**teacher guide**

**Hydrocarbon chemistry 3:**

**Naming hydrocarbons**

# Components

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| --- | --- | --- | --- |
|  | NAME | DESCRIPTION | AUDIENCE |
|  | *Naming hydrocarbons*teacher guide | This guide describes use of a learning object to teach students about how hydrocarbons are named, and different models that can be used to represent their structure. | teachers |
|  | *How to name hydrocarbons*fact sheet | This fact sheet introduces IUPAC naming of alkanes, alkenes and alkynes to students, with examples. | students |
|  | *Hydrocarbon explorer*learning object | Students use this learning object to construct models of alkanes, alkenes, alkynes and cycloalkanes with their correct name. Properties and 3-D views of selected hydrocarbons are also displayed. | students |
|  | *Hydrocarbon models*worksheet | This worksheet accompanies the learning object,*Hydrocarbon explorer*. | students |

Purpose

To **Explain** how hydrocarbons are named. Students use a computer animation to look at different models of alkanes, alkenes, alkynes and cycloalkanes.

# Activity summary

Outcomes

Students:

* draw and name alkanes, alkenes and alkynes;
* describe differences in the structures and properties of alkanes, alkenes and alkynes.

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| --- | --- |
| ACTIVITY | POSSIBLE STRATEGY |
| Distribute and read through the fact sheet, *How to name hydrocarbons*. Teachers may ask students to draw and name additional examples of hydrocarbons. | whole group |
| Students explore the learning object, *Hydrocarbon explorer*. It may be useful for students to use a ‘ball and stick’ model kit to make some models that they observe in the learning object. | pairs |
| Students complete the worksheet, *Hydrocarbon models,* while using the learning object, then discuss results with a peer. | pairs, share |

# Technical requirements

The guide, fact sheet and worksheet require Adobe Reader (version 5 or later), which is a free download from [www.adobe.com.](http://www.adobe.com/) The worksheet is also provided in Microsoft Word format.

The learning object may be placed on a web or file-server, and run locally or remotely in any modern browser on computer or tablet. Jmol/JSmol software is used to display 3-D models. This requires Java or HTML5 support.

The learning object can also be accessed online at <http://spice.wa.edu.au/resources/hydrocarbon-explorer/>

# Using the learning object

The learning object *Hydrocarbon explorer* allows users to interactively construct models of acyclic and cyclic hydrocarbons, see how they are named and look up their basic physical properties.

C

**B**

**A**

The second screen of the learning object (Straight- chain hydrocarbons) is divided into three sections (**A**, **B** and **C**), as shown above.

The molecule is built in section **A**; properties of the molecule are displayed in section **B**; and a 3-D model displayed in section **C**.

Initially methane will be displayed. Build a molecule by selecting **Add carbon** to make progressively longer alkanes (ethane, propane, ... , up to decane). **Take carbon** reverses the process.

To insert a double or triple bond in the molecule, hover over any carbon-carbon bond in section **A** to display a pop-up bond menu. Select the bond type you want. Neighbouring bonds will be changed if the molecule you create is not possible (eg if you select a triple bond next to an existing double bond then the double bond will be reduced to a single bond).

As the molecule is changed, section **B** displays its IUPAC name, formula, structure and, where available, its melting point and boiling point.

At the same time, a 3-D ‘Jmol’ model of the molecule is displayed in section **C**. This model can be rendered as either **Ball & stick** or **Space fill**. It can be dragged with the mouse to display the molecule from different view points, or set to **Spin** automatically.

Additional Jmol options are available by right- clicking in the window (control-click for Macintosh users). A guide to using Jmol is available at http:// wiki.jmol.org/index.php/Mouse\_Manual

Select **Next** to display a similar page for cyclic hydrocarbons (propane to decane).

3-D models are available for only some of the molecules that can be created in the top section. Those currently available in the learning object are listed below.

|  |  |  |  |
| --- | --- | --- | --- |
| ALKANES | ALKENES | ALKYNES | CYCLIC HYDROCARBONS |
| methane | ethene | ethyne | cyclopropane |
| ethane | propene | propyne | cyclobutane |
| propane | propa-1,2-diene | but-1-yne | cyclopentane |
| butane | but-1-ene | but-2-yne | cyclohexane |
| pentane | but-2-ene | pent-1-yne | cycloheptane |
| hexane | buta-1,3-diene | pent-2-yne | cyclooctane |
| heptane | pent-1-ene | hex-1-yne |  |
| octane | pent-2-ene | hex-2-yne |  |
| nonane | hex-3-ene | hex-3-yne |  |
| decane |  | non-1-yne |  |
|  |  | nona-1-en-7-yne |  |
|  |  | dec-4-yne |  |

# Acknowledgements

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Designed and developed by the Centre for Learning Technology, The University of Western Australia, Production team: Anton Ball, Alwyn Evans, Bob Fitzpatrick, Jenny Gull, Dan Hutton and Michael Wheatley.

Molecular models in *Hydrocarbon explorer* are represented using JSmol (an extension of the Java- based molecular visualization applet, Jmol, as an HTML5 JavaScript-only web app). See [http://www.](http://www/) jmol.org/ for details.

Jmol data files used to construct the models in

*Hydrocarbon explorer* come from two sources:

* Prof Albert Pratt, Dublic City University<http://webpages.dcu.ie/~pratta/jmgallery/>
* Dr Dave Woodcock, Okanagan University College <http://elchem.kaist.ac.kr/jhkwak/okanaganpdb97/> molecule/molecule.html

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# Associated SPICE resources

*Hydrocarbon chemistry 3: Naming hydrocarbons* may be used in conjunction with related SPICE resources to address the broader topic of organic chemistry.

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| DESCRIPTION | LEARNING PURPOSE |
| *Hydrocarbon chemistry*This learning pathway shows how a number of SPICE resources can be combined to teach the topic of organic chemistry. |  |
| *Hydrocarbon chemistry 1: Coconut oil*This resource engages students in organic chemistry by showing them how fuel can be made from plants in a very basic home set-up. | Engage |
| *Hydrocarbon chemistry 2: Biodiesel*This resource further explores biodiesel production as students make their own biodiesel and compare its properties with those of other fuels. | Explore |
| *Hydrocarbon chemistry 3: Naming hydrocarbons*This resource explains to students how hydrocarbons can be drawn and systematically named. | Explain |
| *Hydrocarbon chemistry 4: Hydrocarbon economy*Australia uses a wide range of hydrocarbons for domestic and industrial purposes. How is this range supplied from available sources? | Elaborate |