**Electron shells**

Sometimes electrons are said to be arranged in different electron shells.

A picture containing clock

Description automatically generated

The word shell is used because in some ways an electron shell is like a real shell. Shell is a metaphor.

A nest with an egg on top

Description automatically generated A picture containing food, shellfish, fruit, different

Description automatically generated

Egg shells Sea shells

1. Complete the following sentences.

An electron shell is like a real shell because…

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An electron shell is not like a real shell because…

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*Chemistry > Big idea CPS: Particles and structure > Topic CPS7: Metallic bonding > Key concept CPS7.1: Metallic structure model*

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| **Response activity** |
| **Electron shells** |

**Overview**

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| Learning focus: | A model of metallic structure, made up of positive metal ions surrounded by ‘free’ outer electrons, can explain some properties of metals. |
| Observable learning outcome: | Recognise that a diagram of electron arrangement is a model and not a copy of reality. |
| Activity type: | Critiquing language |
| Key words: | electron, model |

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

* Electron diagram

**What does the research say?**

Research into students’ mental models (see key concept notes) of atoms (Harrison and Treagust, 1996) found that metaphors used in teaching, such as ‘electron shell’ tended to conjure up in the minds of students quite different models to those intended by the teacher.

The students in the study all responded as though an electron shell was an actual physical entity that offered some form of protection. The authors recommend that a metaphor should only be used if its intended meaning is clearly explained.

The paper also refers to the three levels of thinking about models described by Grosslight et al (1991).

The authors suggest that functioning at the most basic level, think of models as copies of reality. At the next level of thinking students recognise that the models are not copies of reality. The students understand that a model can help to explain ideas that they are learning about and that a model has limitations. Students with the most advanced thinking about models are able to work with multiple models.

The paper recommends that science curricula include explicit instruction in scientific modelling in particular to help ensure that students do not think that models are copies of reality.

**Ways to use this activity**

Students should complete this activity in pairs or small groups, and the focus should be on the discussions. It is through the discussions that students can check their understanding and rehearse their explanations.

Students should work together to follow the instructions on either the worksheet or the PowerPoint. Giving each group one worksheet to complete between them is helpful for encouraging discussion, but each member should be able to report back to the class. Listening in to the conversations of each group will often give you insights into how your students are thinking.

*Differentiation*

Some students could be challenged to think about other uses of metaphor in relation to atoms. For example, some may have heard of the term “electron cloud” or “energy levels”.

**Expected answers**

An electron shell is like a real shell because it goes round a central core (the nucleus).

An electron shell is not like a real shell because it is not a physical entity.

**Acknowledgments**

Developed by Helen Harden (UYSEG)

Images:

Electron shell diagram by Helen Harden (UYSEG)

Egg shell image by [Myriam Zilles](https://pixabay.com/users/Myriams-Fotos-1627417/?utm_source=link-attribution&utm_medium=referral&utm_campaign=image&utm_content=1268240) from [Pixabay](https://pixabay.com/?utm_source=link-attribution&utm_medium=referral&utm_campaign=image&utm_content=1268240)

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**References**

Grosslight , L., et al. (1991). Understanding models and their use in science: Conceptions of middle and high school students and experts. *Journal of Research in Science Teaching,* 28**,** 799-822.

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.