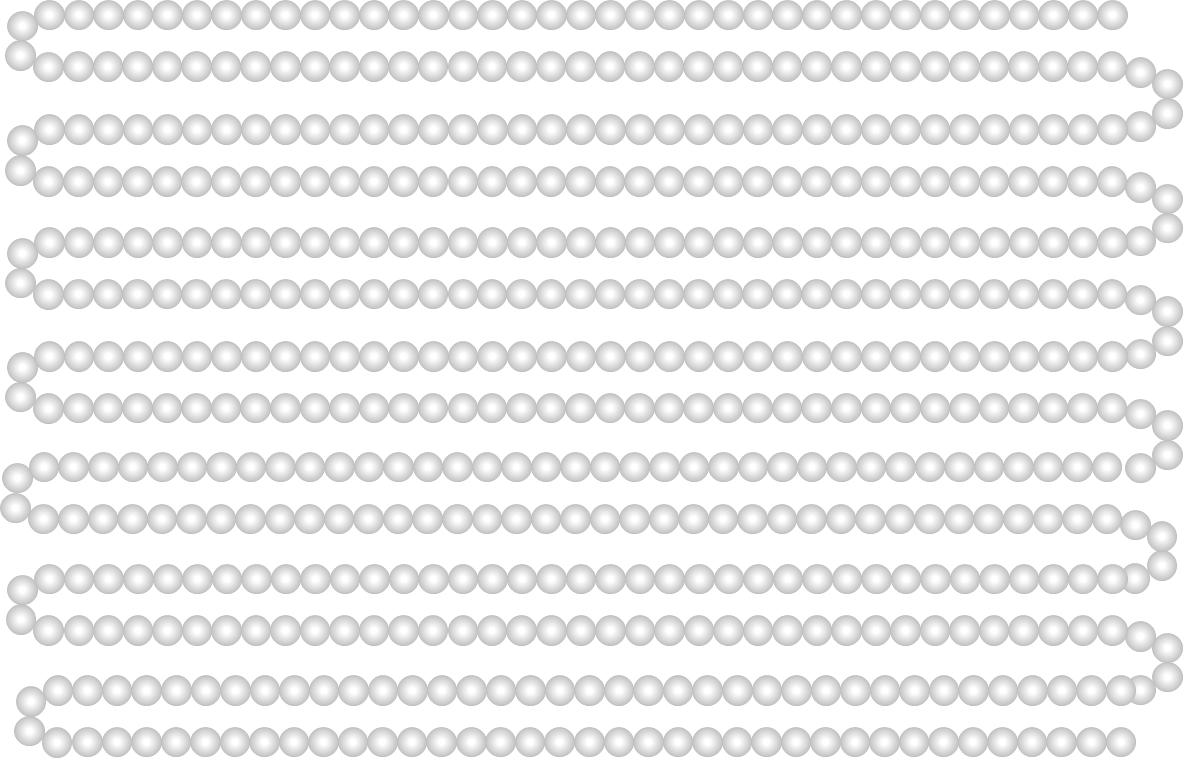
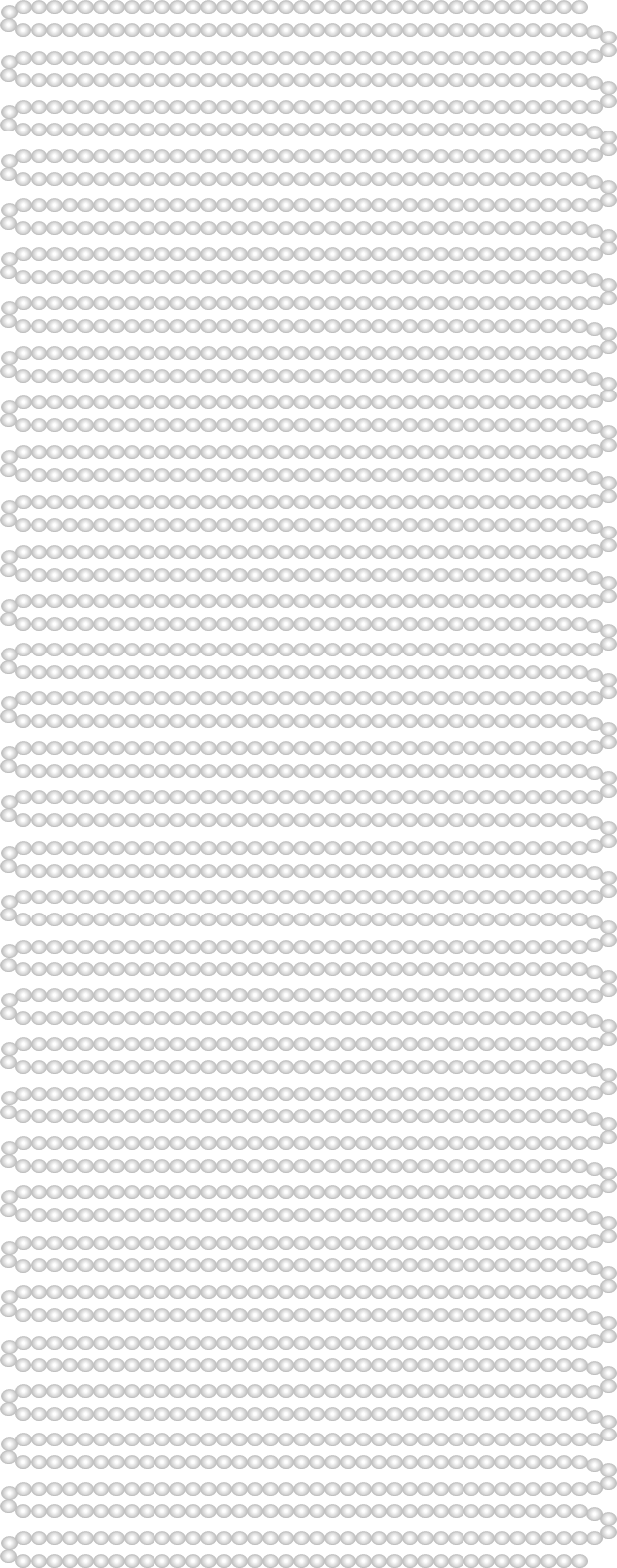
**Molecule size**

How many atoms are there in a typical polymer molecule?

A B C D



Put a tick (✓) in the box next to the best answer.

|  |  |  |
| --- | --- | --- |
| **A** | <10 |  |
|  |  |  |
| **B** | <100 |  |
|  |  |  |
| **C** | <1000 |  |
|  |  |  |
| **D** | >1000 |  |
|  |  |  |

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

|  |
| --- |
| **Diagnostic question** |
| **Molecule size** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Materials scientists can design polymers with specific properties. |
| Observable learning outcome: | Recognise that a polymer molecule can be made up of thousands of atoms. |
| Question type: | simple multiple choice |
| Key words: | atom, polymer, molecule |

**What does the research say?**

Johnstone (1991) explains the difficulties that many students face in understanding science as the degree of ‘multilevel’ thought required. In chemistry students are frequently required to think about very different types of thing all at once.

Johnstone presented this in the form of a triangle:



*(after Johnstone, 1991, p78)*

Students will be familiar with polymers, at a macroscopic level, from everyday life but their mental models of the sub-microscopic structure of polymers may be very different to the actual structure of a polymer. In particular, students may not realise that polymers are made up of vastly more atoms than the smaller molecules that they may have been introduced to so far. Carbon dioxide is made up of three atoms, whereas a polymer may be made up of tens of thousands of atoms.

**Ways to use this question**

Students should complete the question 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.

The answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

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**

D

Please note that D shows about 2250 atoms but polymers can have tens off thousands of atoms in a single molecule and even hundreds of thousands.

**How to respond - what next?**

A student who selects A, B or C may not realise how many more atoms there are in a polymer molecule than the type of molecule that they may have met in chemistry before.

If students have misunderstandings about the size of molecules, they could be told that polymers may contain tens of thousands of atoms or even hundreds of thousands of atoms.

The following BEST ‘response activities’ could be used in follow-up to this diagnostic question:

* Polymer chains

**Acknowledgments**

Developed by Helen Harden (UYSEG)

Images: Peter Fairhurst (UYSEG)

**References**

Johnstone, A. H. (1991). Why is chemistry difficult to learn? Things are seldom what they seem. *Journal of Computer Assisted Learning,* 7**,** 75-83.