**Atom overlays**

The basic particle model shows a simple arrangement of atoms in a metal.

However, it does not show the more detailed structure of an atom.

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Create an overlay to show the nucleus and electrons of each atom.

**To do**

1. Place a piece of tracing paper or clear acetate sheet over the particle model diagram.
2. Over the first particle, draw a diagram to show the nucleus and inner electron shells of a sodium atom.
3. Repeat for the other particles.
4. Now add the correct number of ‘free’ electrons.

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

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| **Response activity** |
| **Atomic overlay** |

**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: | Describe a model of metallic structure (positive ions and ‘free’ outer electrons). |
| Activity type: | Clarifying |
| Key words: | nucleus, nuclei, electron, model |

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

* Metallic structure

**What does the research say?**

Taber and Coll (2002) list possible sources of student misunderstandings as early experiences, folk science and everyday meanings of technical words. However, the authors note that chemical bonding does not fall within everyday experience, so misunderstandings are more likely to have arisen from teaching.

Taber (2003) proposes that anachronistic notions of the atom that survive in the chemistry curriculum encourage students to give atoms priority in their thinking. For example, it is common to talk about an element being made up of one type of atom. This level of simplification may be appropriate for younger students but whilst an experienced chemist knows that a metal is not actually made up of bonded atoms a learner of chemistry may think that the whole atom is involved. The model of metallic structure commonly used when teaching fourteen to sixteen year olds consists of metal ions surrounded by ‘free’ outer electrons. Making this explicit and exploring how this model has progressed from a basic particle model may therefore help to reduce student misconceptions.

**Ways to use this activity**

This activity gives you the opportunity to re-teach a challenging concept and show your students how it builds up from simpler ideas, using a structured teacher-led discussion.

You should use carefully selected questions to check your students’ understanding.

* What does the circle of each atom become when the atomic structure is added?

The circle does not become the outer shell because these electrons are not bound to a particular nucleus. The circle is therefore the next electron shell.

* How does this particle diagram differ from the diagram usually used to show the solid state? Why?

The atoms have been drawn more spread out in order to allow the drawing of the ‘free’ electrons.

* Do the circles in the particle diagrams actually represent atoms?

No. The circles in the particle diagram represent metal ions. The ions are positively charged because they no longer have their outer electrons.

*Differentiation*

Some students may need greater support in understanding this idea. It may be easier for some students to be shown the two representations first before they consolidate their understanding by making their own overlay.

**Equipment**

For each student/pair/group:

* tracing paper or
* clear acetate sheet and pen

**Expected answers**

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**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Helen Harden (UYSEG)

**References**

Taber , K. S. (2003). The atom in the chemistry curriculum: Fundamental concept, teaching model or epistemological obstacle? *Foundations of Chemistry,* 5**,** 43-84.

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