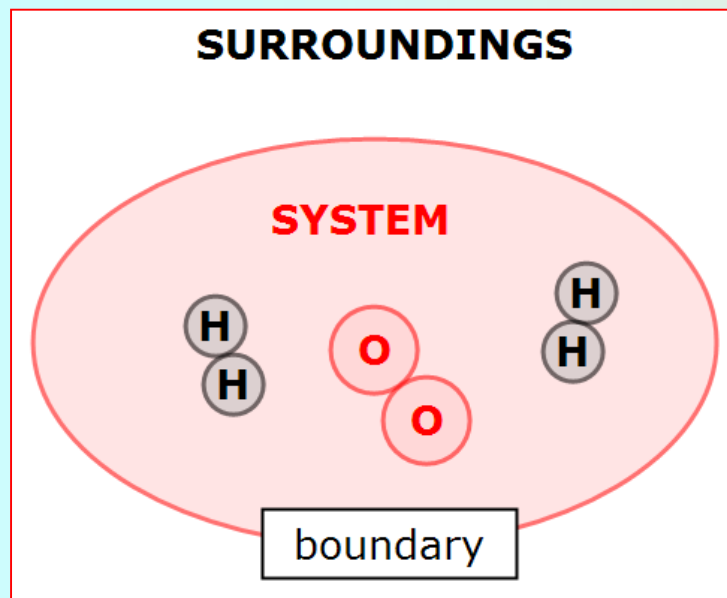


Thermochemistry: Basic Concepts



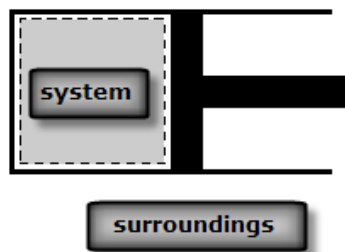
System and Surroundings

The **system** is a well-defined part of the universe that we single out for study.

Everything else is called the **surroundings**.

Between the system and surroundings is a **boundary**, across which transfers of matter, energy, or both may take place.

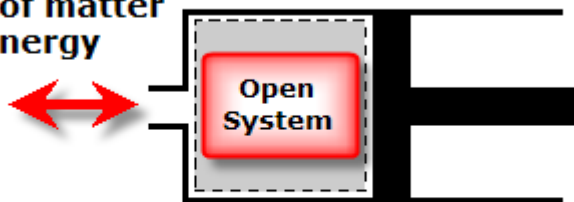
A system may be **open**, **closed**, or **isolated**.



http://en.wikibooks.org/wiki/Image:Closed_system_Engineering_Thermodynamics.png

Thermochemistry: Basic Concepts

Transfer of matter
and energy



http://upload.wikimedia.org/wikibooks/en/7/72/Open_system_Engineering_Thermodynamics.png

Types of Systems

An **open system** exchanges matter and energy with its surroundings.

A **closed system** exchanges energy but not matter.

An **isolated system** exchanges neither matter nor energy with the surroundings.

Almost all real systems are open. Open systems are very difficult to describe quantitatively. So, much of our discussion concerns closed and isolated systems.

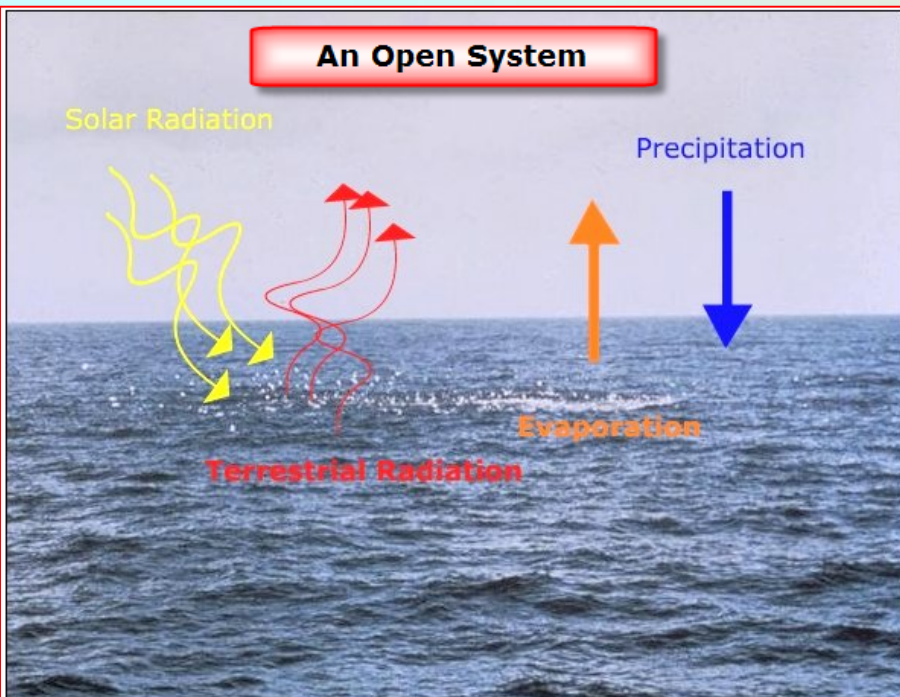
An Open System

Solar Radiation

Precipitation

Evaporation

Terrestrial Radiation



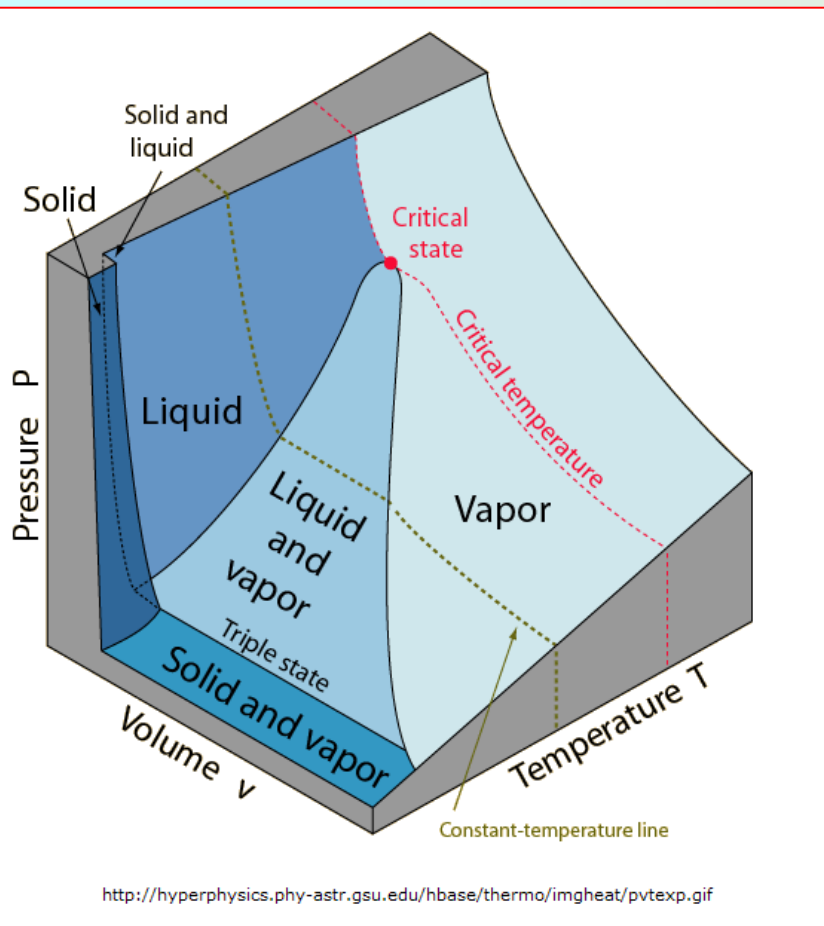
<http://universe-review.ca/I13-23-open2.jpg>

Exchange of
energy but not
matter



http://upload.wikimedia.org/wikibooks/en/a/ab/Closed_system_Engineering_Thermodynamics.png

Thermochemistry: Basic Concepts



State and Changes of State

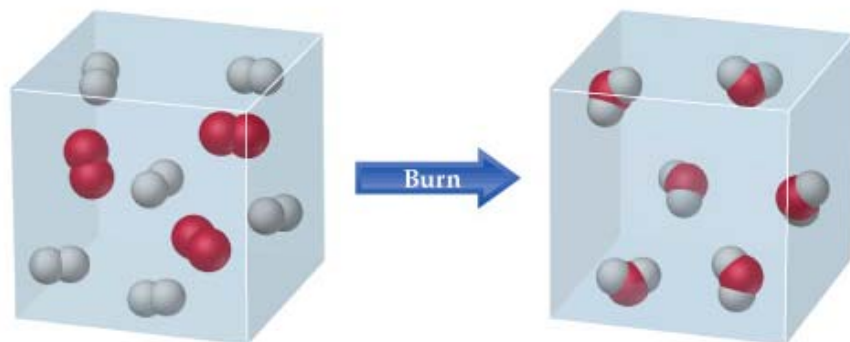
The conditions that describe a system is called its **state**.

A change in conditions is a **change of state**.

Conditions that must be specified to establish the state of a system are called **state variables**.

For chemical systems, state variables are: pressure (P), volume (V), temperature (T), and amounts of substances (n).

Thermochemistry: Basic Concepts



Mixture of hydrogen and oxygen

Water

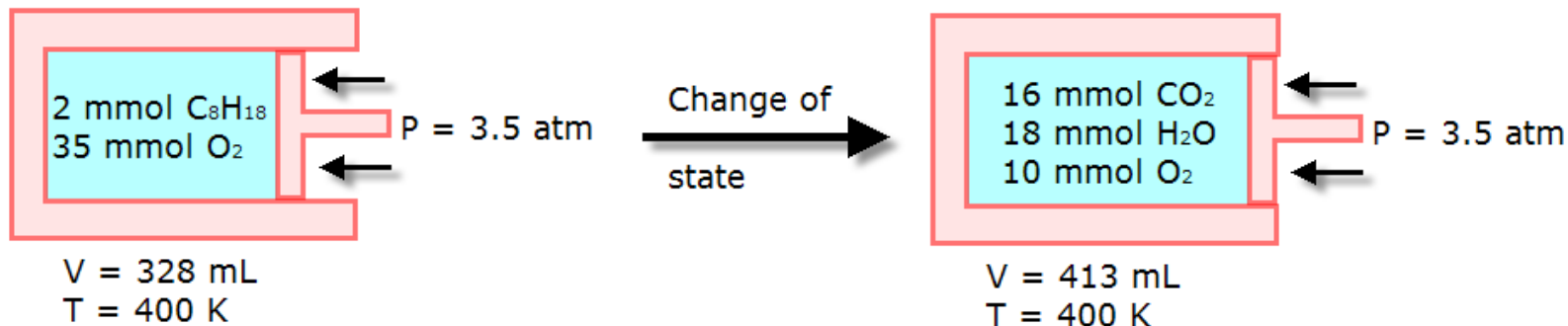
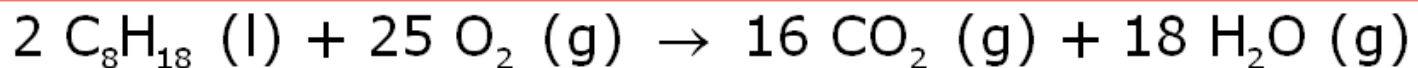
<http://wps.prenhall.com/wps/media/objects/165/169061/GIFS/AAAUASS0.JPG>

Chemical Changes of State

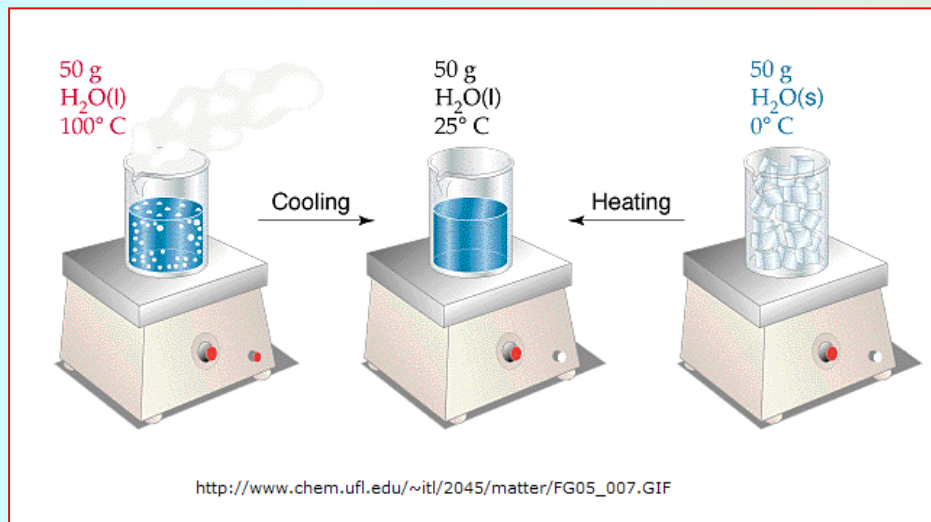
In a chemical change of state, the amounts of reactants and products change in addition to changes in physical variables.

To describe a chemical change of state, we must specify not only the changes in the physical variables (P, V, and T) but also changes in the identities and the amounts of starting materials and products.

This requires a chemical equation and information about the amount (n) of each species.



Thermochemistry: Basic Concepts



The energy of 50 g of water at 25°C does not depend on how its state is achieved: this energy is a state function.

State Functions

State variables can be classified in two broad categories. Variables such as pressure, temperature, and energy depend only on the state of the system.

A change on one of these variables depends on the difference between the initial conditions and the final conditions, but it does not depend on how the change of the state is accomplished.

"X"
is a state function $\Rightarrow \Delta X = X_{\text{final}} - X_{\text{initial}}$

Variables that depend only on the state of the system are called **state functions**