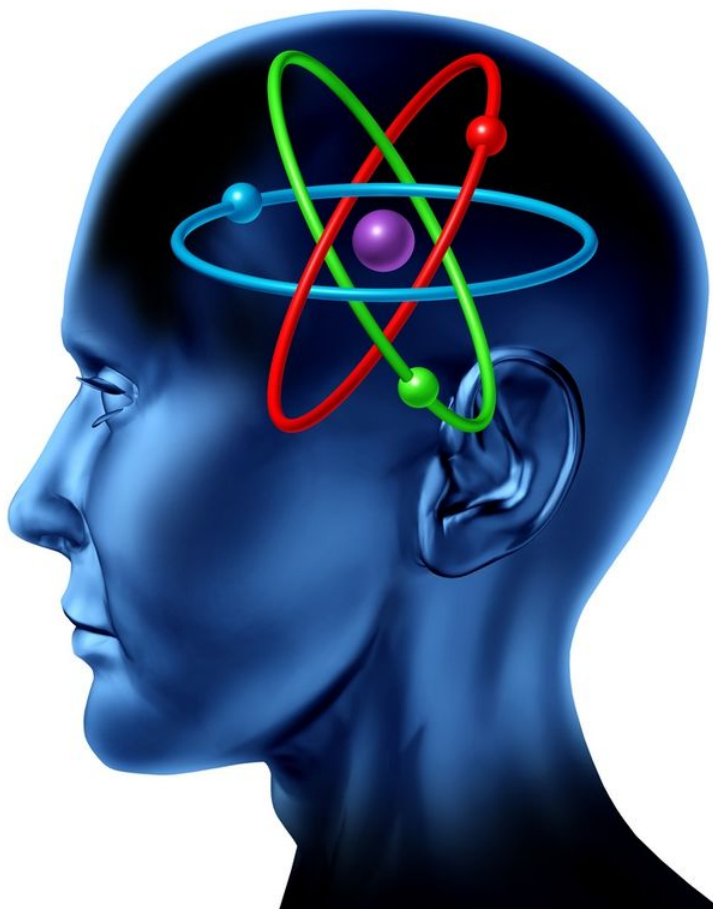


## CONCEPT

## 1

# Atoms to Molecules-SWS

- Describe structure of atoms.
- Distinguish between elements, atoms, isotopes, ions, and molecules.



## What is your brain made of?

Everything you can see, touch, smell, feel, and taste is made of atoms. **Atoms** are the basic building-block of all matter (including you and me, and everyone else you'll ever meet), so if we want to know about what Earth is made of, then we have to know a few things about these incredibly small objects.

## Atoms

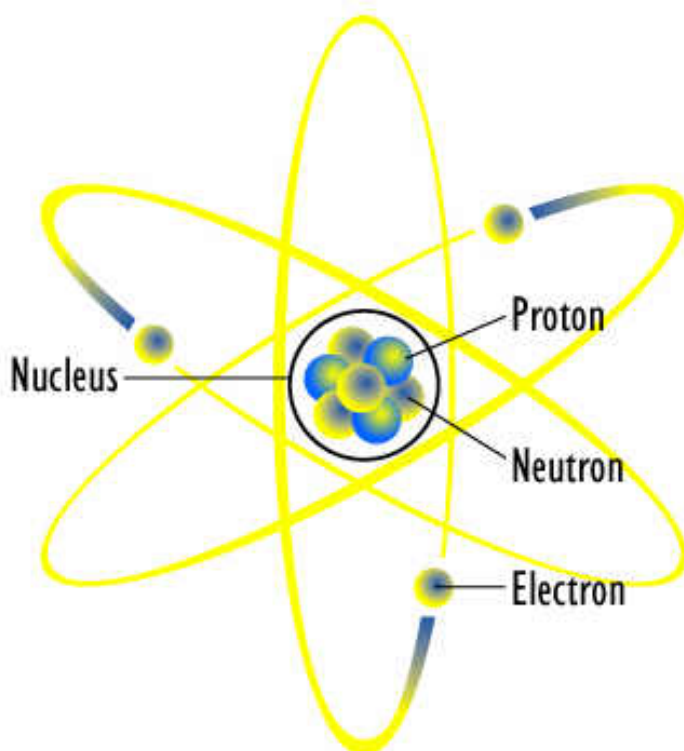
Everyday experience should convince you that matter is found in myriad forms, yet all the matter you have ever seen is made of atoms, or atoms stuck together in configurations of dizzying complexity. An **element** is a substance that cannot be made into a simpler form by ordinary chemical means. Elements contain the same kind of atom. For example, carbon is an element. The smallest unit of a chemical element is an **atom**, and all atoms of a particular element are identical.

## Parts of an Atom

There are two parts to an atom (**Figure 1.1**):

- At the center of an atom is a **nucleus** made up of two types of particles called **protons** and **neutrons**.
  - **Protons** have a positive electrical charge. The number of protons in the nucleus determines what element the atom is.
  - **Neutrons** are about the size of protons but have no charge.
- **Electrons**, much smaller than protons or neutrons, have a negative electrical charge, move at nearly the speed of light, and orbit the nucleus at exact distances, depending on their energy.

An introduction to the atom is seen on this Khan Academy video: <http://www.khanacademy.org/video/introduction-to-the-atom>.



**FIGURE 1.1**

Major parts of an atom. What chemical element is this? (Hint: 3 protons, 3 electrons)

## Atomic Mass

Because electrons are minuscule compared with protons and neutrons, the number of protons plus neutrons gives the atom its **atomic mass**. All atoms of a given element always have the same number of protons, but may differ in the number of neutrons found in the nucleus.

## Isotopes

Atoms of an element with differing numbers of neutrons are called **isotopes**. For example, carbon always has 6 protons but may have 6, 7, or 8 neutrons. This means there are three isotopes of carbon: carbon-12, carbon-13, and carbon-14, however, carbon-12 is by far the most abundant.

## Ions

Atoms are stable when they have a full outermost electron energy level. To fill its outermost shell, an atom will give, take, or share electrons. When an atom either gains or loses electrons, this creates an **ion**. Ions have either a positive or a negative electrical charge.

- What is the charge of an ion if the atom loses an electron?
  - An atom with the same number of protons and electrons has no overall charge, so if an atom loses the negatively charged electron, it has a positive charge.
- What is the charge of an ion if the atom gains an electron?
  - If the atom gains an electron, it has a negative charge.

## Molecules

When two or more atoms link up, they create a **molecule**. For example, a molecule of water (H<sub>2</sub>O) is made of two (2) atoms of hydrogen (H) and one (1) atom of oxygen (O). The **molecular mass** is the sum of the masses of all the atoms in the molecule. A collection of molecules is called a compound.

## Vocabulary

- **atom**: The smallest unit of matter
- **atomic mass**: The number of protons and neutrons in an atom.
- **electron**: Tiny negatively charged particles that orbit the nucleus of an atom.
- **element**: A pure chemical substance with one type of atom.
- **ion**: An atom with one or more electrons added or subtracted; it has an electrical charge.
- **isotope**: A chemical element that has a different number of neutrons in the nucleus.
- **molecular mass**: The sum of the masses of all of the atoms in a molecule.
- **molecule**: One or more atoms bonded together.
- **neutron**: A neutral particle in the nucleus of an atom.
- **nucleus**: The center of an atom, made of protons and neutrons.
- **proton**: A positively charged particle in a nucleus.

## Summary

- An atom is the smallest unit of matter, composed of negatively-charged electrons in orbit around a nucleus, which is made of positively-charged protons and neutrons, which have no charge.
- Isotopes of an element must have a given number of protons but may have variety of numbers of neutrons.
- An atom that gains or loses electrons is an ion.
- A molecule is made of two or more atoms bonded together.
- An element is a substance containing all the same atoms. Elements have unique and predictable properties.

## Practice

Use this resource to answer the questions that follow.

Basic Atomic Structure <http://www.youtube.com/watch?v=IP57gEWcisY>.

Please follow the link above to answer the following questions:

1. What is found at the center of an atom?

2. What makes up the nucleus?
3. What is the charge on the nucleus?
4. What is equal in neutral atoms?
5. List the parts of an atom and identify the charge of each.

Review the basic chemistry with these matching games at:

1. <http://www.neok12.com/quiz/ATOM0001>
2. <http://www.neok12.com/quiz/ATOM0002>
3. <http://www.neok12.com/quiz/ATOM0003>

## Review

1. If an atom has 8 protons, 8 neutrons, and 8 electrons and then loses an electron, what is it? If it loses a neutron, what is it?
2. What charge(s) does an ion have, positive, negative, or neutral?
3. What is a molecule made of and what is its molecular mass?

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# Atoms to Molecules-SWS

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