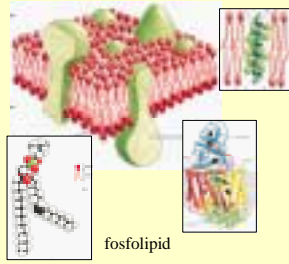


# DIFFUSION

Dias 1

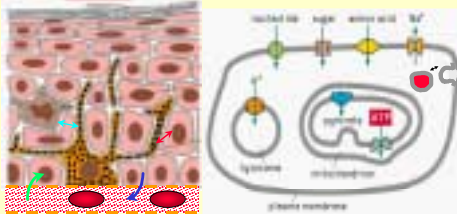
## CELLEMEMBRANEN



- Cellemembranen består af et lipid-dobbeltlag af fosfolipider og kolesterol hvori proteiner er indlejret.
- Proteinet krydser membranen som en  $\alpha$ -helix.
- Der kan være mange transmembrane segmenter.

Dias 2

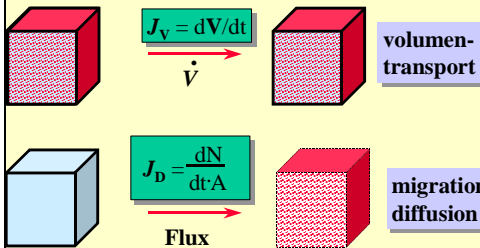
## Transport af molekyler



- Stoftransport sker mellem blod og væv - mellem celler - og mellem organeller.
- Stoftransporten sker som **volumen**transport, som **diffusion**, og som **aktiv transport**.

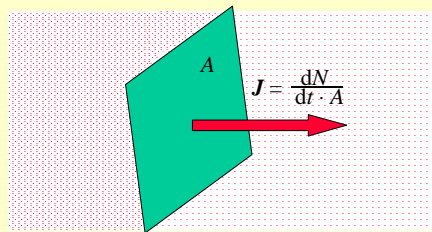
Dias 3

## TRANSPORT



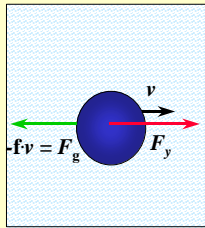
Dias 4

## FLUX



Dias 5

### MIGRATION



- $m \cdot dv/dt = F_y + F_g$   
 $= F_y - f \cdot v = F_y - 1/B \cdot v$
- $dv/dt = 0 \Rightarrow F_y \cdot B = v$
- $J = C \cdot v \Rightarrow$

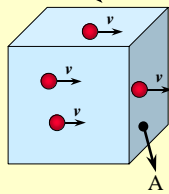
$$J = F_y \cdot B \cdot C$$

(Teorell)

Dias 6

### FLUX ved MIGRATION

$$dx = v \cdot dt$$

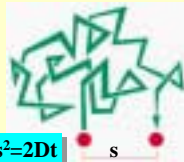


- $J = dN/dt \cdot A$
- $V = A \cdot dx = v \cdot dt \cdot A$
- $dN = C \cdot V = C \cdot v \cdot dt \cdot A$

$$J = C \cdot v$$

Dias 7

### DIFFUSION



$$s^2 = 2Dt$$

$$D = kT/f \text{ (Einstein)}$$

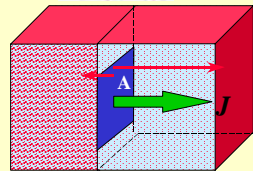
- Diffusion skyldes molekylernes tilfældige og uordnede bevægelse.
- Spredningen (s) er den afstand stoffet kan forventes at tilbagelægge i tiden t.
- D er stoffets diffusionskoefficient.

Dias 8

random walk

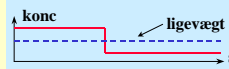


### Ficks lov



- Fluxen af et stof er en vektor hvis størrelse er det antal mol af stoffet der passerer et enhedsareal hvert sekund. Enhed:  $[\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}]$

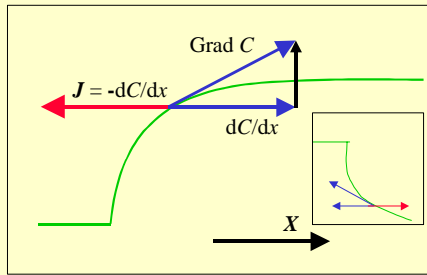
$$J = -D \cdot dC/dx$$



- Diffusion forudsætter koncentrationsforskelle og tenderer til at udligne disse.

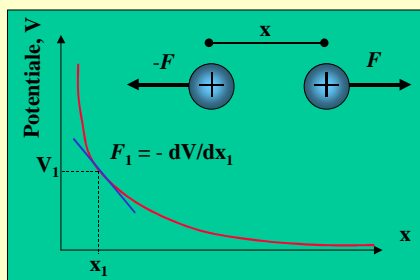
Dias 9

### Koncentrationsgradient



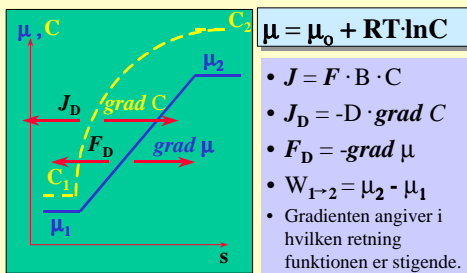
Dias 10

### POTENTIALEGRADIENT



Dias 11

### KEMISK POTENTIALE

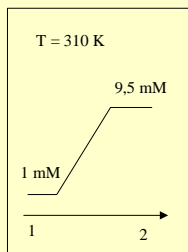


$$\mu = \mu_0 + RT \cdot \ln C$$

- $J = F \cdot B \cdot C$
- $J_D = -D \cdot \text{grad } C$
- $F_D = -\text{grad } \mu$
- $W_{1 \rightarrow 2} = \mu_2 - \mu_1$
- Gradienten angiver i hvilken retning funktionen er stigende.

Dias 12

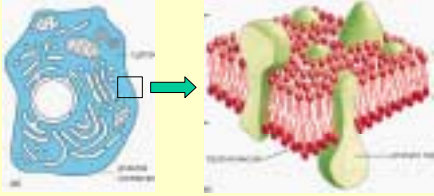
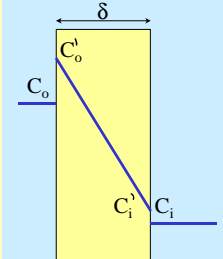
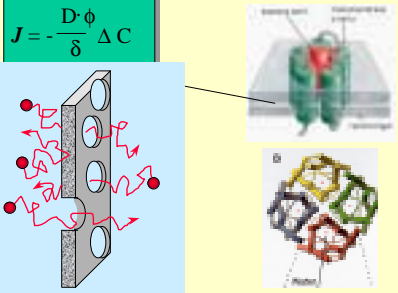
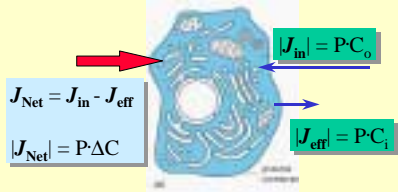
### Arbejde ved diffusion



T = 310 K

$$\begin{aligned} W_{1 \rightarrow 2} &= \mu_2 - \mu_1 \\ &= RT \ln C_2 - RT \ln C_1 \\ &= + 5,8 \text{ kJ/mol} \end{aligned}$$

$$\begin{aligned} W_{2 \rightarrow 1} &= \mu_1 - \mu_2 \\ &= RT \ln C_1 - RT \ln C_2 \\ &= - 5,8 \text{ kJ/mol} \end{aligned}$$

<p>Dias 13</p>	<p style="text-align: center;"><b>CELLEMEMBRAN</b></p> 	
<p>Dias 14</p>	<p style="text-align: center;"><b>Diffusion over membraner</b></p>  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: auto; margin-right: auto;"> <math display="block">J = [-D_m \cdot dC/dx]_i^o</math> <math display="block">J = \frac{-D_m \beta}{\delta} \cdot \Delta C = -P \cdot \Delta C</math> <div style="border: 1px solid green; padding: 2px; display: inline-block; margin: 5px;"> <math>\frac{D_m \beta}{\delta} = P</math> </div> <ol style="list-style-type: none"> <li>1. Stationær</li> <li>2. Linear</li> <li>3. <math>C' = \beta C</math></li> </ol> </div>	
<p>Dias 15</p>	<p style="text-align: center;"><b>PORER</b></p> <div style="display: flex; align-items: center;"> <div style="border: 1px solid green; padding: 5px; margin-right: 10px;"> <math display="block">J = -\frac{D \cdot \phi}{\delta} \Delta C</math> </div>  </div>	
<p>Dias 16</p>	<p style="text-align: center;"><b>UNIDIREKTIONEL FLUX</b></p>  <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="border: 1px solid blue; padding: 5px;"> <math>J_{Net} = J_{in} - J_{eff}</math>  <math> J_{Net}  = P \cdot \Delta C</math> </div> <div style="border: 1px solid green; padding: 5px; margin-left: 20px;"> <math> J_{in}  = P C_o</math> </div> <div style="border: 1px solid green; padding: 5px; margin-left: 20px;"> <math> J_{eff}  = P C_i</math> </div> </div>	

Dias 17

### ELEKTRODIFFUSION

$$F_D = -\frac{d\mu}{dx}$$

$$F_e = \frac{dV_m}{dx}$$

$$F_i = -\frac{d\tilde{\mu}}{dx}$$

$$\tilde{\mu} = \mu_o + RT \ln C + zFV$$

Dias 18

### KATZ FAKTOR

$$J_{in} = \gamma_{in} \cdot P \cdot C_o$$

$$J_{eff} = \gamma_{eff} \cdot P \cdot C_i$$

$$\gamma_{in} = -\xi / (1 - e^{-\xi})$$

$$\gamma_{eff} = +\xi / (1 - e^{-\xi})$$

$$\xi = zFV_m / RT$$

Dias 19

### ELEKTRODIFFUSION

ude inde

+ -

$z=0$

+ -

$z=+1$

$\gamma_{in} > 1$   
 $\gamma_{eff} < 1$

+ -

$z=-1$

$\gamma_{in} < 1$   
 $\gamma_{eff} > 1$

Dias 20

### Arbejde ved elektrodiffusion

$T = 310 \text{ K}, V_m = -60 \text{ mV}$   
(-5,8 kJ)

9,5 mM KCl

1 mM KCl

1 2

$$W_{1 \rightarrow 2(K)} = \mu_2 - \mu_1 = RT \ln(C_2/C_1) + zF(V_2 - V_1) = 0$$

$$W_{1 \rightarrow 2(Cl)} = \mu_2 - \mu_1 = 11,6 \text{ kJ/mol}$$