Covalent bonding in water: Johnstone's triangle

Learning objectives

1 Describe a covalent compound based on observations.

2 Use symbolic models to represent a covalent compound.

3 Explain how the type of bonding in a covalent compound relates to the properties you can observe.

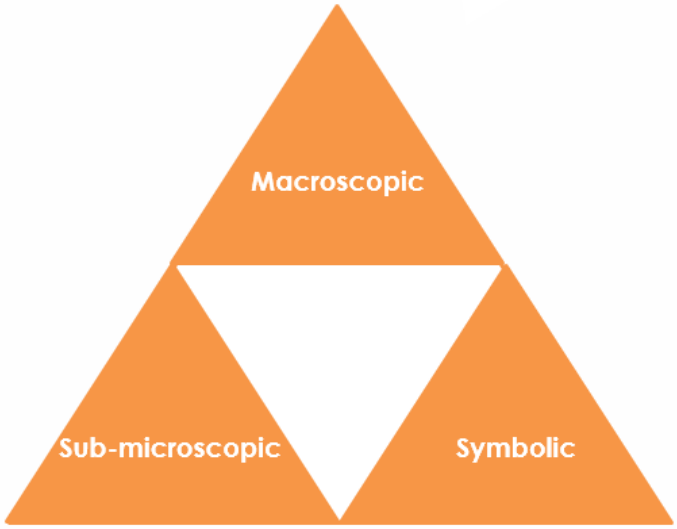
Introduction

Water is a covalent compound consisting of two hydrogen atoms and one oxygen atom.

Johnstone's triangle

In chemistry we make sense of the things that we can see by representing what we can't see using formulas, equations, diagrams and models.

Johnstone's triangle is a way of thinking about these different concepts as different corners of a triangle:



- Macroscopic – what we can see. Think about the properties we 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.

Being able to connect and move between these three different levels is important for scientific understanding.

Macroscopic – what we can see

Observe water in the solid, liquid and gas state.

What are the freezing and boiling temperatures of water?

What state is water in at room temperature?

What do you see when water boils?

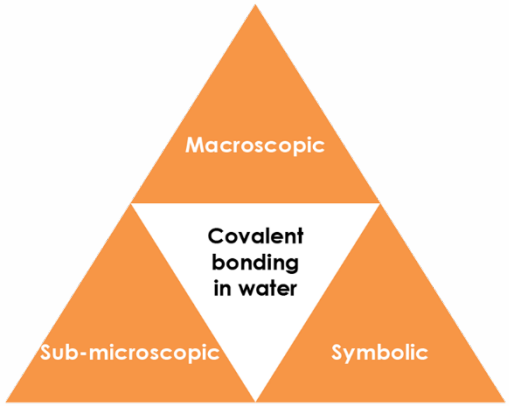
Sub-microscopic – smaller than we can see

Is water a simple covalent molecule or a giant covalent compound?

Which of these are the strongest in water?

covalent bond **intermolecular force**

Explain why simple covalent compounds have relatively low or very low boiling points.



Symbolic – representations

Draw a dot and cross diagram for a water molecule. The formula of water is H_2O.

On the diagram below label a covalent bond and an intermolecular force.