

TEACHER NOTES

Relative atomic mass of boron: Johnstone's triangle

This resource is from the **Johnstone's triangle** series which can be viewed at: rsc.li/43jMfSn. It will help learners to understand the different ways you need to think in chemistry, and to build their mental models and understanding.

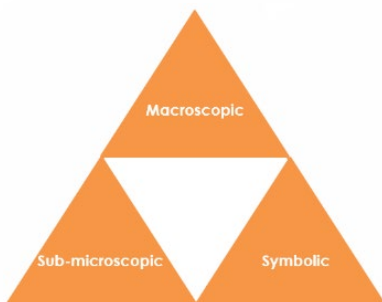
Learning objectives

- 1 Give the properties of boron that show it is a semi-metal.
- 2 Calculate the relative atomic mass of boron.
- 3 Interpret the atomic symbol of a boron isotope.

How to use Johnstone's triangle

Use Johnstone's triangle to develop learners' thinking about scientific concepts at three different conceptual levels:

- Macroscopic – what we can see. Think about the properties you can observe, measure and record.
- Sub-microscopic – smaller than we can see. Think about the particle or atomic level.
- Symbolic – representations. Think about how we represent chemical ideas including symbols and diagrams.



For learners to gain a deeper awareness of a topic, they need to understand it at all three levels.

When introducing a topic, don't introduce all three levels of thinking at once. This will overload working memory. Instead complete the triangle over a series of lessons, beginning with the macroscopic level, ideally followed the symbolic and then sub-microscopic levels.

The levels are interrelated. For example, learners need visual representation of the sub-microscopic in order to develop mental models of the particle or atomic level.

Find further reading about Johnstone's triangle and how to use it in your teaching at: rsc.li/4566Efy.

Scaffolding

Share the structure of the triangle with learners prior to use. Tell them why you are using it and how it will help them to develop their understanding. Use an 'I try, we try, you try' approach when introducing Johnstone's triangle for the first time.

More resources

To further develop learner's thinking in all areas of Johnstone's triangle, try our **Developing understanding** worksheets (rsc.li/43jMfSn). These include icons in the margin referring to the conceptual level of thinking needed to answer the question.

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Macroscopic – what we can see

The image shows the element boron. Boron is a semi-metal.

Give one property of boron that is similar to a metal.
Boron is shiny (allow also: high melting point).

Boron has a melting point of 2076 °C. It is a poor electrical conductor and is very hard.

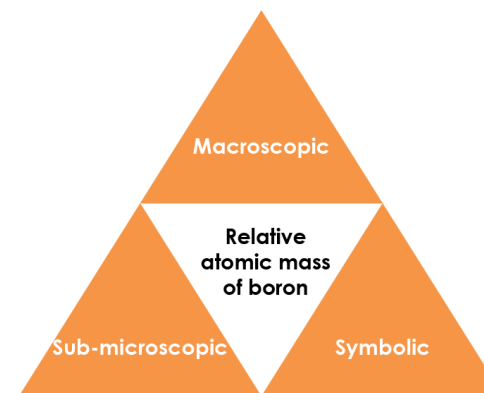
Give one property of boron that is not similar to a metal.

It is a poor electrical conductor.



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Crystalline form of Boron

**Sub-microscopic – smaller than we can see**

The percentage of the two isotopes of boron (to 2 significant figures) are: ^{10}B 20% and ^{11}B 80%

Give the number of atoms of each isotope in 100 atoms of boron.

^{10}B *20 atoms*

^{11}B *80 atoms*

$$\text{Relative atomic mass} = \frac{\text{total mass of atoms}}{\text{total number of atoms}}$$

Calculate the relative atomic mass of boron.

$$(20 \times 10 + 80 \times 11) / 100 = 10.8$$

Suggest why the calculation did not give the exact value shown in the periodic table.

The percentage abundances were rounded to 2 significant figures.

Symbolic – representations

The atomic symbol for the isotope boron-11 is $^{11}_5\text{B}$

Complete the table to give the information provided by the different parts of the atomic symbol.

Parts of atomic symbol	Information about boron
element symbol	<i>B</i>
mass number	<i>11</i>
atomic number	<i>5</i>

Give the atomic symbol for the boron-10 isotope.



The periodic table gives the relative atomic mass of the element boron. Explain why this is not equal to 11.

The element boron is made of a mixture of isotopes with different mass numbers.