

Open & Closed Systems (Unit 1)

A primary goal of the study of chemistry is to determine the quantity of matter exchanged between a system and its surroundings. The system is the part of the universe being studied, while the surroundings are the rest of the universe that interacts with the system. A system and its surroundings can be as large as the rain forests in South America or as small as the contents of a beaker in a chemistry laboratory. The type of system one is dealing with can have very important implications in chemistry because the type of system dictates certain conditions and laws associated with that system.

Open System

An open system is a system that freely exchanges matter with its surroundings. For instance, when you are boiling soup in an open saucepan on a stove, matter is being transferred to the surroundings through steam. The saucepan is an open system because it allows for the transfer of matter like adding spices in the saucepan or losing water through steam. Let us examine how matter is exchanged in an open system. Matter can be exchanged rather easily: by adding matter (i.e spices) or removing matter (i.e tasting what is being cooked).

Closed System

Putting a lid on the saucepan makes the saucepan a closed system. A closed system is a system that exchanges only energy with its surroundings, not matter. By putting a lid on the saucepan, matter can no longer transfer because the lid prevents matter from entering the saucepan and leaving the saucepan. Still, the saucepan allows energy transfer. Imagine putting the saucepan on a stove and heating it. The saucepan allows energy transfer as the saucepan heats up and heats the contents inside it. No water boils off because it condenses on the bottom of the lid and drips back into the saucepan.

Isolated System

Now let's examine the type of system you have if you substituted a thermos for the saucepan. A thermos is used to keep things either cold or hot. Thus, a thermos does not allow for energy transfer. Additionally, the thermos, like any other closed container, does not allow matter transfer because it has a lid that does not allow anything to enter or leave the container. As a result, the thermos is what we call an isolated system. An isolated system does not exchange energy or matter with its surroundings.

