

## Atomic Structure

### Skills to Develop

- Define the sub-atomic particles making up an atom
- Distinguish isotopes from typical atoms of an element
- Identify the atomic mass and mass number of an element
- Understand how to utilize units such as coulombs, atomic mass units, and angstroms

Atoms of an element are not all identical and indivisible as Dalton said. They are made of three main types of particles.

Particle	Mass (amu)	Charge
Electrons	$5.5 \times 10^{-4}$	Negative (1-)
Protons	1.0073	Positive (1+)
Neutrons	1.0087	Neutral

The protons and neutrons together form a very small dense center of the atom, called a **nucleus**. The nucleus contains all the mass of the atom except the small mass of electrons. The electrons move around the nucleus, and occupy a much bigger space than the nucleus, so that most of the atom is empty space.

An element is defined by the number of protons, or atomic number, which is equal to the number of electrons in the neutral element. Atoms of an element can have different numbers of neutrons, resulting in different masses. **Isotopes** are atoms that have the same number of protons, but different numbers of neutrons. Chemical properties depend mostly on the atomic number, so isotopes are nearly the same chemically. The **atomic mass** is the average mass of the atom, including all the different isotopes that are likely to be present. If you want to show what isotope of an element you can use special notation, like this:  $^{12}\text{C}$ . This is read as carbon-12. The 12 is the **mass number**, or the number of protons + neutrons. Since carbon always has 6 protons,  $^{12}\text{C}$  must have 6 neutrons also.

We use some very small units to describe atoms. For instance, the charge of a proton or electron (which we will use as the unit of charge) is  $1.602 \times 10^{-19}$  coulombs (C). The atomic mass unit, or amu, is  $1.661 \times 10^{-24}$  g. Sizes of atoms are usually measured in angstroms or Å, which is  $1 \times 10^{-10}$  m. The diameter of most atoms is 1-5 Å. The diameter of nuclei is roughly  $10^{-4}$  Å. Electrons are smaller than nuclei, so most of the atom is empty.

### Outside Links

- [Khan Academy "Elements and Atoms"](#) (13 min)
- [CrashCourse Chemistry 1: The Nucleus](#) (10 min)

### Contributors and Attributions

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