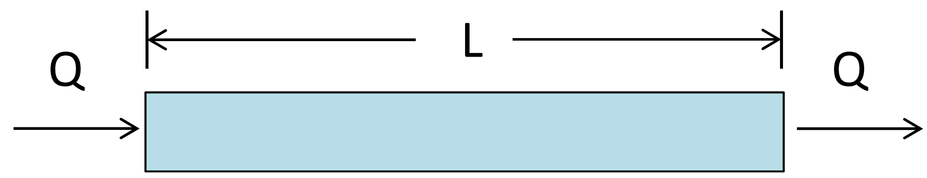
Reactors II

Today's lecture

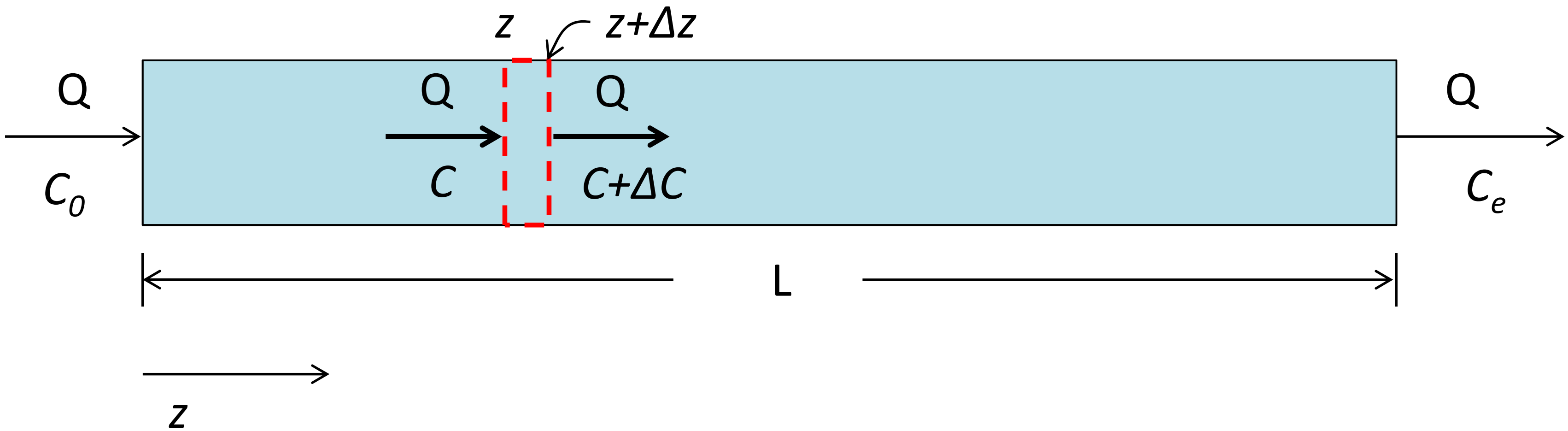
- Plug flow reactor
  - Concept
  - PFR analysis for 1st order reaction
  - PFR analysis for Monod kinetics

Reactor analysis: PFR



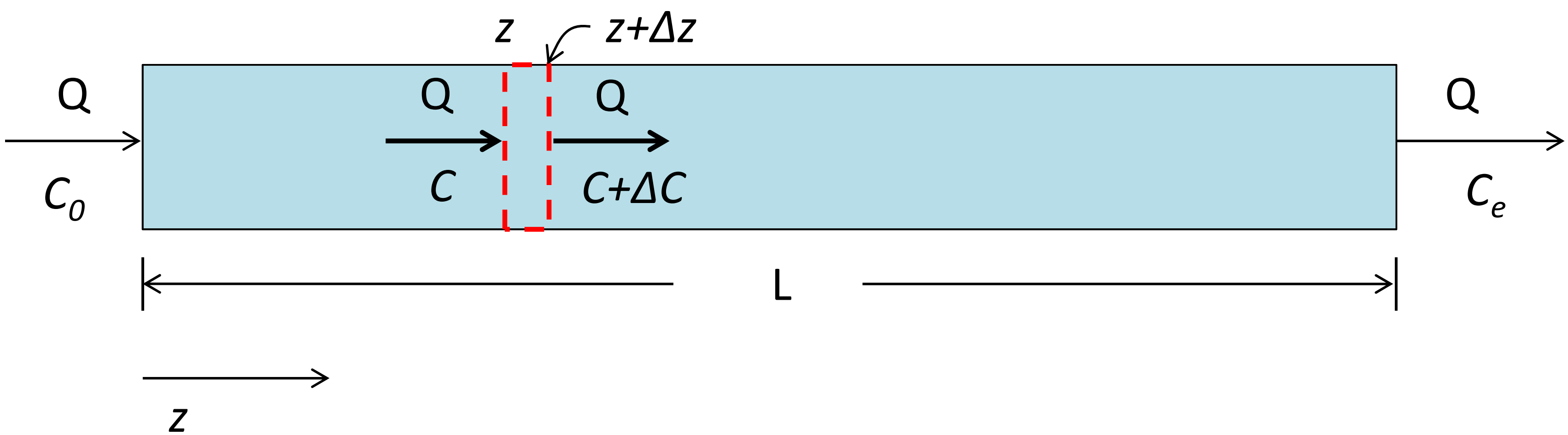
- Plug flow reactor (PFR)
  - assumption: no mixing in the direction of flow & completely mixed in the direction perpendicular to the flow
  - reactors get close to PFR as the length gets longer than the width and depth (e.g., rivers)

PFR, first-order reaction



- Take control volume as a thin plate perpendicular to the flow at $z=z$ with a dimension of Δz in z dir.

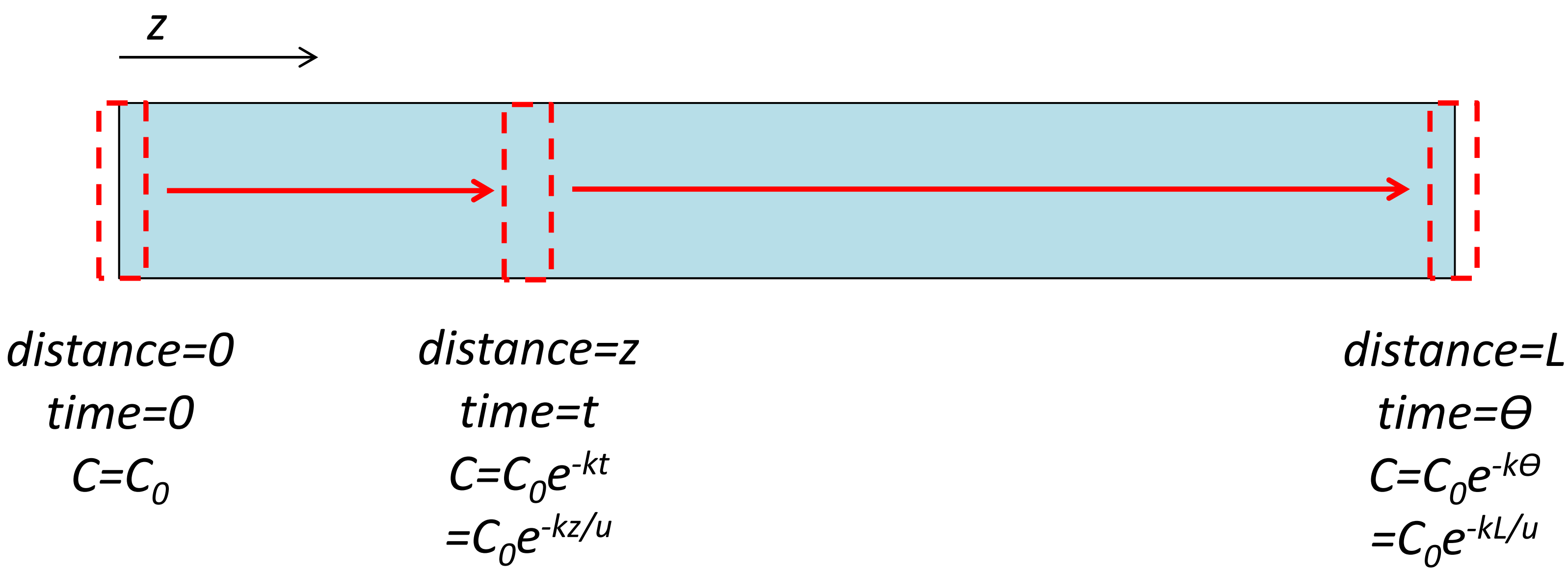
PFR, first-order reaction



$$C / C_0 = e^{-k\theta}$$

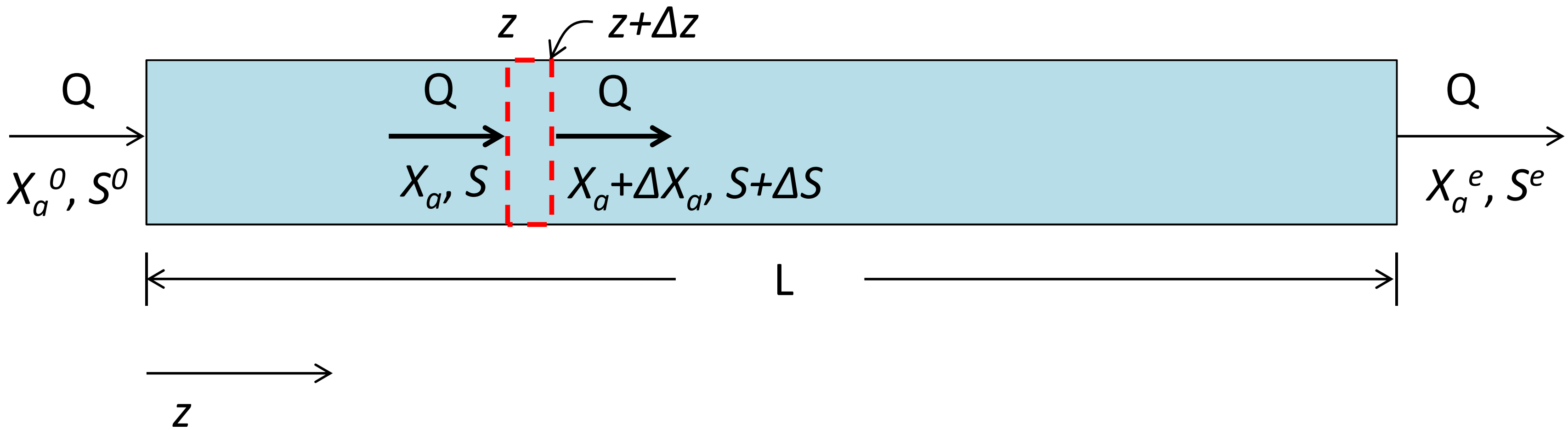
→ Same form as the batch reactor (why??)

PFR, first-order reaction



- We model plug flow reactor as a movement of a "plug"
- The plug has a cross sectional area same as the reactor dimension and an infinitesimal dimension in z-dir (a thin plate)
- Complete mixing within the plug → batch reactor moving in the direction of flow

PFR, Monod kinetics



$$u\frac{dS}{dz} = -\frac{\hat{q}S}{K+S}\left[X_a^{\,0} + Y\left(S^0 - S\right)\right]$$