

Development of the Atomic Theory

Atom – The smallest particle into which an element can be divided and still be the same substance.

Element – A pure substance that cannot be separated into simpler substances by physical or chemical means.

- **Atoms make up elements.**
- **Elements are made of only one kind of atom.**
- **Elements combine to form compounds.**
- **All matter is made of elements or compounds, so all matter is made of atoms.**

- **Atoms are so small that, until recently, no one had ever seen one. But ideas, or theories, about atoms have been around for over 2,000 years.**

Theory – A unifying explanation for a broad range of hypotheses and observations that have been supported by testing.

Democritus (440 B.C.)

- **Democritus proposed that if you kept cutting a substance in half forever, eventually you would end up with an “uncuttable” particle.**
- **He called these particles *atoms*, meaning “indivisible” in Greek.**
- **Democritus thought that atoms were small, hard particles of a single material and in different shapes and sizes.**
- **He thought that atoms were always moving and formed different materials by combining with each other.**
- **Aristotle disagreed with Democritus’s idea that you would end up with an indivisible particle. Because Aristotle had greater public influence, Democritus’s ideas were ignored for centuries.**

John Dalton (1803)

- **Scientists knew that elements combined with each other in specific proportions to form compounds.**

- **Dalton claimed that the reason for this was because elements are made of atoms.**
- **He published his own three-part atomic theory:**
 - 1) *All substances are made of atoms. Atoms are small particles that cannot be created, divided, or destroyed.*
 - 2) *Atoms of the same element are exactly alike, and atoms of different elements are different.*
 - 3) *Atoms join with other atoms to make new substances.*
- **Much of Dalton's theory was correct, but some of it was later proven incorrect and revised as scientists learned more about atoms.**

J.J. Thomson (1897)

- **Thomson used a cathode-ray tube to conduct an experiment which showed that there are small particles *inside* atoms.**
- **This discovery identified an error in Dalton's atomic theory. Atoms *can* be divided into smaller parts.**

- **Because the beam moved away from the negatively charged plate and toward the positively charged plate, Thomson knew that the particles must have a negative charge.**
- **He called these particles corpuscles. We now call these particles electrons.**
- **Electrons – The negatively charged particles found in all atoms.**
- **Thomson changed the atomic theory to include the presence of electrons. He knew there must be positive charges present to balance the negative**

charges of the electrons, but he didn't know where.

- **Thomson proposed a model of an atom called the “plum-pudding” model, in which negative electrons are scattered throughout soft blobs of positively charged material.**

Ernest Rutherford (1909)

- **Rutherford conducted an experiment in which he shot a beam of positively charged particles into a sheet of gold foil.**
- **Rutherford predicted that if atoms were soft, as the plum-pudding model suggested, the particles would pass**

through the gold and continue in a straight line.

- **Most of the particles did continue in a straight line. However some of the particles were deflected to the sides a bit, and a few bounced straight back.**
- **Rutherford realized that the plum-pudding model did not explain his observations. He changed the atomic theory and developed a new model of the atom.**

- **Rutherford's model says that most of the atom's mass is found in a region in the center called the nucleus.**
- **Nucleus – The tiny, extremely dense, positively charged region in the center of an atom.**
- **Rutherford calculated that the nucleus was 100,000 times smaller than the diameter of the atom.**
- **In Rutherford's model the atom is mostly empty space, and the electrons travel in random paths around the nucleus.**

Niels Bohr (1913)

- **Bohr suggested that electrons travel around the nucleus in definite paths.**
- **These paths are located at certain "levels" from the nucleus.**

- **Electrons cannot travel between paths, but they can jump from one path to another.**

Modern Theory: Schrödinger and Heisenberg

- **Our current model of the atom says that electrons do not travel in definite paths around the nucleus.**
- **The exact path or position of moving electron cannot be predicted or determined. Rather, there are regions inside the atom where electrons are *likely* to be found.**
- **Electron clouds – Regions inside an atom where electrons are likely to be found.**