# Scheme of work

## Combined Science: Trilogy - Foundation

## Chemistry – Organic chemistry

This resource provides guidance for teaching the Organic chemistry topic from our new GCSE Combined Science: Trilogy specification (8464). It has been updated from the draft version to reflect the changes made in the accredited specification. These changes are also reflected in the learning outcomes and opportunities to develop skills.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive; it only suggests activities and resources you could find useful in your teaching.

### 5.7 Organic chemistry

#### 5.7.1 Carbon compounds as fuels and feedstock

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop scientific communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment**  **Opportunities an resources**  *Reference to past questions that indicate success* |
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| 5.7.1.1 | Crude oil is a finite resource found in rocks. Crude oil is the remains of an ancient biomass consisting mainly of plankton that was buried in mud.  Crude oil is a mixture of a very large number of compounds. Most of the compounds in crude oil are hydrocarbons, which are molecules made up of hydrogen and carbon atoms only. |  | 1 | Students can create a cartoon strip to illustrate the formation of crude oil (links to the Carbon Cycle in Biology).  Describe the composition of crude oil.  Recall the symbols for hydrogen and carbon.  Define hydrocarbon. | Make molecular models of the different sized hydrocarbons using two colours of jelly tots and cocktail sticks. | [Exampro user guide PowerPoint](http://filestore.aqa.org.uk/resources/science/AQA-GCSE-SCIENCE-EXAMPRO-UG.PPTX) |
| 5.7.1.1 | Most of the hydrocarbons in crude oil are hydrocarbons called alkanes. The general formula for the homologous series of alkanes is  The first four members of the alkanes are methane, ethane, propane and butane.  Alkane molecules can be represented in the following forms:  or | Recognise substances as alkanes given their formulae in these forms.  Students do **not** need to know the names of specific alkanes other than methane, ethane, propane and butane.  WS 1.2. | 1 | Define the prefix: meth-, eth-, pro-, but- .  Describe the formula CnH2n+2 and what it means.  Describe alkane molecules of methane, ethane, propane, butane in a format like C2H6  and:    Provide students with a table of hydrocarbon boiling points and ask them to plot a graph of the boiling points against number of carbons. | Make molecular models of the different alkanes using plasticine and cocktail sticks or molecular sets |  |
| 5.7.1.2 | The many hydrocarbons in crude oil may be separated into fractions, each of which contains molecules with a similar number of carbon atoms, by fractional distillation.  The fractions can be processed to produce fuels and feedstock for the petrochemical industry.    Many of the fuels on which we depend for our modern lifestyle such as petrol, diesel oil, kerosene, heavy fuel oil and liquefied petroleum gases, are produced from crude oil.  Many useful materials on which modern life depends are produced by the petrochemical industry, such as solvents, lubricants, polymers, detergents.  The vast array of natural and synthetic carbon compounds occur due to the ability of carbon atoms to form families of similar compounds. | Explain how fractional distillation works in terms of evaporation and condensation.  Knowledge of the names of other specific fractions or fuels is **not** required.  WS 1.2 | 2 | Describe the process of fractional distillation.  Draw a fractionating column and label each fraction including molecule size and temperature.  Describe uses of the different materials from the petrochemical industry.  Describe how life would be without oil derived products. | Demonstrate fractional distillation of cherry cola.  Demonstrate the fractional distillation of simulated crude oil :  [Nuffield Foundation – Fractional distillation of crude oil](http://www.nuffieldfoundation.org/practical-chemistry/fractional-distillation-crude-oil)  Investigate the heat energy of different fuels.  Students can investigate the properties of some different polymers:  [Nuffield Foundation – Identifying polymers](http://www.nuffieldfoundation.org/practical-chemistry/identifying-polymers) | Video clips  YouTube: [Fractional distillation](https://www.youtube.com/watch?v=PYMWUz7TC3A)  YouTube:  [Crude Oil Fractions and their uses](https://www.youtube.com/watch?v=JZdvsQzOKuk) |
| 5.7.1.3 | Some properties of hydrocarbons depend on the size of their molecules, including boiling point, viscosity and flammability. These properties influence how hydrocarbons are used as fuels.  The combustion of hydrocarbon fuels releases energy. During combustion, the carbon and hydrogen in the fuels are oxidised. The complete combustion of a hydrocarbon produces carbon dioxide and water. | Recall how boiling point, viscosity and flammability change with increasing molecular size.  Write balanced equations for the complete combustion of hydrocarbons with a given formula.  Knowledge of trends in properties of hydrocarbons is limited to:   * boiling points * viscosity * flammability.   WS 1.2, 4.1 | 1 | Describe trends in properties of boiling point, viscosity and flammability of hydrocarbons with increasing molecular size.  Describe the products of combustion of alkanes using a balanced equation. | Students can investigate the flammability of heavy paraffin oil (alkane), butane and pentane on a deflagrating spoon and observing the colour of the flame.  Compare this with products of a Bunsen flame (methane) with both the air hole open and closed (combustion apparatus with limewater and condensing tube). | Video clips:  [BBC Bitesize Combustion of carbon](http://www.bbc.co.uk/education/clips/zwjvcdm)  [BBC Bitesize Combustion of natural gas](http://www.bbc.co.uk/education/clips/z72gkqt) |
| 5.7.1.4 | Hydrocarbons can be broken down (cracked) to produce smaller, more useful molecules.  Cracking can be done by various methods including catalytic cracking and steam cracking.  The products of cracking include alkanes and another type of hydrocarbon called alkenes.  Alkenes are more reactive than alkanes and react with bromine water, which is used as a test for alkenes.  There is a high demand for fuels with small molecules and so some of the products of cracking are useful as fuels.  Alkenes are used to produce polymers and as starting materials for the production of many other chemicals. | Describe in general terms the conditions used for catalytic cracking and steam cracking.  Recall the colour change when bromine water reacts with an alkene.  Balance chemical equations as examples of cracking given the formulae of the reactants and products.  Give examples to illustrate the usefulness of cracking.  Be able to explain how modern life depends on the uses of hydrocarbons.  For Combined Science: Trilogy and Synergy students do not need to know the formulae or names of individual alkenes.  WS 1.2 | 2 | Describe the process of cracking.  Write balanced symbol equations for the cracking of alkanes given the formulae of the reactants and products.  Describe examples to illustrate the usefulness of cracking.  Explain how modern life depends on the uses of hydrocarbons. | Demonstrate cracking liquid paraffin over aluminium oxide:  [Nuffield Foundation – Cracking hydrocarbons](http://www.nuffieldfoundation.org/practical-chemistry/cracking-hydrocarbons)  Or class can do this practical on a microscale:  [Nuffield Foundation – Cracking hydrocarbons on a microscale](http://www.nuffieldfoundation.org/practical-chemistry/cracking-hydrocarbons-microscale)  Use bromine water to identify alkenes and unsaturation in other compounds:  [Nuffield Foundation – Unsaturation in fats and oils](http://www.nuffieldfoundation.org/practical-chemistry/unsaturation-fats-and-oils)  Students can perform a practical to create a polymer:  [Nuffield Foundation – Addition polymerisation](http://www.nuffieldfoundation.org/practical-chemistry/addition-polymerisation)  Students can make polymer paper chains. | Video clips  YouTube:  [Hydrocarbon Cracking and Why It Is Done](https://www.youtube.com/watch?v=Xsqlv4rWnEg) |