Sample Unit: Chemistry – Year 12

Sample for implementation for Year 12 from Term 4, 2018

<table>
<tr><td>Unit title</td><td>Module 7: Organic Chemistry</td><td>Duration</td><td>30 hours plus an additional 8 hours for an ongoing Depth Study</td></tr>
<tr><td>Unit description</td><td colspan="3">Content Focus
Students focus on the principles and applications of chemical synthesis in the field of organic chemistry. Current and future applications of chemistry include techniques to synthesise new substances – including pharmaceuticals, fuels and polymers – to meet the needs of society. Each class of organic compounds displays characteristic chemical properties and undergoes specific reactions based on the functional groups present. These reactions, including acid/base and oxidation reactions, are used to identify the class of an organic compound. In this module, students investigate the many classes of organic compounds and their characteristic chemical reactions. By considering the primary, secondary and tertiary structures of organic materials, students gain an understanding of the properties of materials – including strength, density and biodegradability – and relate these to proteins, carbohydrates and synthetic polymers.

Working Scientifically
In this module, students focus on collecting, analysing and processing data and information to identify trends, patterns and relationships to solve problems and communicate scientific understanding of ideas about organic chemistry. Students should be provided with opportunities to engage with all the Working Scientifically skills throughout the course.</td></tr>
<tr><td colspan="4">Outcomes
• develops and evaluates questions and hypotheses for scientific investigation CH11/12-1*
• analyses and evaluates primary and secondary data and information CH11/12-5
• solves scientific problems using primary and secondary data, critical thinking skills and scientific processes CH11/12-6
• communicates scientific understanding using suitable language and terminology for a specific audience or purpose CH11/12-7
• analyses the structure of, and predicts reactions involving, carbon compounds CH12-14

* CH11/12-1 is not a focus outcome but has been included for the purposes of the depth study assessment requirements</td></tr>
<tr><td colspan="2">Resources

• Molymods
• Access to a laboratory with a fume cupboard
• Risk assessments conducted for each practical investigation
• 7 hours of depth study</td><td colspan="2">Depth Study

The Depth Study takes the form of a secondary-sourced investigation and may be used as a formal assessment task.

Students are required to maintain a process diary in relation to conducting a secondary sourced investigation and produce an in-class written response to a stimulus provided.

Aspects of the Depth Study are included throughout the unit to guide teachers in assisting students carry out the secondary sourced investigation.</td></tr>
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Unit title	**Module 7:** Organic Chemistry	**Duration**	30 hours plus an additional 8 hours for an ongoing Depth Study

Working Scientifically skills

CH11/12-5 Analyses and evaluates primary and secondary data and information
Students:

- derive trends, patterns and relationships in data and information
- assess error, uncertainty and limitations in data (ACSCH004, ACSCH005, ACSCH033, ACSCH099)
- assess the relevance, accuracy, validity and reliability of primary and secondary data and suggest improvements to investigations (ACSCH005)

CH11/12-6 Solves scientific problems using primary and secondary data, critical thinking skills and scientific processes
Students:

- use modelling (including mathematical examples) to explain phenomena, make predictions and solve problems using evidence from primary and secondary sources (ACSCH006, ACSCH010)
- use scientific evidence and critical thinking skills to solve problems

CH11/12-7 Communicates scientific understanding using suitable language and terminology for a specific purpose
Students:

- select and use suitable forms of digital, visual, written and/or oral forms of communication
- select and apply appropriate scientific notations, nomenclature and scientific language to communicate in a variety of contexts (ACSCH008, ACSCH036, ACSCH067, ACSCH102)
- construct evidence-based arguments and engage in peer feedback to evaluate an argument or conclusion (ACSCH034, ACSCH036)

Depth Study – 7 Hours

Students carry out a secondary-sourced investigation that may be used as formal assessment task.

Depth Study: Hydrocarbons – their applications and/or uses

Students are to take responsibility for their own learning and use a process diary to complete Depth Study investigation and produce an in-class final written response

Nomenclature		
Inquiry question: How do we systematically name organic chemical compounds?		
Content	**Teaching, learning and assessment**	**Diary/Resources**
Students: • investigate the nomenclature of organic chemicals, up to C8, using IUPAC conventions, including simple methyl and ethyl branched chains, including: (ACSCH127) – alkanes – alkenes – alkynes – alcohols (primary, secondary and tertiary) – aldehydes and ketones – carboxylic acids – amines and amides – halogenated organic compounds reactions (ACSCH046) • explore and distinguish the different types of structural isomers, including saturated and unsaturated hydrocarbons, including: (ACSCH035) – chain isomers – position isomers – functional group isomers	**Introduction to the Depth Study: Hydrocarbons – their applications and/or uses** Students commence the development of their process diary • Students brainstorm what elements might be present in the compound family called hydrocarbons • Students brainstorm compounds that contain hydrogen and carbon in society • Students conclude that more scientific information needs to be gathered about these compounds so that a question for scientific investigation can be developed. **CH11/12-1** **Nomenclature** **1. Nomenclature** • Students recall the meaning of IUPAC nomenclature with respect to the naming of inorganic acids and bases • Students explore hydrocarbon molecules by comparing molecular diagrams of various hydrocarbons. Think, Pair, Share similarities and differences between the molecules. • In groups, students attempt to informally classify the molecular structures. Give One Get One to share classifications with other groups. Assess the uncertainty and limitations in the different group classification systems. **CH11/12-5** • Students draw conclusions about the various hydrocarbons presented. **CH11/12-5** • Students examine the need for IUPAC nomenclature for naming hydrocarbons. • Students in jigsaw groups, research the nomenclature of organic chemicals, up to C8, using IUPAC conventions, including simple methyl and ethyl branched chains, including: (ACSCH127) – alkanes – alkenes – alkynes – alcohols (primary, secondary and tertiary) – aldehydes and ketones – carboxylic acids – amines and amides – halogenated organic compounds reactions (ACSCH046) **CH11/12-7** **2. Structural isomers** • Students, in groups, are given molymod models of different types of structural isomers of a particular hydrocarbon and use the Explanation Game to explore and distinguish between their structures using the 'Name it, Explain it, Give Reasons and Generate Alternatives' game structure. *CH11/12-5, CH11/12-6* • In groups, students communicate their scientific understandings to the class. **CH11/12-7** • Students provide feedback to their peers about the conclusions drawn and suggest improvements to the models made. **CH11/12-5, CH11/12-7**	

Hydrocarbons		
Inquiry question: How can hydrocarbons be classified based on their structure and reactivity?		
Content	**Teaching, learning and assessment**	**Diary/Resources**
Students: • construct models, identify the functional group, and write structural and molecular formulae for homologous series of organic chemical compounds, up to C8 (ACSCH035) : – alkanes – alkenes – alkynes	**Models** • Students use molymods or digital media to construct models, identify the functional group, and write structural and molecular formulae for homologous series of organic chemical compounds, up to C8 (ACSCH035): **CH11/12-6** – alkanes – alkenes – alkynes • Students use the models made to analyse the shape of molecules formed between carbon atoms when a single, double or triple bond is formed between them.	
• conduct an investigation to compare the properties of organic chemical compounds within a homologous series, and explain these differences in terms of bonding (ACSCH035) • analyse the shape of molecules formed between carbon atoms when a single, double or triple bond is formed between them	**Homologous series** • In groups, students prepare a report about an investigation they carry out to compare the properties of one homologous series of organic chemical compounds: – alkanes – alkenes – alkynes • Students compare the properties of organic chemical compounds within a homologous series • Students explain these differences in terms of bonding • In class presentations, share the groups' reports about their analysis of the shape of molecules formed between carbon atoms when a single, double or triple bond is formed between them **CH11/12-5, CH11/12-6, CH11/12-7** This presents students with opportunities for peer assessment.	
• explain the properties within and between the homologous series of alkanes with reference to the intermolecular and intramolecular bonding present. • describe the procedures required to safely handle and dispose of organic substances (ACSCH075)	**Alkanes** • Students use available references to research and explain the properties within and between the homologous series of alkanes with reference to the intermolecular and intramolecular bonding present • Students assess the relevance, accuracy, validity and reliability of the secondary data. **CH11/12-5c** **Safe handling and disposal of organic substances** **Depth Study: Hydrocarbons – their applications and/or uses** Students commence the process diary using the following as stimulus – 1 hour • Students recall the definition of an organic substance and brainstorm some examples studied so far • Students briefly research ONE organic substance and its use in society • Students describe the procedures required to safely handle and dispose of the organic substance **CH11/12-5** • Students compile a table of organic substances that includes safe handling and disposal instructions **CH11/12-7**	Student's commence their process diaries adding information and resources as they are found

Hydrocarbons		
Inquiry question: How can hydrocarbons be classified based on their structure and reactivity?		
Content	**Teaching, learning and assessment**	**Diary/Resources**
• examine the environmental, economic and sociocultural implications of obtaining and using hydrocarbons from the Earth	**Hydrocarbons from the Earth** **Depth Study: Hydrocarbons – their applications and/or uses** Students update their process diary by responding to the following – 1 hour • Students list different hydrocarbons that are obtained from the Earth • For three different hydrocarbons students note a: – scientific description – brief outline of how it is extracted from the Earth – brief outline of its uses • Students complete a PMI (Pluses, Minuses and Interesting Facts) for the environmental, economic and sociocultural implications of obtaining and using each hydrocarbon. Include an annotated bibliography in the Depth Study process diary. **CH11/12-5, CH11/12-6a, CH11/12-7** Teacher has the opportunity here to provide feedback on students' process diaries and PMI	Student's update their process diaries adding information and resources as they are found

Products of reactions involving hydrocarbons		
Inquiry question: What are the products of reactions of hydrocarbons and how do they react?		
Content	**Teaching, learning and assessment**	**Diary/Resources**
Students: • investigate, write equations and construct models to represent the reactions of unsaturated hydrocarbons when added to a range of chemicals, including but not limited to: – hydrogen (H_2) – halogens (X_2) – hydrogen halides (HX) – water (H_2O) (ACSCH136)  • investigate, write equations and construct models to represent the reactions of saturated hydrocarbons when substituted with halogens	• Students use molymods and digital technologies to investigate, construct models to represent the reactions of unsaturated hydrocarbons when added to a range of chemicals, including but not limited to: – hydrogen (H2) – halogens (X2) – hydrogen halides (HX) – water (H2O) • Students use a digital device to record the structure of these models • Students create a collage of the products formed when unsaturated hydrocarbons are added to a range of chemicals. **CH11/12-6, CH11/12-7** • Students write equations to represent these reactions **CH11/12-6, CH11/12-7** **Substitution reactions of saturated hydrocarbons** • Students use appropriate alkenes and bromine water to investigate, construct models to represent the reactions of saturated hydrocarbons when substituted with halogens. For this investigation students use the following scaffold to conduct the investigation. (The bolded items in the scaffold emphasise the focus skills for this investigation) • Problem • Aim • Hypothesis • Equipment • **Risk assessment** – **CH11/12-2** • **Procedure** – **CH11/12-3** • **Results** – photos before and after • **Conclusion** – Students identify trends in the data, assess error, uncertainty, validity and reliability of the data and include word equations where approoriate. **CH11/12-4 CH11/12-5** • Students use molymods and digital technologies to construct models to write equations that represent the reactions of saturated hydrocarbons when substituted with halogens **CH11/12-6** **Reflection** • Students participate in a Think, Pair, Share to update their process diary about what the products of reactions of hydrocarbons are and how do they react **CH11/12-7**	

Alcohols		
Inquiry question: How can alcohols be produced and what are their properties?		
Content	**Teaching, learning and assessment**	**Diary/Resources**
Students: • investigate the structural formulae, properties and functional group including: – primary – secondary – tertiary alcohols	• Students use secondary sources, molymods and digital animations to investigate the structural formulae, properties and functional group including: – primary – secondary – tertiary alcohols	
• explain the properties within and between the homologous series of alcohols with reference to the intermolecular and intramolecular bonding present	• Students use PEEL (point, explanation, example, link) to explain the properties within and between the homologous series of alcohols with reference to the intermolecular and intramolecular bonding present. • Students write an annotated bibliography to assess the relevance, accuracy, validity and reliability of sources used, **CH11/12-5** • The teacher provides the students with guidance from Cornell University in relation to constructing an annotated bibliography.	**Cornell University** **Guide to annotated bibliographies**
• conduct a practical investigation to measure and reliably compare the enthalpy of combustion for a range of alcohols	**Investigation: Compare the enthalpy of combustion for a range of alcohols** • In small groups, students follow a procedure to measure and reliably compare the enthalpy of combustion for a range of alcohols • Students evaluate and manage risks, ensure and evaluate accuracy, apply quantitative processes and evaluate the quality of the data collected • Students calculate the heat of combustion for each alcohol investigated, graph the results and make a concluding comparison **CH11/12-5** • Students assess the relevance, accuracy, validity and reliability of the primary data by comparing it to secondary sources **CH11/12-5** • Students suggest improvements to the investigation **CH11/12-5**	
• write equations, state conditions and predict products to represent the reactions of alcohols, including but not limited to (ACSCH128, ACSCH136): – combustion – dehydration – substitution with HX – oxidation	• Students complete worksheets and textbook exercises to write equations, state conditions and predict products to represent the reactions of alcohols, including but not limited to (ACSCH128, ACSCH136), **CH11/12-6**: – combustion – dehydration – substitution with HX – oxidation	

Alcohols		
Inquiry question: How can alcohols be produced and what are their properties?		
Content	**Teaching, learning and assessment**	**Diary/Resources**
• investigate the production of alcohols, including: – substitution reactions of halogenated organic compounds – fermentation	**Production of alcohols** • Students research secondary sources to investigate the production of alcohols in substitution reactions of halogenated organic compounds **CH11/12-5** • Students write equations to show the substitution **CH11/12-6, CH11/12-7** **Investigating fermentation** • In small groups, students follow a procedure to investigate the production of ethanol by fermentation • Students evaluate and manage risks, ensure and evaluate accuracy, apply quantitative processes and evaluate the quality of the data collected • Students write an equation to represent the reaction **CH11/12-6, CH11/12-7** • Students write a conclusion and engage in peer feedback to evaluate the argument for the conclusion **CH11/12-7**	
• investigate the products of the oxidation of primary and secondary alcohols	**Oxidation reactions** • Students revise oxidation reactions and half equations • Students revise definitions and examples of primary and secondary alcohols • Students use secondary sources to investigate the oxidation of primary and secondary alcohols using acidified sodium or potassium dichromate(VI) solution • Students write the half equations for the products of reduction and oxidation **CH11/12-6**	
• compare and contrast fuels from inorganic sources to biofuels, including ethanol	**Fuels** **Depth Study: Hydrocarbons – their applications and/or uses** Students update their process diary by responding to the following – 1 hour • Students use secondary sources to research fuels from inorganic sources and biofuels from organic sources, including ethanol • Students use a Venn diagram to compare and contrast the production and uses of these fuels. **CH11/12-6** • Students include balanced equations **CH11/12-6**	Student's update their process diaries adding information and resources as they are found

Reactions of organic acids and bases		
Inquiry question: What are the properties of organic acids and bases?		
Content	**Teaching, learning and assessment**	**Diary/Resources**
Students: • investigate the structural formulae, properties and functional group including: – primary, secondary and tertiary alcohols – aldehydes and ketones (ACSCH127) – amines and amides	• Students use secondary sources, molymods and digital animations to investigate the structural formulae, properties and functional group including: – primary, secondary and tertiary alcohols – aldehydes and ketones (ACSCH127) – amines and amides	
• explain the properties within and between the homologous series of carboxylic acids amines and amides with reference to the intermolecular and intramolecular bonding present	• Students use PEEL (*point, explanation, example, link*) to explain the properties within and between the homologous series of carboxylic acids, amines and amides with reference to the intermolecular and intramolecular bonding present • Students write an annotated bibliography to assess the relevance, accuracy, validity and reliability of sources used **CH11/12-5**	PEEL
• investigate the production, in a school laboratory, of simple esters	**Investigating esters** **Depth Study: Hydrocarbons – their applications and/or uses** Students update their process diary by responding to the following – 1 hour • In small groups, students follow a procedure to investigate the production of esters. • Students evaluate and manage risks, ensure and evaluate accuracy, apply quantitative processes and evaluate the quality of the data collected • Students write an equation to represent the reaction **CH11/12-6, CH11/12-7** • Students write a conclusion and engage in peer feedback to evaluate the argument for the conclusion **CH11/12-7**	Students update their process diaries adding information and resources as they are found
• investigate the differences between an organic acid and organic base	• Students use secondary sources to investigate the differences between an organic acid and organic base.	
• investigate the structure and action of soaps and detergents	**Depth Study: Hydrocarbons – their applications and/or uses** Students update their process diary by responding to the following – 1 hour • Students use secondary sources to investigate the structure and action of soaps and detergents • Students conduct a first-hand investigation of the action of soaps and detergents • Students use diagrams to represent the action of soaps and detergents as surfactants **CH11/12-7**	
• draft and construct flow charts to show reaction pathways for chemical synthesis, including those that involve more than one step	**Depth Study: Hydrocarbons – their applications and/or uses** Students update their process diary by responding to the following – 1 hour • Students draft and construct flow charts to show reaction pathways for chemical synthesis, including those that involve more than one step **CH11/12-6, CH11/12-7**	

Polymers		
Inquiry question: What are the properties and uses of polymers?		
Content	**Teaching, learning and assessment**	**Diary/Resources**
Students: • model and compare the structure, properties and uses of addition polymers of ethylene and related monomers, for example: – polyethylene (PE) – polyvinyl chloride (PVC) – polystyrene (PS) – polytetrafluoroethylene (PTFE) (ACSCH136) • model and compare the structure, properties and uses of condensation polymers, for example: – nylon – polyesters	• Students revise a definition and examples of addition reactions and condensation reactions • Students use molymods and digital animations to model and compare the structure, properties and uses of: **CH11/12-6** – addition polymers of ethylene and related monomers, for example: o polyethylene (PE) o polyvinyl chloride (PVC) o polystyrene (PS) o polytetrafluoroethylene (PTFE) – condensation polymers, for example: o nylon o polyesters • Students record the models with photographs • Students write equations to represent the addition and condensation reactions **CH11/12-6, CH11/12-7** **Depth Study: Hydrocarbons – their applications and/or uses** Students update their process diary by responding to the following – 2 hour • In jigsaw groups students research the structure, properties and uses of each of the above polymers and their related monomers. • Students engage in peer feedback to evaluate the data collected. Suggest improvements to the models constructed. **CH11/12-5c, CH11/12-7c** • Students use a table to compare the structure, properties and uses of each of the above polymers and their monomers **CH11/12-5**	Students update their process diaries adding information and resources as they are found

Depth Study Conclusion: Hydrocarbons – their applications and/or uses		
Content	**Teaching, learning and assessment**	**Diary/Resources**
	Depth Study: Hydrocarbons – their applications and/or uses **Reflection** • Students write a reflection on the application and uses of hydrocarbons in society • In the process diary students – following the background information already gathered within this module, develop a question for further investigation CH11/12-1 – research and present solutions to the question • Students analyse and evaluate the secondary data and information **CH11/12-5** • Students include balanced chemical equations to support the gathered information wherever possible **CH11/12-6** • Students communicate scientific understanding using suitable language and terminology **CH11/12-7** • use the Process Diary to complete an in-class assessment **CH11/12-6, CH11/12-7**.	

REFLECTION AND EVALUATION

TEACHER: **CLASS:**

DATE UNIT COMMENCED: **DATE UNIT CONCLUDED:**

- **Variations to program:** (List additional resources and outline alternative strategies used)

- **The most effective teaching/learning strategies and resources in this unit were:** (Please nominate 3 at least)

- **Less effective teaching strategies and resources for this unit were:** (Please nominate 2 at least)

TEACHER'S SIGNATURE_____

DATED_____**CHECKED**_____