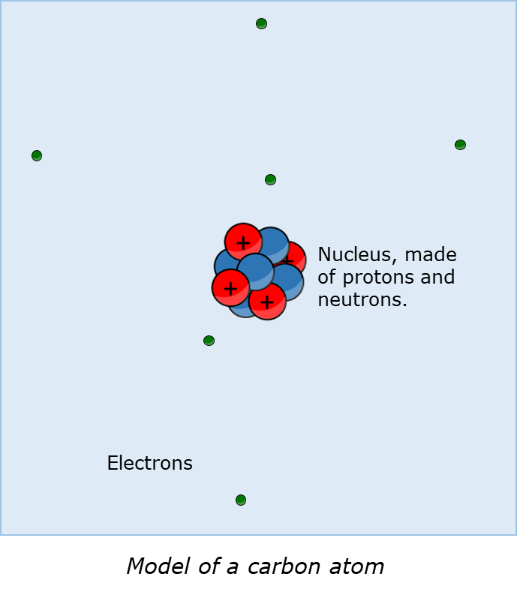
**Holding it together**

****A carbon atom is made of protons, neutrons and electrons.

It has six of each.

Protons have a positive charge.

Neutrons have no charge.

Electrons have a negative charge.

*Fill in the gaps to describe the forces inside the nucleus of an atom.*

*You should only use the words* ***electrostatic*** *and* ***strong nuclear***.

**The nucleus of a carbon atom**

The nucleus of a carbon atom contains 6 protons and 6 neutrons.

Protons repel each other with the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force.

Protons attract each other with the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force.

Protons attract neutrons with the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force.

Neutrons attract each other with the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force.

In the carbon nucleus, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force holding the protons together is stronger than the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force pushing them apart.

*Physics > Big idea PMA: Matter > Topic PMA5: Nuclear physics > Key concept PMA5.1: Atomic nuclei*

|  |
| --- |
| **Response activity** |
| **Holding it together** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | There is a fixed number of positively charged protons in the nucleus of each atom of an element, but the number of neutrons can vary to make isotopes that are either stable or unstable. |
| Observable learning outcome: | Describe the properties of protons and neutrons in a nucleus. |
| Activity type: | Focused cloze |
| Key words: | Atom, nucleus, electron, proton, neutron, positive charge, negative charge, attract, repel, electrostatic force, strong nuclear force |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic question:

* Diagnostic question: Protons and neutrons

**What does the research say?**

The level of awareness is low amongst students, that an electrostatic force attracts electrons to a nucleus and causes electrons around a nucleus (or protons within a nucleus) to repel each other (Harrison and Treagust, 1996; Tabor, 2013). In his study, Taber (2013) found that it was more common for students aged 15-18 (N=105) to think instead, that gravity or magnetism attracts electrons towards a nucleus.

This activity helps to clarify the forces acting in the nucleus of an atom. It prepares students for developing an understanding of why some nuclei are stable and some are unstable.

**Ways to use this activity**

Students should complete the activity individually as a pencil and paper exercise. The large text on the worksheet allows it to be copied A5 size, which fits a standard exercise book.

How students fill in the gaps will show you whether they 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 sentences 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**

**The nucleus of a carbon atom**

The nucleus of a carbon atom contains 6 protons and 6 neutrons.

Protons repel each other with the **electrostatic** force.

Protons attract each other with the **strong nuclear** force.

Protons attract neutrons with the **strong nuclear** force.

Neutrons attract each other with the **strong nuclear** force.

In the carbon nucleus, the **strong nuclear** force holding the protons together is stronger than the **electrostatic** force pushing them apart.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

Harrison, A. G. and Treagust, D. F. (1996). Secondary students' mental models of atoms and moelcules: Implications for teaching chemistry. *Science Education,* 80(5)**,** 509-534.

Tabor, K. S. (2013). Upper secondary students' understanding of the basic physical interactions in analogous atomic and solar system models. *Research in Science Education,* 43**,** 1377-1406.