Diffusion

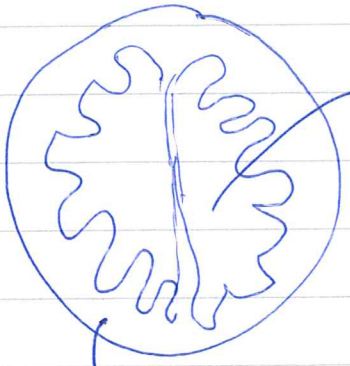
- Very slow on large scales
- Very fast on small scales.
  - what is the average velocity of a H_2O molecule in a glass of water?
    $v \sim 100$ m/s
    distance to neigbour : molecular size

Equation:

$$\frac{\partial}{\partial t} c = \nabla \cdot (D \nabla c) + f$$

Needs boundary conditions and initial conditions.

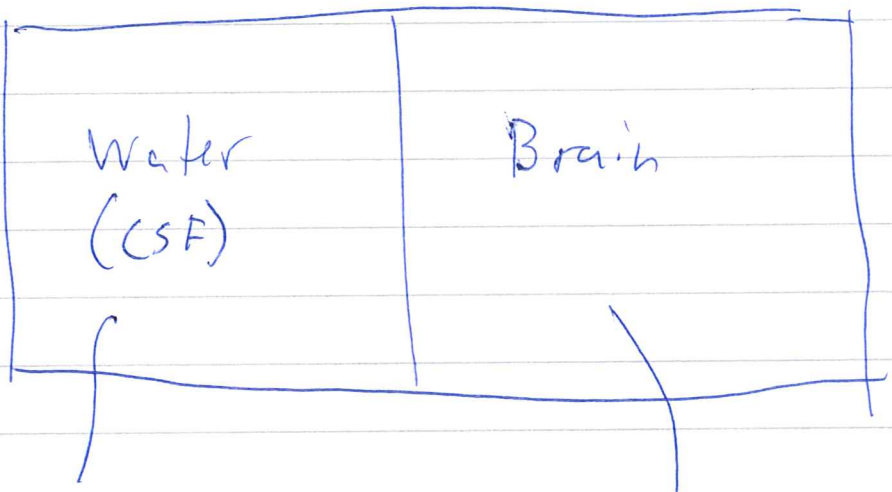
Situation :



brain surface is ~ 5 times bigger than for a sphere with the same volume

CSF = cerebrospinal fluid

We simplify



porous media.

3)

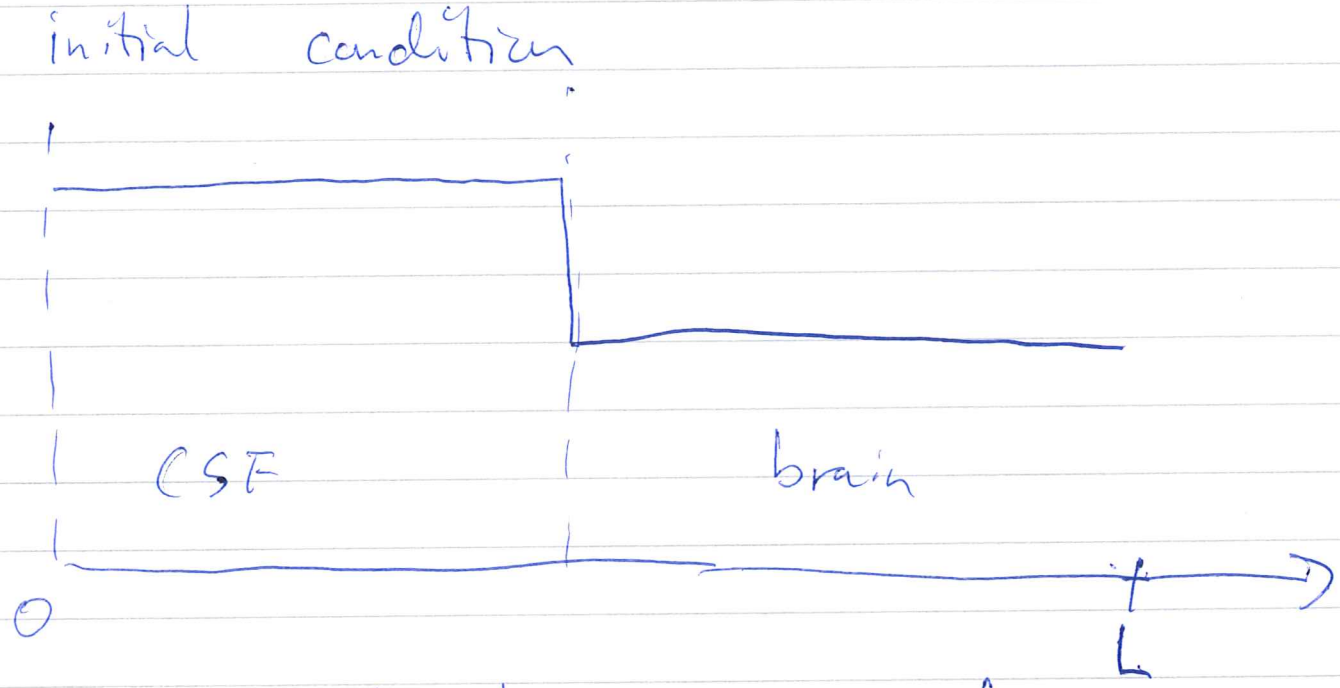
When we fall asleep
there is a sudden change

→ extra-cellular volume
increase by 50%
14% → 21%

→ consentration there
that previously was
in balance with
CSF is no longer
in balance.

4)

We start in 1D



Either solve for both CSF and brain

or only brain.

$$C_t = \frac{\partial}{\partial x}\left(D \frac{\partial}{\partial x} C\right)$$

$$D_{brain} \approx D_{CSF} \times 3$$

equilibrium

$$\left.\frac{\partial}{\partial x} c\right|_{x=0} = \left.\frac{\partial}{\partial x} c\right|_{X=L} = 0$$

5)

How should this be solved?

Analytically / Numerically?

→ Typically a combination

In particular numerical simulations must be verified.

Bugs are frequent!