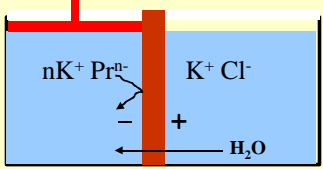
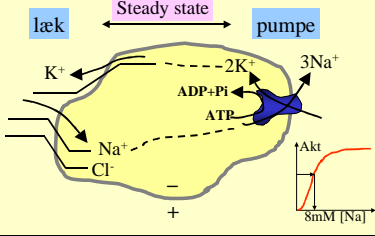
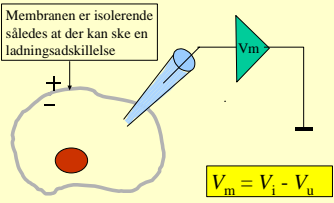
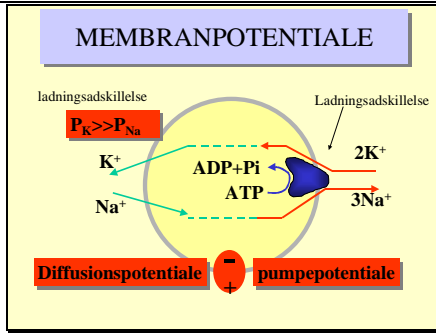


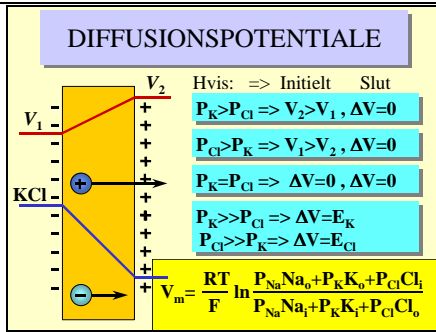
Membranpotential

<p>Dias 1</p>	<p style="text-align: center;">Donnan ligevægt</p> <p style="text-align: center;">1. $\frac{K_1}{K_2} = \frac{Cl_2}{Cl_1} \neq 1$ 2. $\Delta\pi \neq 0$ 3. $\Delta V \neq 0$</p> 																			
<p>Dias 2</p>	<p style="text-align: center;">Ligevægt og steady state</p> <table border="0" style="width: 100%; text-align: center;"> <tr> <td style="border: 1px solid black; padding: 2px;">Ligevægt</td> <td style="border: 1px solid black; padding: 2px; color: red;">C=konst</td> <td style="border: 1px solid black; padding: 2px;">Steady State</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">$\Delta\tilde{\mu} = 0$</td> <td></td> <td style="border: 1px solid black; padding: 2px;">$\Delta\tilde{\mu} \neq 0$</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">$E_{eq} = V_m$</td> <td></td> <td style="border: 1px solid black; padding: 2px;">$E_{eq} \neq V_m$</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">$J_{net} = 0$</td> <td></td> <td style="border: 1px solid black; padding: 2px;">$J_{net} \neq 0$</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">$J_{uni} \neq 0$</td> <td></td> <td style="border: 1px solid black; padding: 2px;">$J_{uni} \neq 0$</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">$W = 0$</td> <td></td> <td style="border: 1px solid black; padding: 2px;">$W > 0$</td> </tr> </table>	Ligevægt	C=konst	Steady State	$\Delta\tilde{\mu} = 0$		$\Delta\tilde{\mu} \neq 0$	$E_{eq} = V_m$		$E_{eq} \neq V_m$	$J_{net} = 0$		$J_{net} \neq 0$	$J_{uni} \neq 0$		$J_{uni} \neq 0$	$W = 0$		$W > 0$	
Ligevægt	C=konst	Steady State																		
$\Delta\tilde{\mu} = 0$		$\Delta\tilde{\mu} \neq 0$																		
$E_{eq} = V_m$		$E_{eq} \neq V_m$																		
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$J_{uni} \neq 0$		$J_{uni} \neq 0$																		
$W = 0$		$W > 0$																		
<p>Dias 3</p>	<p style="text-align: center;">Pumpe-Læk teorien</p> 																			
<p>Dias 4</p>	<p style="text-align: center;">membranpotential</p> <p>Membranen er isolerende således at der kan ske en ladningsadskillelse</p>  <p style="text-align: center;">$V_m = V_i - V_u$</p>																			

Dias 5



Dias 6



Dias 7

Goldman ligningen

$V_m = \frac{RT}{F} \ln \frac{P_{Na}Na_o + P_KK_o + P_{Cl}Cl_i}{P_{Na}Na_i + P_KK_i + P_{Cl}Cl_o}$ hvis Cl⁻ er i ligevægt fås:

$$V_m = \frac{RT}{F} \ln \frac{P_{Na}Na_o + P_KK_o}{P_{Na}Na_i + P_KK_i} = \frac{RT}{F} \ln \frac{(P_{Na}/P_K)Na_o + K_o}{(P_{Na}/P_K)Na_i + K_i}$$

$P_K = 10^{-8} \text{ ms}^{-1}$ $P_{Na} = 10^{-10} \text{ ms}^{-1}$ $Na_o = 110 \text{ mM}$ $Na_i = 13 \text{ mM}$
 $K_o = 2.5 \text{ mM}$ $K_i = 130 \text{ mM}$

$V_m = 8.31 \times 310 / 9.65 \times 10^4 \ln((\infty \times 110 + 2.5) / (\infty \times 13 + 130)) = -96 \text{ mV}$
 $E_K = -106 \text{ mV}$

Dias 8

Pumpens elektrogene bidrag

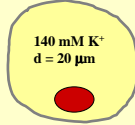
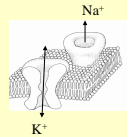
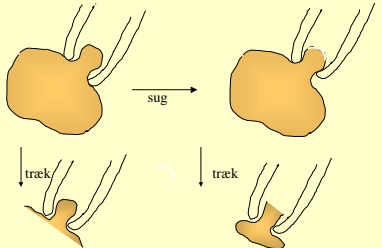
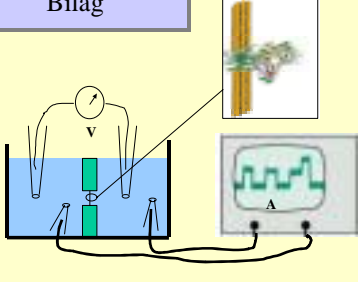
$$V_{m\beta} = \frac{RT}{F} \ln \frac{P_{Na}Na_o + P_KK_o}{P_{Na}Na_i + P_KK_i} = -95.8$$

Hvis pumpen er elektroneutral

$$V_m = \frac{RT}{F} \ln \frac{P_{Na}Na_o + \beta P_KK_o}{P_{Na}Na_i + \beta P_KK_i} = -98.6 \text{ mV}$$

Hvis pumpen er elektrogen f.eks $\beta = 1.5$

<p>Dias 9</p>	<p style="text-align: center;">Cellemembranen som K⁺- elektrode</p> $V_m = -\frac{RT}{F} \ln \frac{P_{Na}Na_o + P_KK_o + P_{Cl}Cl_i}{P_{Na}Na_i + P_KK_i + P_{Cl}Cl_o}$ <p>Hvis Cl⁻ er i ligevægt og P_K >> P_{Na}: V_m ~ E_K</p> <p>AB: E_K = -59,5 log(K_i/140) AC: V_m = -59,5 log((K_o/0,01Na_o)/140)</p> <p>Kalium koncentration udenfor/mM</p> <p>1) ÆKVIVALENT CIRKUIT 2) BIOLOGISKE TILNÆRMELSE</p> <p>I elektriske eksperimenter opfører membranen sig som et eq. kredsløb med to grene: en strømførende del, der antyder en K⁺ selektiv pore og en kapacitativ gren, membranens lipidlag</p>	
<p>Dias 10</p>	<p style="text-align: center;">Elektrisk ækvivalens</p>	
<p>Dias 11</p>	<p style="text-align: center;">Membranpotential</p>	
<p>Dias 12</p>	<p style="text-align: center;">Membran som kapacitor</p> <p>extracellulær membran intracellulær</p> <p>$C_m = 1 \mu\text{F}/\text{cm}^2$ $\sim 6 \times 10^{12}$ ladin./1cm^2</p> <p>$V = Q/C$</p>	

<p>Dias 13</p>	<div style="text-align: center; border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Membranen som capacitor </div>  <p>140 mM K⁺ d = 20 μm</p> <p>$V_m = -60 \text{ mV}$ $C_m = 1 \mu\text{F}/\text{cm}^2$ Antal ladninger: $Q = C_m A V_m$</p> <p>$A = 4\pi r^2 = 4\pi (10 \times 10^{-4})^2 \text{ cm}^2$ $Q = 1 \times 10^{-6} \cdot 4\pi (10 \times 10^{-4})^2 \cdot 60 \times 10^{-3}$ $= 7,5 \times 10^{-13} \text{ coulomb svarende til}$ $7,5 \times 10^{-13} / 9,65 \times 10^4 \text{ mol}$ $= 7,8 \times 10^{-18} \text{ mol}$ $\sim 5.000.000 \text{ ioner}$ dvs. 1 ud af 80.000</p> <p>140 mM svare til $0,14 \cdot \text{Cm}^{-3}$ $= 5,9 \times 10^{-13} \text{ mol}$ $\sim 4 \times 10^{11} \text{ ioner}$</p>	
<p>Dias 14</p>	<div style="text-align: center; border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Hastigheden af ladningsændringen </div>  <p>Na⁺</p> <p>K⁺</p> <p>Tætheden af kanaler er typisk 50-200/μm² sv.t. 50.000-200.000 kanaler per celle.</p> <p>Hver kanal transporterer i str. ordenen mill ioner/sec sv.t en ændring i V_m på ca 60 mV. Dvs V_m ændres i sub-ms området.</p>	
<p>Dias 15</p>	<div style="text-align: center; border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Patch clamp </div>  <p>sug</p> <p>træk</p> <p>træk</p>	
<p>Dias 16</p>	<div style="text-align: center; border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Bilag </div>  <p>V</p> <p>A</p>	

Dias 17

Rekonstituering

