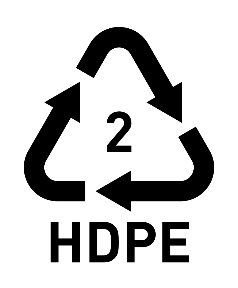
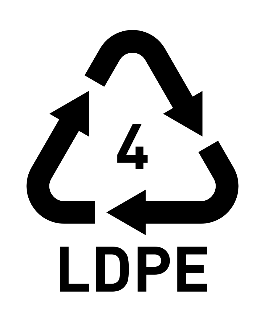
**Plastic labels**

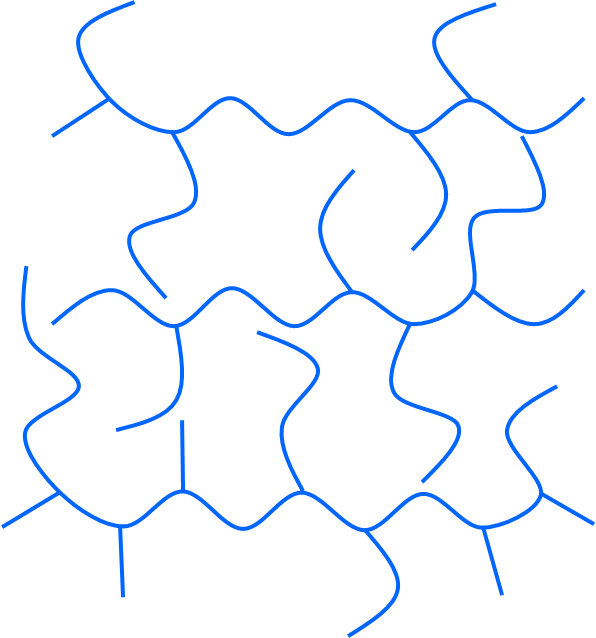
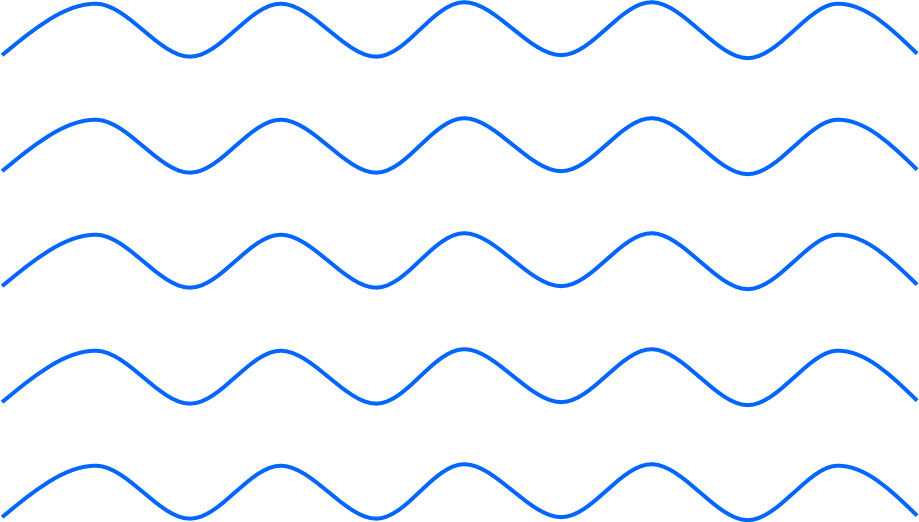
Labels on plastic containers identify what type of polymer they are made from.

Milk bottles are made of HDPE. Many plastic bags are made of LDPE.



HDPE: High density polyethylene LDPE: Low density polyethylene

A solid block of HDPE has more than the same sized block of LDPE.



HDPE is made up of linear molecules. LDPE is made up of branched polymer molecules.

These statements are about why a block of HDPE has more mass.

For each statement, tick (✓) **one** column to show what you think*.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | I am **sure** this is right | I think this is right | I think this is wrong | I am **sure** this is wrong |
| **A** | Linear molecules are heavier. |  |  |  |  |
| **B** | Linear molecules can fit closer together. |  |  |  |  |
| **C** | Linear molecules have larger forces between them. |  |  |  |  |

*Chemistry > Big idea CMS: Materials science > Topic CMS2: Designing materials > Key concept CMS2.1: Polymer properties*

|  |
| --- |
| **Diagnostic question** |
| **Plastic labels** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Materials scientists can design polymers with specific properties. |
| Observable learning outcome: | Describe how linear or branched molecules affect the mass of a given volume of polymer. |
| Question type: | confidence grid |
| Key words: | molecule, polymer |

**What does the research say?**

Research (Krnel, Watson and Glažar, 1998) suggests that students, even at the age of 14-15 often do not have a clearly differentiated the idea of mass and density. Density is identified by the authors as an important property for distinguishing different materials.

This diagnostic question introduces the idea of polymers having different densities by comparing the mass of 1 cm3 of two different polymers.

**Ways to use this question**

Students should complete the confidence grid individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations, it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

1cm3 of HDPE has (slightly) greater mass because linear molecules can fit closer together.

**How to respond - what next?**

A student who is confident about statement C has not linked the structural feature with the property. The forces between molecules help to explain differences in melting and boiling point.

A student who is confident about statement A may not recognise that it is the number of atoms in the molecule that affects the mass.

If students have misunderstandings about how the branching of a polymer molecule affect how closely the molecules can pack together, try using the students to model. Ask the class to move around with their arms by their sides and then repeat with arms out at 90° and then compare the numbers that fit in a fixed space.

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Peter Fairhurst (UYSEG)

**References**

Krnel, D., Watson, R. and Glažar, S. A. (1998). Survey of research related to the development of the concept of 'matter'. *International Journal of Science Education,* 20(3)**,** 257-289.