



TOPIC
EXPLORATION PACK

Theme: Organic Structures

March 2015



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CHEMISTRY

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Oxford Cambridge and RSA

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This Topic Exploration Pack should accompany the OCR resource ‘Organic Structures’ learner activities 1-15, which you can download from the OCR website.

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This activity offers an opportunity for maths skills development.

Introduction

Most AS level students will have some familiarity with the ideas of organic structures. Throughout their GCSE specifications they are likely to have touched on a range of topics involving complex organic molecules and various homologous series eg crude oil (alkanes, alkenes, addition polymers); perfumes (esters; carboxylic acids); detergents; fats and oils; alcohols and analgesics

This guide looks at ways of helping students to acquire an understanding of some of the simple Organic Structures which are amongst the building blocks for more complex molecules. Within this they will develop the skills required to draw and interpret the range of different types of molecules.

Context

Organic chemistry is concerned with carbon compounds containing covalent bonds. Since carbon atoms have four valence electrons, they are able to form four covalent bonds either with other carbon atoms (catenation) or with other non-metal elements. The carbon-carbon bond can be a single, double or triple bond and the various different structures formed give us functional groups which are responsible for the physical and chemical characteristics of organic compounds. Whilst many natural molecules make use of these functional groups the power of Carbon as an element comes in our ability now to alter these structures to create the physical and chemical properties we desire for the use we wish to put the molecule to. Whilst there are a myriad of uses for organic compounds one of the most basic and fundamental still remains their usefulness as energy sources.

The Developing Fuels topic focuses on the use of organic substances (predominantly hydrocarbons) as fuels. The story starts with the obtaining and making useful of Crude oil. However the alteration of structures through reforming to give more effective fuels, blending and the comparisons of hydrocarbons and oxygenated substances such as alcohols and ethers as fuels is also addressed.

Approaches to teaching the content

Whilst the emphasis of this exploration pack is placed on naming and recognising organic compounds it is important to recognise that such emphasis is misplaced, and that students should be made aware of the importance of structure as a determinant of the chemical and physical properties of a substance through the presence of the various functional groups.

Students are required to learn to recognise the names and appearance of the various functional groups in order to be able to recognise these in molecules they may not have seen before thus enabling them to make comments and predictions regarding their behaviour in various reactions. At first students may seem overwhelmed by the structures however the systematic nomenclature developed by IUPAC brings some logic to the process.

Isomerism is covered in terms of structural isomerism (chain, position and functional group) isomerism it does not tackle stereoisomerism (E/Z or cis/trans isomerism) which is covered later in the AS course or optical isomerism which is covered later in A2.

Some student misconceptions

Students need to be clear on the different use of the terms across the sciences and that carbonates, bicarbonates, carbon dioxide and carbon monoxide are not organic compounds. Students struggle with the different styles of structure from molecular through to structural and displayed formulae. Modelling can help to improve this understanding significantly.

Suggested activities

- Activity 1 Big Picture Quiz
- Activity 2 Easy Peasy Chineasy
- Activity 3 Organic Building Blocks
- Activity 4 Organic Semantics
- Activity 5 The Arenes
- Activity 6 Isomeronomoes
- Activity 7 Organised Organics
- Activity 7 Tarsia Organics

Activity 1 – Big Picture Quiz

The purpose of this activity is for students to recognise the importance of organic chemistry as an area of study. Reference can be made to the displayed formula of these compounds at the end of the session to enable students to make connections with some of the functional groups/homologous series covered.

Resources:

- Activity sheet 1
- Activity sheet 2 Big Picture Quiz

Instructions: Give students a copy of the first nine slides (print as handouts 9 slides per page). Ask them to name the substance and guess the connection.

Activity 2 – Easy Peasy Chineasy

The purpose of this activity is for students to understand that the recognition of the building blocks (or in our case functional groups) can help us identify the structure of more complex molecules. Armed with this knowledge we can predict how such molecules may behave or comment on why they behave the way they do.

Resources: <http://chineasy.org/basics.aspx?set=1502>

- Activity Sheet 3 Easy Peasy Chineasy building blocks
- Activity Sheet 4 Easy Peasy Chineasy Complex words

Instructions:

- a) Split the class into small groups (suggest 3 or 4). Copy the Activity Sheet 2 Easy Peasy Chineasy building blocks onto card, (suggest A3). Place this on a table at the front of the room for each team. Students try to match up the correct word to the building block in a relay. Each team member having a time limit (2 minutes suggested) to match up the words. A prize can be allocated to the winners.
- b) Give students a copy of the answers. Can they now work out some of the more complex words built up from these symbols in Activity Sheet 3 Easy Peasy Chineasy Complex words. Copy the words and symbols student sheet onto card and laminate. Cut words and symbols up separately. As with the building blocks pairs or small groups can be used and adding a time restriction and prize for the first set completed will add a competitive element to this game to this aspect. Extension - Students could attempt to create their own words using the symbols.
- c) Once students have been introduced to this game they could be able to adapt it to the idea that organic molecules are built up of building blocks. You can also link to nomenclature too. Students could also design their own game using this idea.

Activity 3 – Organic Building Blocks

The purpose of this activity is for students to develop their understanding for the commonly adopted IUPAC systematic nomenclature.

Resources:

- Activity sheet 5 Organic Structure Cards
- Activity Sheet 6 Organic Building Block Template

Instructions: Split the class into half.

- a) Give half a copy of Activity Sheet 5 Organic Structure Cards. Ask students to identify some of the building blocks from these molecules. Students should complete Activity Sheet 6 Organic template card.
- b) Give the other half of the group the Organic Naming Cards. Using these names can they identify a set of prefix, suffix and stem organic name building blocks (eg 1, 2, di, tri, ol, ene, cyclo, propyl, benzene, butane). Students should complete the Organic template card.
- c) One student from each group should then pair up to see if they can allocate or match a name building block to a structure building block and identify any missing name or structure blocks. Whilst students should produce their own building blocks suggestions for some blocks can be found at <http://www.rsc.org/learn-chemistry/resource/res00000110/afl-naming-hydrocarbons?cmpid=CMP00000138>
- d) This activity could be used as a homework activity or for further practice.) Based on the work undertaken so far student groups should produce a set of naming rules for organic compounds. Give each student team a set of molymods (Carbon, Hydrogen, Oxygen) and ask them to come up with ten different structures. They should draw and name them using the rules they have produced. Other groups are then challenged to name the structures using their own set of rules. Groups can then compare their names and confirm an agreed set of rules. Structures can be checked by entering the molecular formula into a google search. (See IUPAC <http://www.iupac.org/home/publications/provisional-recommendations/under-review-by-the-authors/under-review-by-the-authors-container/nomenclature-of-organic-chemistry.html>)

Extension: Using the template cards students could draw out structural, displayed or skeletal formula for the models along with the names. These can then be swapped with another group to undertake as a matching exercise.

Activity 4 – Organic Semantics

Adapted from the Hasbro game 'Cranium'.

The purpose of this activity is to develop the skills of students in using the variety of different methods to represent organic structures. The game format adds a competitive and fun element (particularly where students are trying to use themselves to model organic molecules!)

Resources:

- Activity Sheet 5 Organic Structure Cards
- Activity Sheet 7 Organic Semantics expert cards
- Activity Sheet 8 Drawing Practice Student Sheet
- Activity Sheet 9 Drawing Practice Answers

Instructions: Using Activity Sheet 7 Organic Semantics expert cards along with the Activity Sheet 5 Organic Structures and Naming cards students take on the expert roles to recreate organic structures through the use of modelling with molymods; writing/drawing structures; drawing or modelling 3D structures and naming.

Extension: As per Activity 3 student's could be tasked with identifying suitable structures for the game. Larger teams could be used for larger molecules particularly when the physical modelling aspects are being undertaken.

Activity Sheet 8 Drawing Practice can be used to consolidate this activity. Students should complete the missing structures for each type of molecule.

Activity 4 – The Arenes

The purpose of this activity is as a comprehension exercise for students to understand the development of our understanding of the structure of arenes and how scientific evidence is used to prove that understanding.

Resources:

- Activity Sheet 10 The Arenes Student
- Activity Sheet 11 The Arenes Answers

Instructions: This piece of work could be set as a home learning activity. Students could work on this activity independently at home. When they return to class they could discuss their answers before peer assessing the document using the answer sheet.

Activity 6 – Isomeronomoes

The purpose of this activity is to enable students to recognise different structural forms of molecules with the same molecular formula. This activity is limited to structural isomerism based on chain, position and functional groups.

Resources:

- Activity Sheet 12 Isomeronomoes
- Activity Sheet 13 Isomeronomoes Answers

Instructions: Isomeronomoes sheet should be printed onto card, laminated and cut up before being given to students.

Students need to match up the correct isomers.

Extension: Students can make additional isomeronomoes as a homework a blank template is included or they could be challenged to name some of the molecules which are not listed.

Activity 7 – Organised Organics

The purpose of this activity is for students to consolidate their understanding of structures.

Resources: Activity Sheet 14 Organised Organics

Instructions: Activity Sheet 12 Organised Organics can be used as a powerpoint quiz at the end of a session or as a handout with slides printed as handouts. A student grid is also included so that students can note down their own choices. Correct responses are highlighted for the teacher benefit and this should be removed before use.

Students are given the work of two fictional students. Student A's choices are shown on the left of the slide and student B's choices are shown on the right. These students have been asked to identify the correct molecular formula, name or functional group present in some organic molecules. Students select the response they think is correct.

Activity 8 – Tarsia Organics

A quick plenary matching exercise summarising some aspects of the topic.

Resources: Activity Sheet 15 Tarsia Organics

Tarsia is free software which can be downloaded to produce a range of shape based matching exercises. <http://www.mmlsoft.com/index.php/products/tarsia>

Instructions: This is a card sorting activity where students need to match the sides of the cards to build an overall pattern. This could be used a plenary activity to consolidate students understanding. It is also possible for students to use this software to make their own activity.



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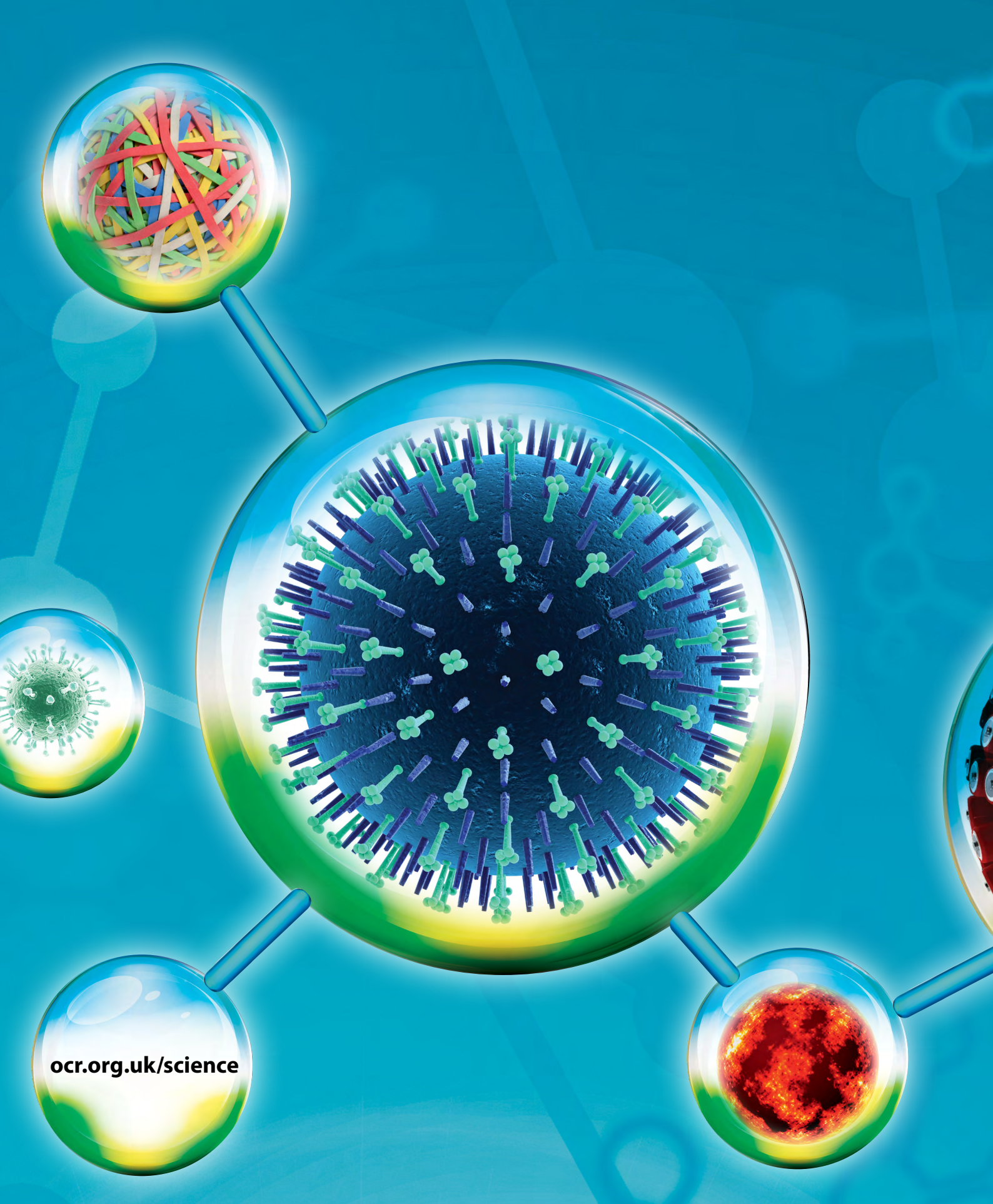
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