Processes, Driving Forces & Steady State Fluxes

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Heat flux due to temperature difference

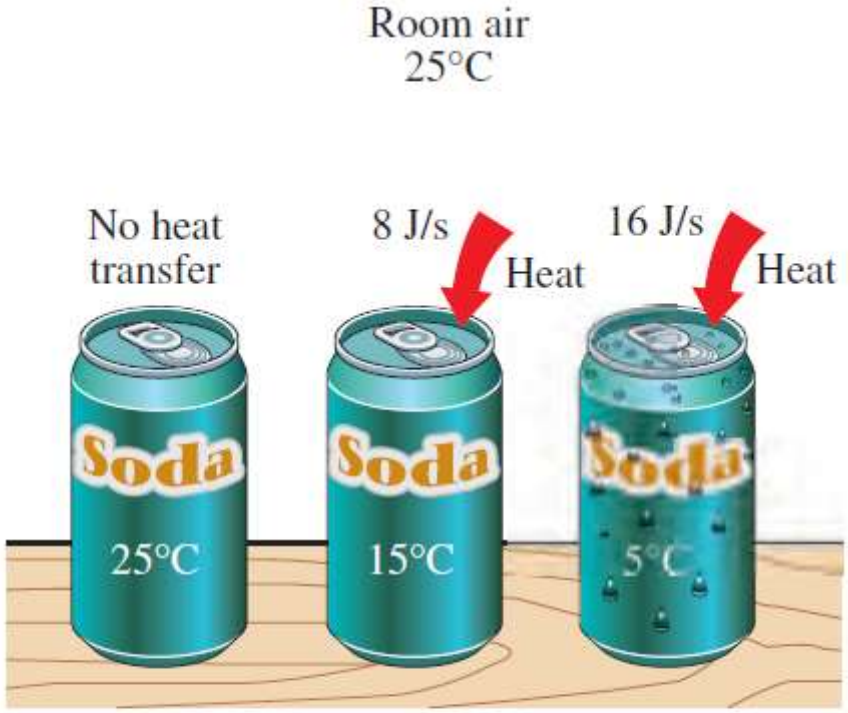
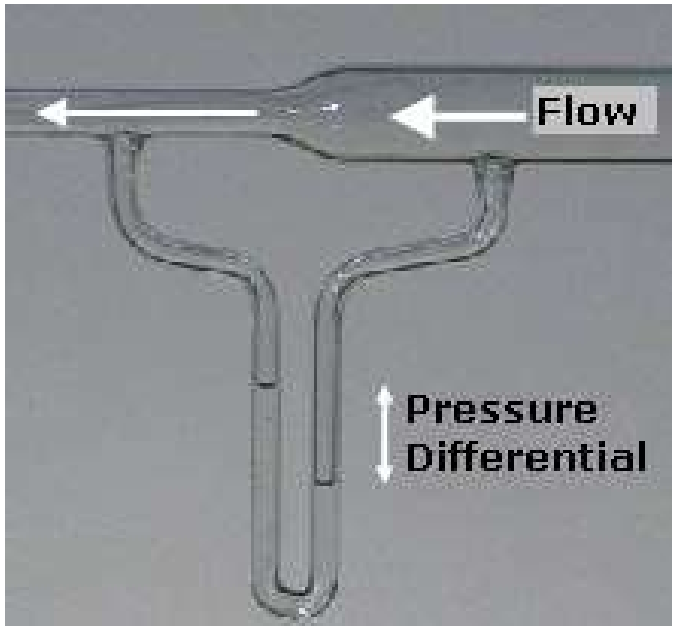


FIGURE 2–15

Temperature difference is the driving force for heat transfer. The larger the temperature difference, the higher is the rate of heat transfer.

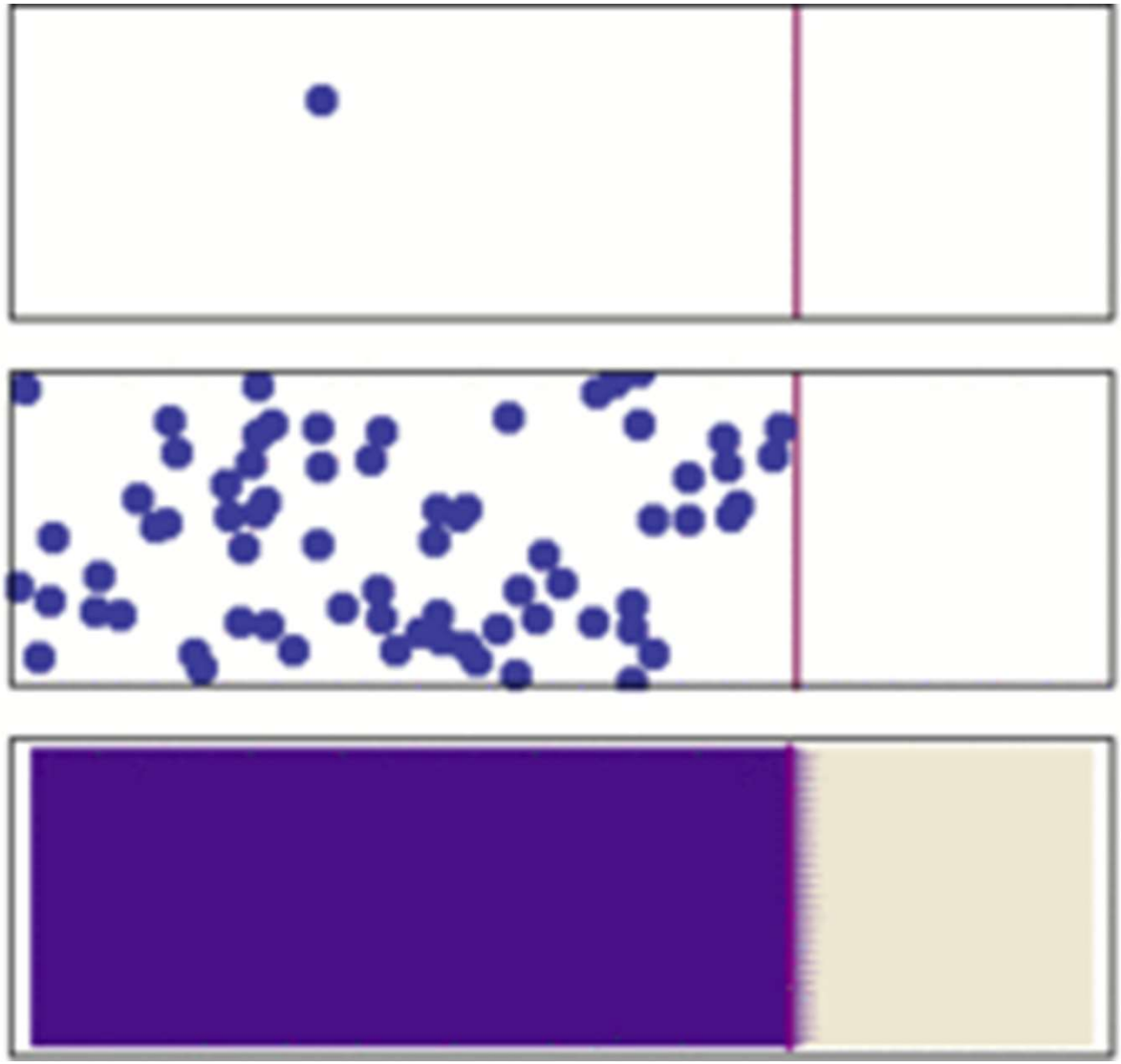
Fig: C & B: TD

Momentum flux/fluid flow due to pressure difference



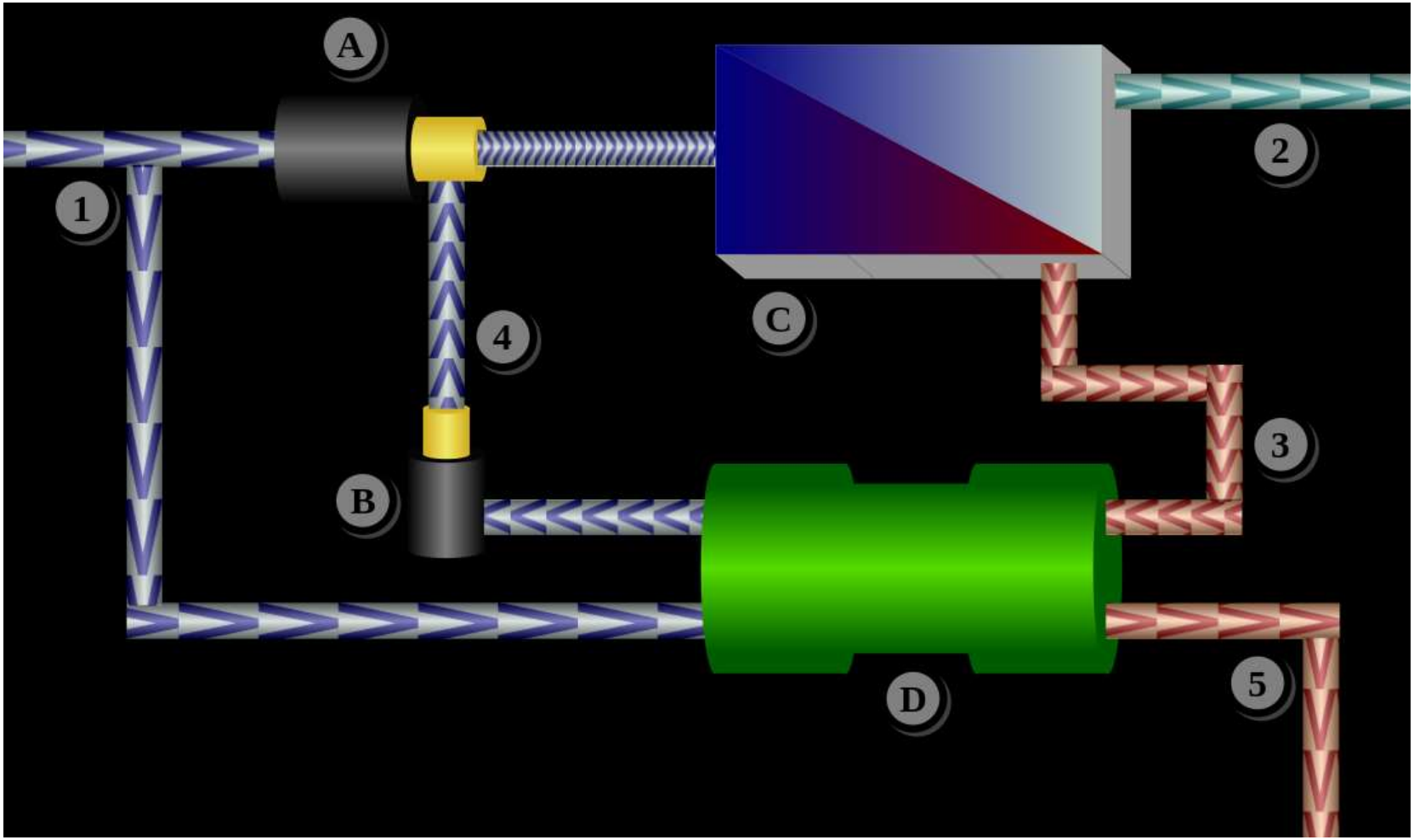
https://en.wikipedia.org/wiki/Pressure_head

Mass flux due to difference in concentration



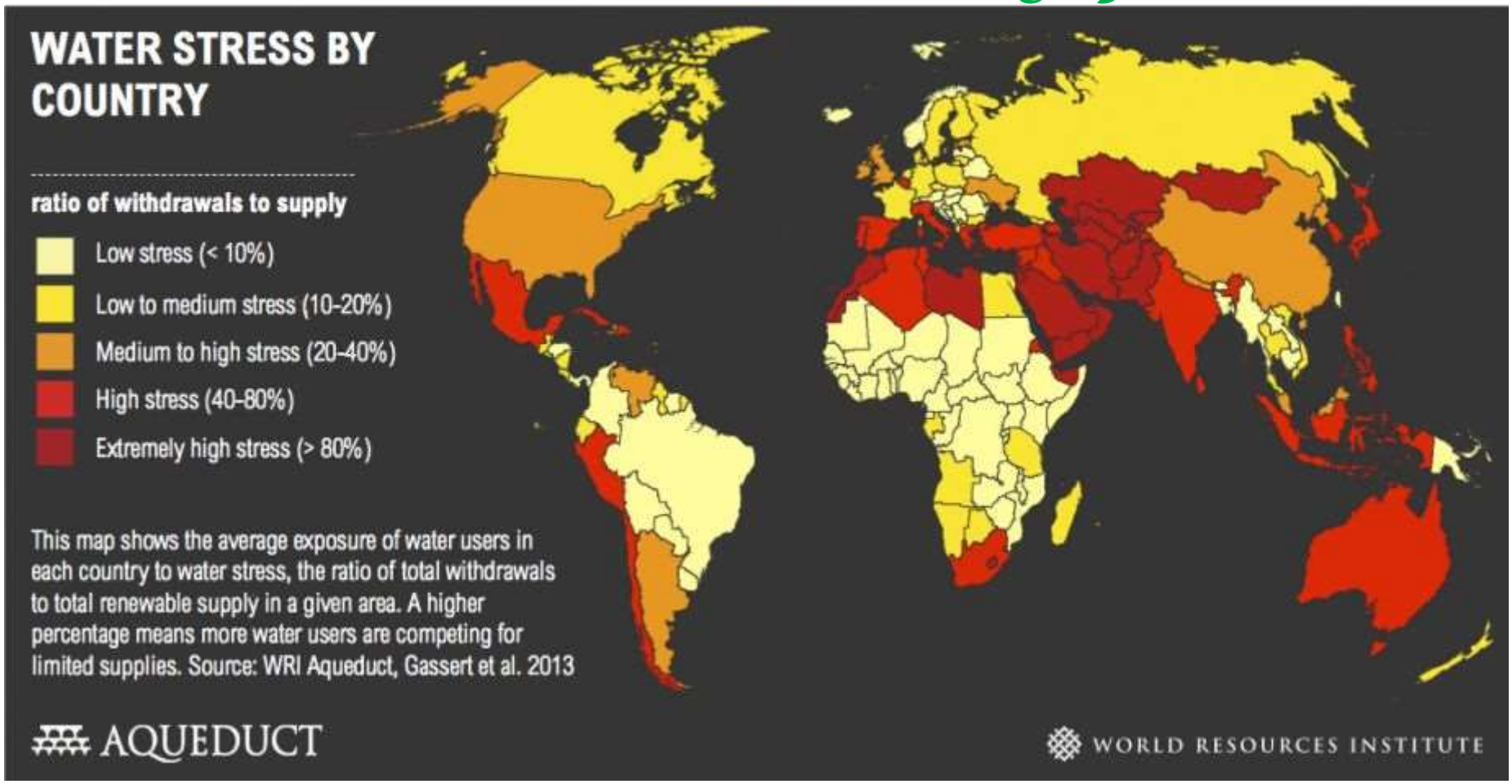
Wikipedia

Reverse Osmosis Desalination: Mass flux due to difference in "chemical potential"



1: Sea water inflow,*2*: Fresh water flow (40%),*3*: Concentrate flow (60%),
4: Sea water flow (60%),*5*: Concentrate (drain),*A: Pump flow (40%),*
B*: Circulation pump,* C*: Osmosis unit with membrane,*D*: Pressure exchanger*
https://en.wikipedia.org/wiki/Reverse_osmosis

Clean water: Grand challenge problem



Smalley's top ten ventures to save the world

10. Population 9. Democracy 8. Education 7. Disease

6. Terrorism and War 5. Poverty 4. Environment 3. Food

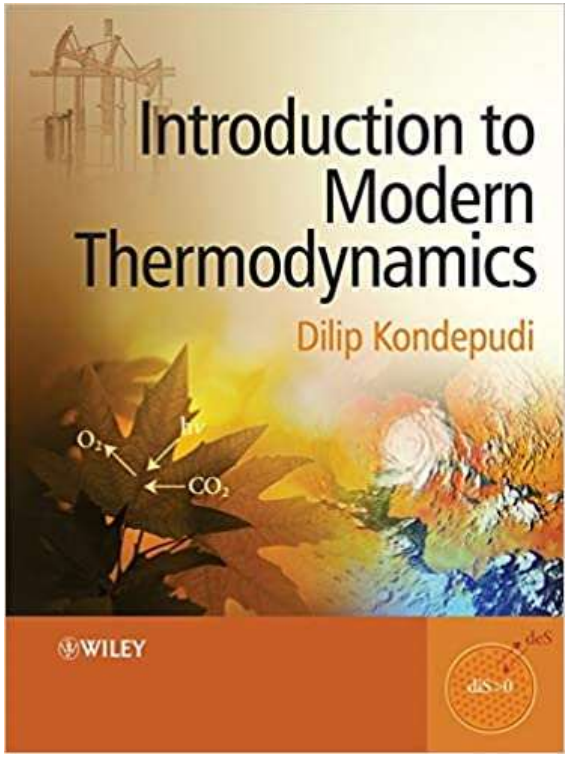
2. Water 1. Energy!!!

TD driving forces is indicate a lack of equilibrium & leads to fluxes

- Heat flux due to temperature difference driving force/lack of thermal equilibrium
- Momentum flux/fluid flow due to “pressure difference”
- Mass flux due to difference in “chemical potential”
- Constant driving force → steady state flux
- Both steady and unsteady processes can be described via relationships involving fluxes to macroscopic variables like T, P…

Flow Processes are not in TD equilibrium

- Steady-flow conditions ~ turbines, pumps, boilers, condensers, and heat exchangers or power plants or refrigeration systems
- TD of steady states will not be discussed here



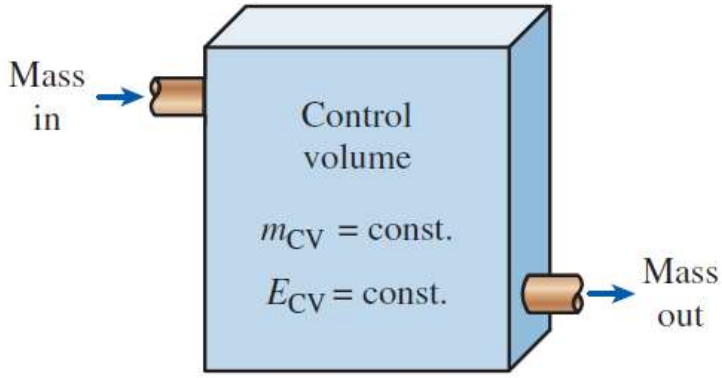


FIGURE 1–33
Under steady-flow conditions, the mass and energy contents of a control volume remain constant.

Fig: C & B: TD