# Stage 6 Chemistry M7 Hydrocarbon Properties

* **IQ2-7** How can hydrocarbons be classified based on their structure and reactivity?

This document references the [Chemistry Syllabus](https://www.educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/pdhpe/pdhpe-k-10-2018) © [NSW Education Standards Authority](https://www.educationstandards.nsw.edu.au/wps/portal/nesa/home) (NESA) for and on behalf of the Crown in right of the State of New South Wales 2020.

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| Guiding question:  | Add question here |
| What are your students going to learn? (Objectives) | Conduct an investigation to compare the properties of organic chemical compounds within a homologous series, and explain these differences in terms of bonding (ACSCH035). |
| How are they going to learn it? (Resources and Strategies) | **Resources**:* [Bozeman Science - London Dispersion Forces](https://www.youtube.com/watch?v=1iYKajMsYPY) (duration 5:01)
* [Khan Academy - London dispersion forces | Intermolecular forces and properties](https://www.youtube.com/watch?v=5OT5l-NZS24) (duration 9:37)
* ~20cm of a thin flexible material such as string, rope, rubber or plastic tubing, cooked cold spaghetti etc
* [Present your data in a scatter chart or a line chart](https://support.office.com/en-us/article/present-your-data-in-a-scatter-chart-or-a-line-chart-4570a80f-599a-4d6b-a155-104a9018b86e)

**Strategies**1. Creating models of molecules using common available materials
2. Presenting data in graphical forms and relating to the modelling scenario
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| Target date for completion | 3 lessons |
| How are you going to know that they learned it? (Success criteria) | Students will be able to describe the influence of intermolecular forces on the properties of hydrocarbons. |
| Collecting evidence of student learning (Verification) | Images of students’ constructions included in their submissions will be appropriately annotated to describe the way in which the model depicts the trend observed in the graphed data. |
| Feedback (Evaluation) | Teachers and peers could provide feedback using comments on the submission to show areas of strength and ideas for further development. |
| Communication | Students will communicate their understanding through a report which includes images of the molecules they have produced and how this relates to the graphed data for the homologous series of alkanes. |

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| Lesson sequence | Activities | How this will be measured |
| One | 1. Familiarise yourself with London dispersion forces, read the description below and watch the two videos presented on YouTube:

[Bozeman Science – London Dispersion Forces](https://www.youtube.com/watch?v=1iYKajMsYPY) (duration 5:01)[Khan Academy – London dispersion forces | Intermolecular forces and properties](https://www.youtube.com/watch?v=5OT5l-NZS24) (duration 9:37)London dispersion forces are the unequal sharing of electrons which causes rapid polarisation and counter-polarisation of the electron cloud around the molecule, forming short-lived dipoles. These dipoles interact with the electron clouds surrounding very close neighbouring molecules forming more dipoles. These forces are weaker than other intermolecular forces and they occur in all substances.1. With your material examine the flexibility of the 20cm length, take a selection of images to show the different spatial arrangements this length of material can form. Let’s call this feature the conformation of the molecule. What is a limitation of this type of modelling?
2. Cut the molecule length in half to obtain two 10cm pieces, how does the number of conformations for a single 10cm length compare to the 20cm length?
3. As each 10cm molecule is moved adjacent to each other they can become entwined. If you had many of these pieces, they may even become knotted. What impact does the chain length have on the ability or ease of the molecule to become entwined?
4. Heat energy is applied to your molecules and this increases their vibration; this causes more rapid shifts in the conformation. As more heat energy is applied, the vibration can continue to a point at which the molecules can no longer hold onto each other and a change of state occurs (solid🡪liquid or liquid🡪gas). What impact does the number of possible conformations have on the ability of each molecule to hold onto adjacent molecules?
 | Students will submit a short report including images and descriptions of their molecule conformations. |
| Two | 1. Using the data of melting and boiling points for straight-chained C1 - C8 alkanes in the table below, [Present your data in a scatter chart or a line chart](https://support.office.com/en-us/article/present-your-data-in-a-scatter-chart-or-a-line-chart-4570a80f-599a-4d6b-a155-104a9018b86e)
2. From your observations in the modelling activity last lesson, how does the chain length determine the number of conformations and how does this relate to the melting and boiling point trend observed?

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| **Alkane** | **Formula** | **Melting point [°C]** | **Boiling point [°C]** |
| **Methane** | CH4 | −182.5 | -161.5 |
| **Ethane** | C2H6 | −182.8 | −88.6 |
| **Propane** | C3H8 | −187.7 | −42.1 |
| **Butane** | C4H10 | −138.3 | -0.5 |
| **Pentane** | C5H12 | −129.7 | 36.1 |
| **Hexane** | C6H14 | −95.3 | 68.7 |
| **Heptane** | C7H16 | −90.6 | 98.4 |
| **Octane** | C8H18 | −56.8 | 125.7 |

Source: Aylward, G. and Findlay, T., 2002. SI Chemical Data. 5th ed. Sydney: John Wiley & Sons Australasia. | Students will submit a graph of the data supplied and a report to describe how this data is explained by the observations made in the first lesson. |
| Three | 1. [Present your data in a scatter chart or a line chart](https://support.office.com/en-us/article/present-your-data-in-a-scatter-chart-or-a-line-chart-4570a80f-599a-4d6b-a155-104a9018b86e) for the data table below of melting and boiling points for straight-chained C1-C8 1-alkenes on the **same graph** from the previous lesson with alkanes.

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| **1-Alkene** | **Formula** | **Melting point [°C]** | **Boiling point [°C]** |
| **Ethene** | C2H4 | -169.1 | -103.7 |
| **Propene** | C3H6 | -185.2 | -47.7 |
| **But-1-ene** | C4H8 | -185.3 | -6.3 |
| **Pent-1-ene** | C5H10 | -165.2 | 30 |
| **Hex-1-ene** | C6H12 | -139.8 | 63.5 |
| **Hept-1-ene** | C7H14 | -119 | 93.6 |
| **Oct-1-ene** | C8H16 | -101.7 | 121.3 |

Source: Aylward, G. and Findlay, T., 2002. SI Chemical Data. 5th ed. Sydney: John Wiley & Sons Australasia.1. From the graph of this data comparing it to the corresponding alkanes, develop a revised model to demonstrate the difference between the corresponding alkane and 1-alkene melting and boiling points.
2. How does the double bond in the 1-alkene alter the number of possible conformations possible in the molecule?
3. Why does this effect the melting and boiling point of the molecule?
 | Students will submit a graph of the data supplied and a report to describe how this data is explained by the revised model created. |