus	

5.8.1 Purifying formulation and chromatography	LO 6 Describe how to separate mixtures by chromatography  TDA Investigate if black ink is a pure colour	5.8.1.3 Chromatography – phases R <sub>f</sub> values How chromatography can be used for distinguishing between pure and impure substances				RP 12 Paper chromatography Determine R <sub>f</sub> values Identifying common errors	WS 1.4 Technological applications  WS 2.4 Experimental skills  WS 2.6 Make and record observations  WS 2.7 and 3.7 Evaluation  WS 4.1 Scientific vocabulary, terminology and definitions	MS 1c ratios Ratios
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5.2.2 How bonding and structure are related	LO 3 States of matter, melting points  LO 8 Bonding and properties of metals	5.2.2.1 States of matter Explanations of changes of state based on energy changes  5.2.2.2 State symbols  5.2.2.7 Properties of metals and alloys Arrangement of atoms in layers  5.2.2.8 Metals as conductors – explanation of conductivity in terms of electrons		5.2.1 Chemical bonds, ionic, covalent and metallic  5.2.2.3 Properties of ionic compounds  5.2.2.4 Properties of small molecules			WS1.2 Using models	
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5.2.3 Structure and bonding of carbon	LO 4 Diamond and graphite – structure and properties	5.2.3.1 Diamond  5.2.3.2 Graphite Details of bonding		5.2.3.3 Graphene and fullerenes			WS1.2 Using models	MS 5b (2D and 3D forms)
5.4.1 Reactivity of metals	Reactivity series covered in component 4  LO 7 Extraction of metals from their ores based on reactivity  LO 9 Alloys – steel	5.4.1.1 Metal oxides  5.4.1.3 Only Extraction of metals and reduction: Definition of reduction and identification of which substances are reduced/oxidised		5.1.2.3 Metals and non-metals in terms of electronic structure  5.4.3.3 Using electrolysis to extract metals  5.2.2.7 Properties of metals and alloys: explanation in terms of the distortion of the layers of atoms				

5.10.2 Life cycle assessment and recycling	LO 7 Recycling metals and limiting environmental impact	5.10.2.2 Ways of reducing the use of resources – part relevant to metals		5.10.2.1 Life cycle assessment				
5.7.1.4 Cracking and alkenes (part only)  5.7 Organic Chemistry  Covered in component 4	LO 10 Polymers: what they are, properties, not biodegradable  Add to teaching on recycling	5.2.2.5 Polymers – recognition of polymers from diagrams showing bonding and structure						

## Medium-term plan: Approach 2 – ELC (5960) Component 3 and parts of Combined Trilogy (8464)

- Step 1 – input the order from your long-term plan into columns 1 (ELC) and 2 (Combined Trilogy) in the template.
- Step 2 – refer to columns 3 and 4 of the co-teaching document and decide on the content you will cover from the Combined Science Trilogy specification. Fill in column 3 (common content to cover) in the template.
- Step 3 – refer to column 5 of the co-teaching document and decide which of the extra content in the Combined Science Trilogy specification you think is appropriate for your students. Use this to fill out column 5 (Extra) in the template.
- Step 4 – note any relevant practical work and what the focus of this might be.
- Step 5 – note any concepts of Working Scientifically you want to draw out and focus on.
- Step 6 – note any maths skills you want to introduce, teach and practice.



### Example

ELC	Combined Trilogy	Common content to cover	✓ x	Extra	✓ x	Practical work	Working Scientifically	Maths
LO 3 States of matter	5.2.2 How bonding and structure are related	5.2.2.1 States of matter Explanations of changes of state based on energy changes  5.2.2.2 State symbols	✓    ✓	5.2.1 Chemical bonds, ionic, covalent and metallic  5.2.2.3 Properties of ionic compounds  5.2.2.4 Properties of small molecules	x  x  x	ELC TDA Investigate the melting points of a range of substances	WS 1.2 Using models	
LO 5 Mixtures and separation techniques	5.1.1.2 Mixtures	5.1.1.2 More complex definition of mixture Leave fractional distillation do later	✓	5.8.1.1 Pure substances  5.8.1.2 Formulations	✓  ✓	Recap separation techniques from KS3 with focus on scientific language linked to properties (solution, soluble, solvent, saturated, filtration)	WS 2.2 Plan experiments  WS 2.3 Techniques and apparatus	

ELC	Combined Trilogy	Common content to cover	✓ ✗	Extra	✓ ✗	Practical work	Working Scientifically	Maths
LO 6 Describe how to separate mixtures by chromatography	5.8.1. Purity, formulations and chromatography	5.8.1.3 Chromatography – definitions of phases; use of Rf values  How chromatography can be used for distinguishing between pure and impure substances				RP 12 Paper chromatography Determination of Rf values Identifying common errors  ELC TDA Investigate the different colours in inks or food colours	WS 1.4 Technological applications  WS 2.4 Experimental skills  WS 3.7 Evaluation	MS 1c ratios

<p>LO 1</p> <p>Atoms, elements and periodic table</p>	<p>5.1.1 A simple model</p> <p>5.1.2 Periodic table</p>	<p>5.1.1.1 Extra parts – atomic symbols: first 20, Group 1 and Group 7</p> <p>5.1.2.1 Arrangement of the periodic table in terms of electronic structure</p> <p>5.1.1.3 Development of the model of the atom</p> <p>5.1.2.2 Development of the periodic table</p>		<p>5.1.1.4 Relative electrical charges of subatomic particles</p> <p>5.1.1.5 Size and mass of atoms</p> <p>5.1.1.6 Relative atomic mass</p> <p>5.1.1.7 Electronic structure</p> <p>5.1.2.4 Group 0</p> <p>5.1.2.5 Group 1</p> <p>5.1.2.6 Group 7</p>			<p>WS1.1 How ideas develop over time</p> <p>Development of the periodic table</p> <p>WS1.2 Using models</p>	
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LO 2 Compounds Word equations	5.1.1 A simple model	5.1.1.1 Formulae and naming compounds; symbol equations  5.3.1.2 RFM could be covered here		5.1.1.1 Chemical reaction definition				
LO 4 Diamonds and graphite – structure and properties	5.2.3 Structure and bonding of Carbon	5.2.3.1 Diamond  5.2.3.2 Graphite		5.2.3.3 Graphene and fullerenes		Construct models of carbon allotropes	WS 1.2 Using models	MS 5b (2D and 3D forms)

LO 8 Bonding and properties of metals	5.2.2.7 Properties of metals and alloys  5.2.2.8 Metals as conductors	5.2.2.7 Properties of metals and alloys related to arrangement of atoms in layers  5.2.2.8 Metals as conductors – explanation of conductivity in terms of electrons					WS 1.2 Using models	
LO 7 Extraction of metals from their ores based on reactivity (Linked to LO 10)	5.4.1.3 Extraction of metals and reduction	5.4.1.1 Metal oxides  5.4.1.3 Extraction of metals and reduction: definition of reduction and identification of which substances are reduced/oxidised		5.1.2.3 Metals and non-metals in terms of electronic structure  5.4.3 Electrolysis to extract metals			WS 2.4 Carry out experiments  WS 2.6 Make and record observations	

LO 9 Alloys	5.2.2.7 Properties of metals and alloys	5.2.2.7 Properties of metals and alloys: explanation in terms of the distortion of the layers of atoms				ELC TDA Investigate the hardness of different alloys		
LO 7 Recycling metals	5.10.2 Life cycle assessment and recycling	5.10.2.2 Ways of reducing the use of resources – part relevant to metals		5.10.2.1 Life cycle assessment			WS 1.4 Technological applications and environmental implications	
LO 10 Polymers	5.2.2.5 Polymers	5.2.2.5 Polymers – recognition of polymers from diagrams showing bonding and structure		5.2.2.6 Giant covalent structures		Construct models of polymers  ELC TDA Investigate the biodegradability of different polymers	WS 1.2 Using models	MS 5b (2D and 3D forms)