

THE KINETIC THEORY

Matter is composed of tiny particles called *atoms*. In some substances, the atoms are joined together in small groups called *molecules*. Atoms are very, very tiny. They are much too small to be seen, even with the best microscopes. More than 1000000000 atoms (10^9) can fit on a full stop like this.

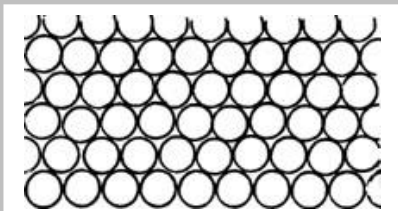


John Dalton (1766 - 1844)

Atoms: More than 400 years before the birth of Christ, Greek philosophers suggested that matter was made of particles. The word *atom* comes from the Greek *atomos*, which means something that cannot be divided. However it was only about 200 years ago that chemists started to be sure about atoms. This was because of the work on an Englishman named John Dalton. John was born in the North of England in 1766. He went to a village school and did so well that he became a teacher at the age of 12. By 19 he was a headmaster! He studied science and at 27 became a Professor of Mathematics and Natural Philosophy in the city of Manchester. In 1808 he published his ideas about atoms in a book called "New Systems of Chemical Philosophy". Even though John never saw an atom, he reasoned that they must exist to explain many of the facts of chemistry. Gradually the idea of atoms came to be accepted by all scientists. John continued studying chemistry until he died in 1844. More than 100 years after his death, large molecules (groups of atoms) were finally observed using electron microscopes. There is a statue of John Dalton at the entrance to Manchester City Hall.

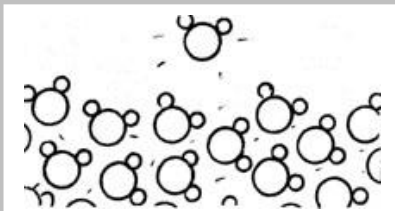
The kinetic theory is a model that shows how particles are arranged, and how they behave, in solids, liquids and gases. The particles in the kinetic model may be atoms or they may be *molecules* (groups of atoms joined together). The particles have energy, so they can move. The diagrams show the kinetic model for solids, liquids and gases. Read the notes below each diagram to find out how the particles behave.

Example of a solid – iron



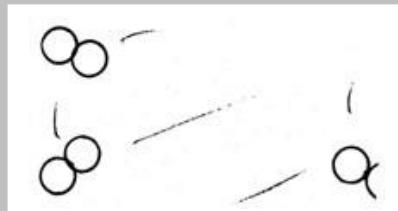
- Particles are packed tightly in a regular pattern.
- Particles vibrate but do not change position.

Example of a liquid – water



- Particles are close together but not in a regular pattern.
- Particles jostle past each other like people in crowds.

Example of a gas – oxygen



- Particles are much further apart.
- Particles move around freely at high speed.

In iron the particles are atoms. In solids the particles are arranged in regular patterns. They have enough energy to vibrate, but they do not change position. In water the particles are molecules. Each water molecule contains three atoms joined together. You will learn about water molecules in Module 9.6. In liquids the particles are crowded close together but they are always on the move, like people jostling in a crowd. In oxygen the particles are molecules that contain two atoms joined together. You will learn about molecules of oxygen in Module 9.4. In gases, the particles are far apart. They have lots of energy and fly around at high speed!

- 1. Why do you think the Greeks called atoms "Things that can not be divided"?
- 2. What is a molecule?
- 3. According to the kinetic theory: (i) Which have the most energy, the particles in solids, liquids or gases? (ii) What do you think happens to the particles in water when the water is heated until it boils?