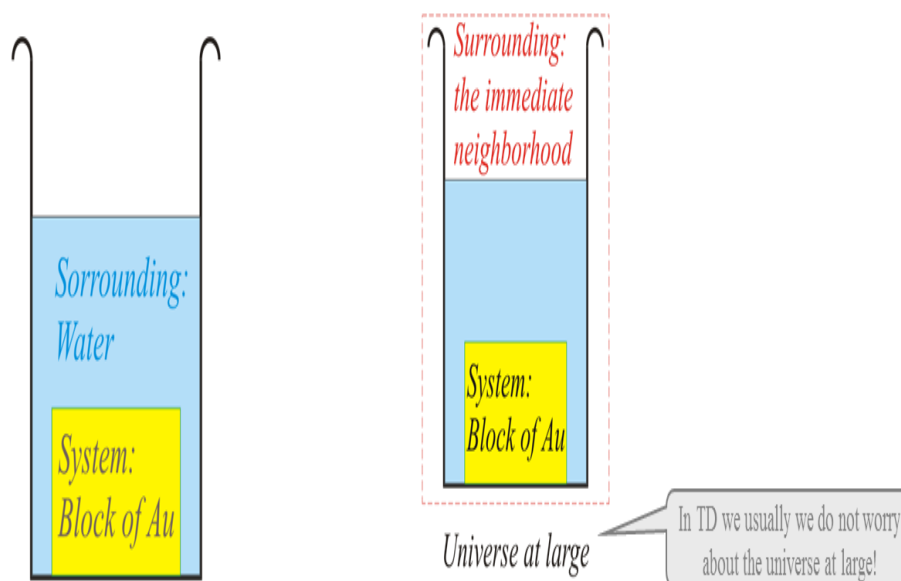


THE PRINCIPLES OF THERMODYNAMICS(TD)

- ❑ To understand the laws of thermodynamics and how they work, first we need to get the terminology right. Some of the terms may look familiar (as they are used in everyday language as well)- but their meanings are *more 'technically' and 'precise'*, when used in TD and hence we should **not** use them 'casually'.
- ❑ **The System** is the region where we focus our attention (*Au block in figure*).
- ❑ **Surrounding** is the rest of the universe (*the water bath at constant 'temperature'*).
- ❑ **Universe = System + Surrounding**
- ❑ More practically, we can consider the 'Surrounding' as the immediate neighbourhood of the system (the part of the universe at large, with which the system 'effectively' interacts). In this scheme of things we can visualize: a system, the surrounding and the universe at large.

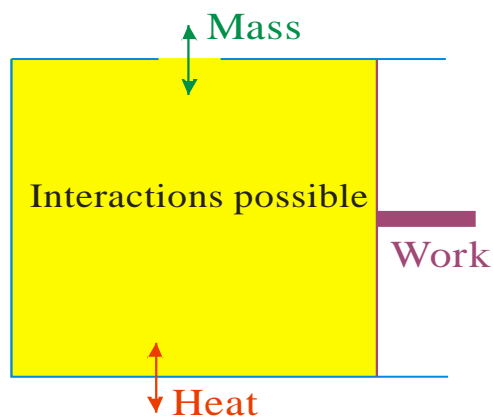


Open, closed and isolated systems

- ❑ To a thermodynamic system two 'things' may be added/removed: **energy** (heat, work) **matter**.

- ❑ An **open system** is one to which you can add/remove matter (e.g. an open beaker to which we can add water). When you add matter- you also end up adding heat (which is contained in that matter).
- ❑ A system to which you cannot add matter is called **closed**. Though you cannot add/remove matter in a closed system, *you can still add/remove heat* (you can cool a closed water bottle in the fridge).
- ❑ A system to which *neither matter nor heat* can be added/removed is called **isolated**.
- ❑ A closed vacuum ‘thermos’ flask can be considered as isolated.

Type of boundary	Interactions
Open	All interactions possible
Closed	Matter cannot enter or leave
Semi-permeable	Only certain species can enter or leave
Insulated	Heat cannot enter or leave
Rigid	Mechanical work cannot be done*
Isolated	No interactions are possible**



* *By or on the system*

** *Mass, Heat or Work*

- ❑ Matter is easy to understand and includes atoms, ions, electrons, etc.

- ❑ Energy may be transferred ('added') to the system as heat, electromagnetic radiation etc.
- ❑ In TD the two modes of transfer of energy to the system considered are Heat and Work.
 - *Heat and work are modes of transfer of energy and not 'energy' itself.*
 - *Once inside the system, the part which came via work and the part which came via heat, cannot be distinguished. More sooner on this!*
- ❑ Matter when added to a system brings along with it some energy. The 'energy density'(energy per unit mass or energy per unit volume) in the incoming matter may be higher or lower than the matter already present in the system.