



Universidade de São Paulo
Escola de Engenharia de Lorena
Departamento de Biotecnologia



Curso: Engenharia Ambiental

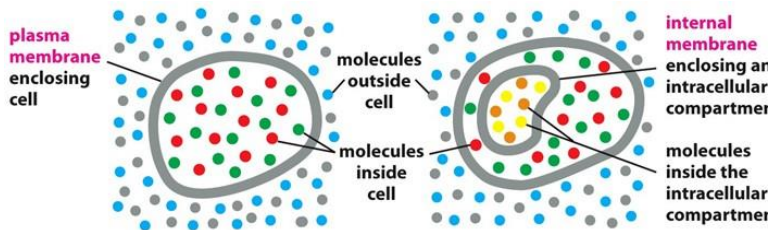
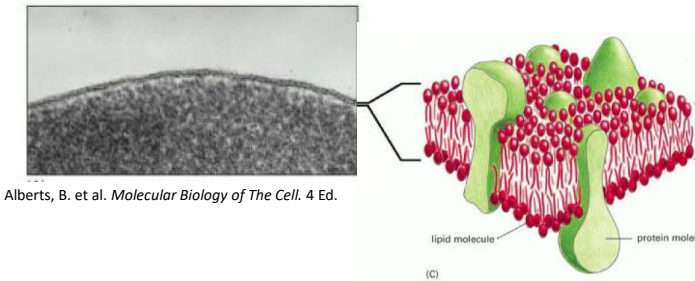
Membrana Plasmática

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tatianedaf Franca@usp.br

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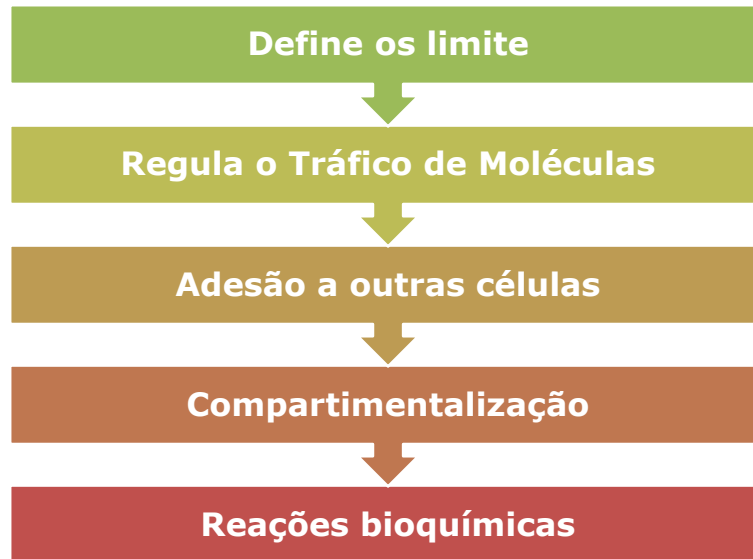
Membrana Celular - Função

❖ Define os limites da célula



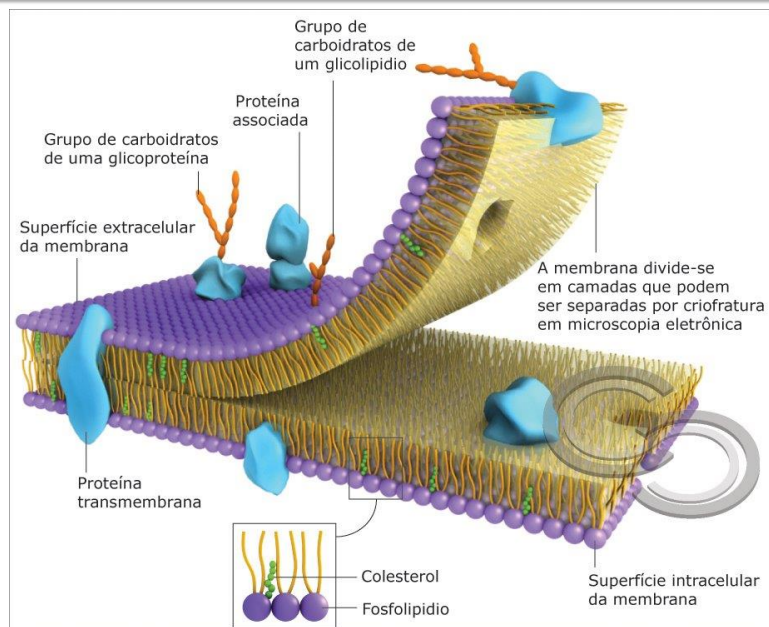
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Funções das membranas celulares



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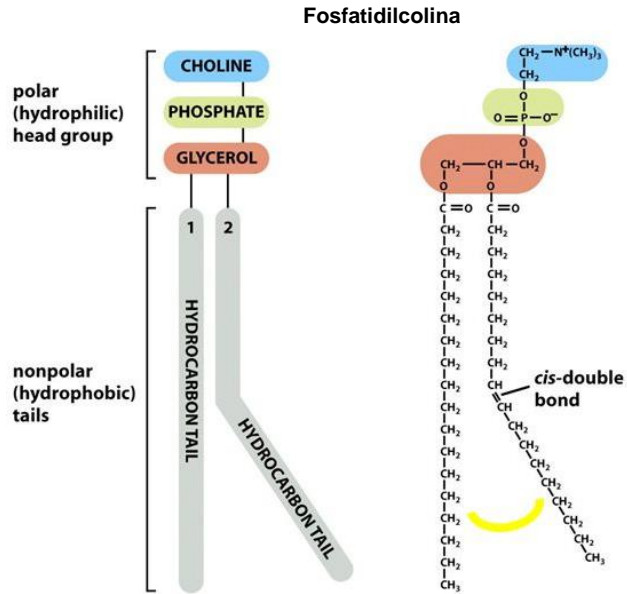
Membranas – Estrutura geral



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Estrutura Geral: Lipídeos

❖ Fosfolipídios

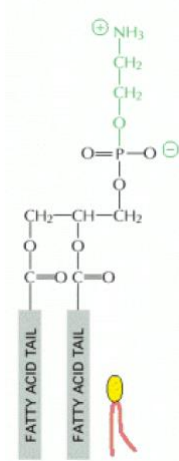


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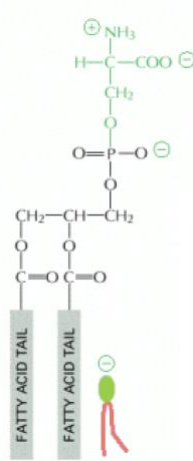
Tipos de Fosfolipídeos

❖ 4 tipos de fosfolipídeos mais comuns.

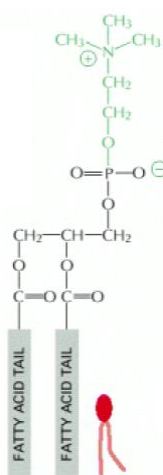
Fosfatiletanolamina



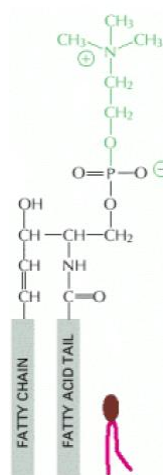
Fosfatidilserina



Fosfatidilcolina



Esfingomielin

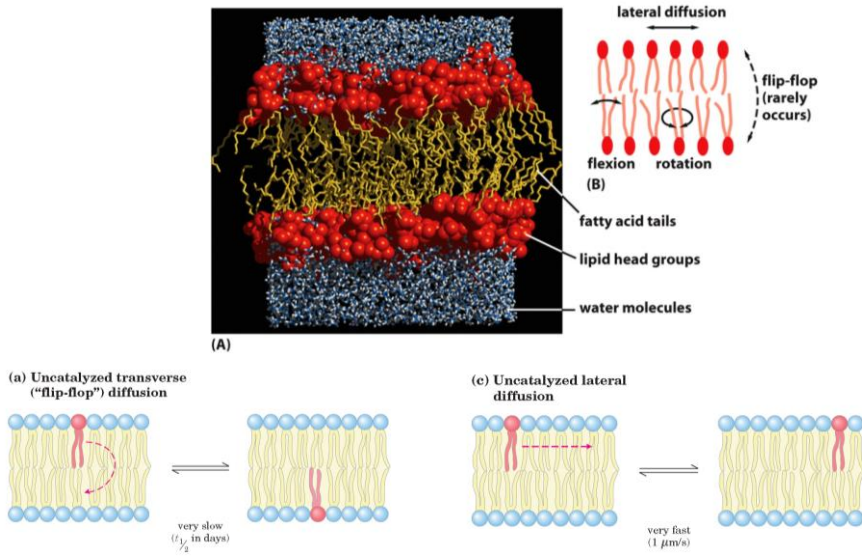


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Dinâmica da Membrana

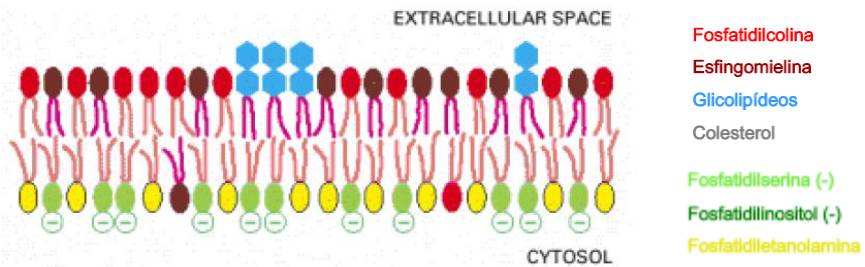
❖ Fosfolídeos movimentam-se pela membrana



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Assimetria de fosfolídeos

❖ Distribuição assimétrica

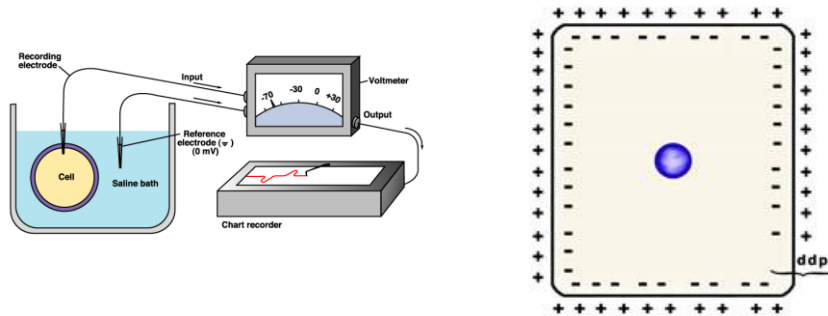


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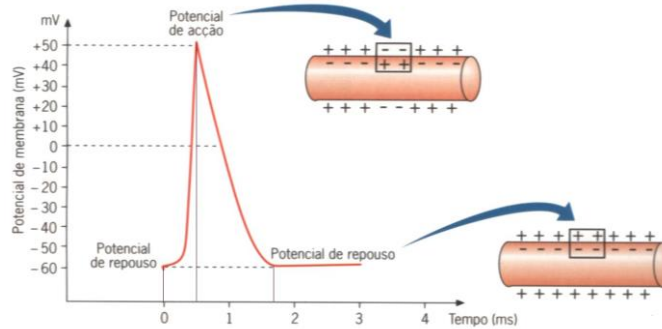
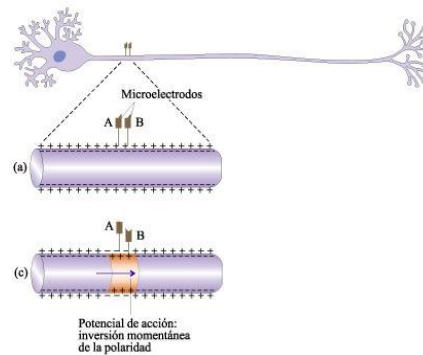
Potência de Membrana

- ❖ Diferença de carga entre os lados da membrana
- ❖ Leve diferença na concentração de íons
- ❖ Em geral: Lado citoplasmático – **negativo**; Lado externo- **positivo**



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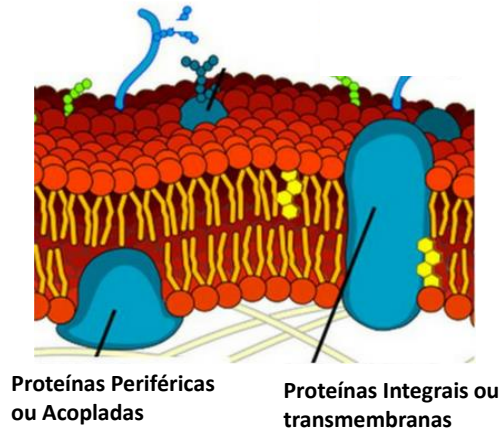
❖ Despolarização da Membrana



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Estrutura Geral: Proteínas

❖ Proteínas Periféricas e Integrais

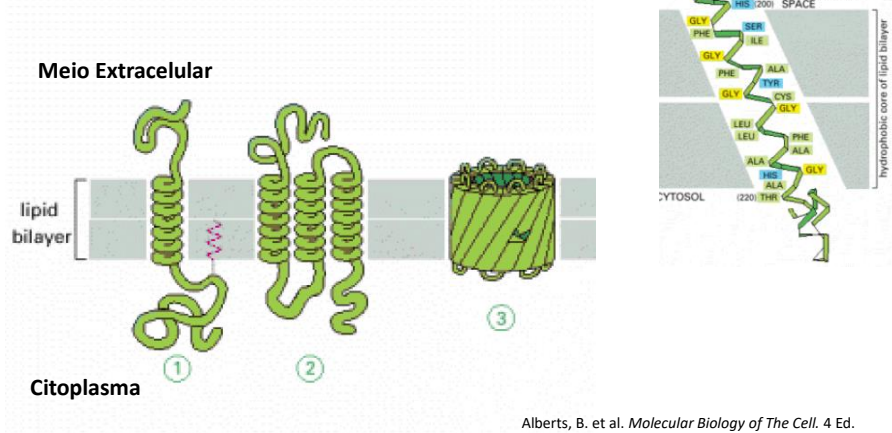


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Estrutura Geral: Proteínas

❖ Proteínas integrais de Membrana ou Transmembranas- cruzam a membrana

❖ Regiões Hidrofóbicas e Hidrofílicas

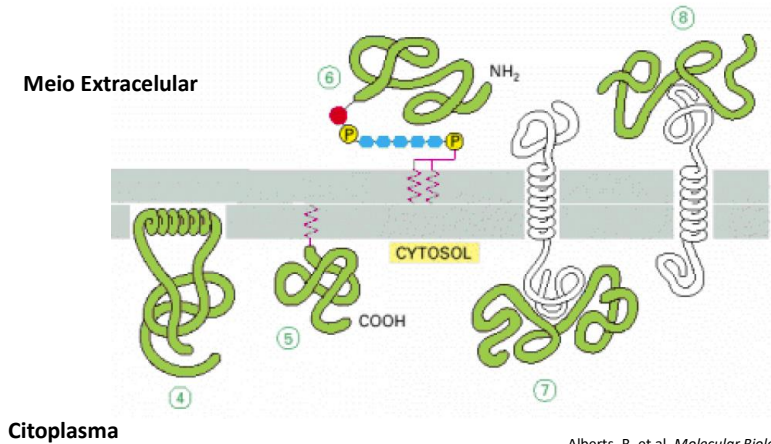


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Proteínas nas membranas

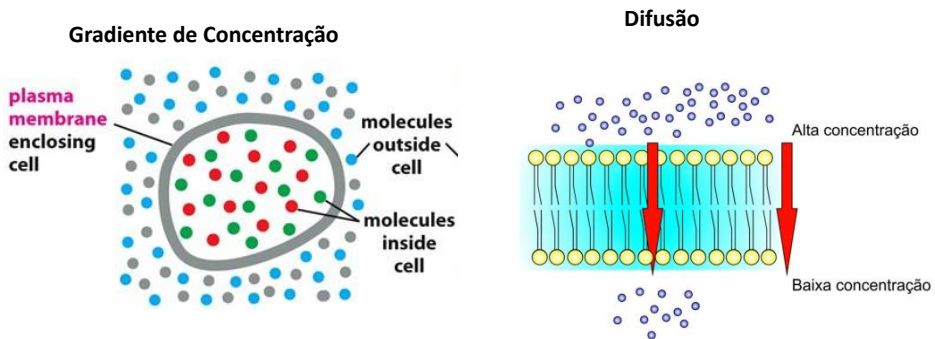
- ❖ **Proteínas Periféricas** - Acopladas a membrana
- ❖ Interação com um dos lados da membrana



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Transporte através da membrana

- ❖ **Permeabilidade Seletiva**



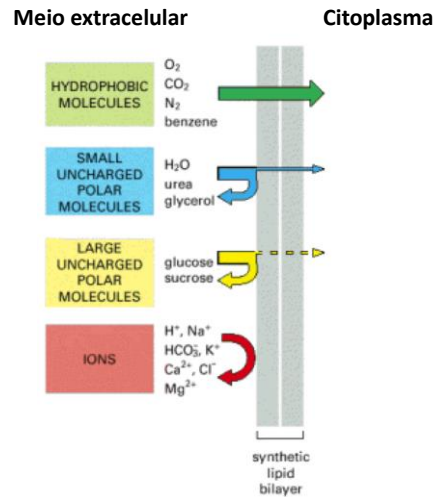
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Diferentes velocidades de Difusão

❖ Características das moléculas afetam o processo de **Difusão**

❖ Fatores:

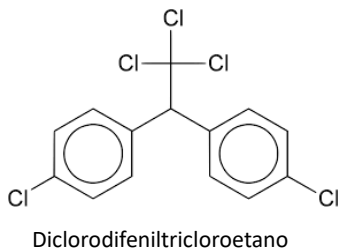
- Tamanho
- Solubilidade
- Carga
- Concentração



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Difusão pela Membrana: Parâmetro Toxicológico

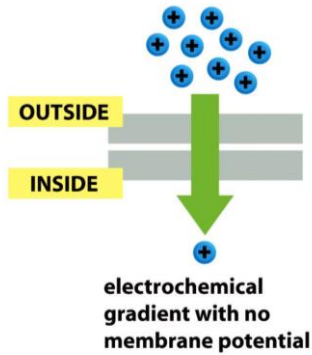
- ✓ Hidrossolúvel ou Lipossolúvel
- ✓ Lipossolúvel– Bioacumulativos
- ✓ Ex: Inseticida DDT (diclorodifeniltricloroetano)



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Transporte através da Membrana

- ❖ Difusão
- ❖ Gradiente de concentração + Potencial de Membrana = **Gradiente eletroquímico**



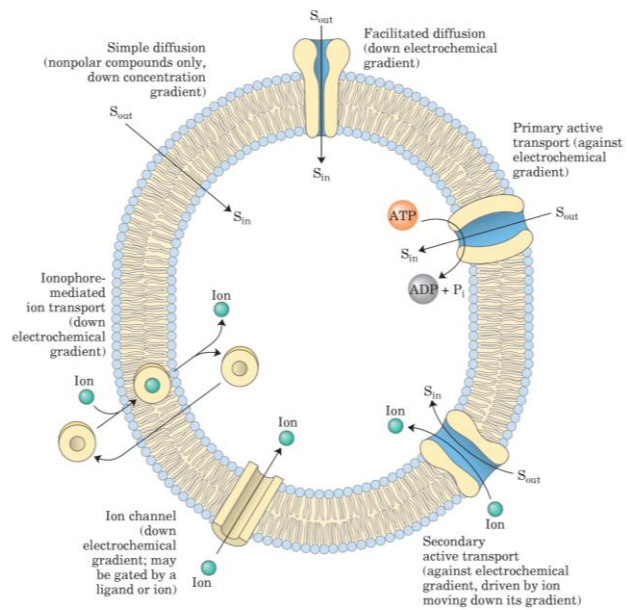
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Transporte através da Membrana

- ❖ Difusão Simples

- ❖ Mediado por Transportadores



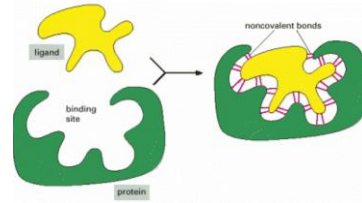
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Transportadores na Membrana

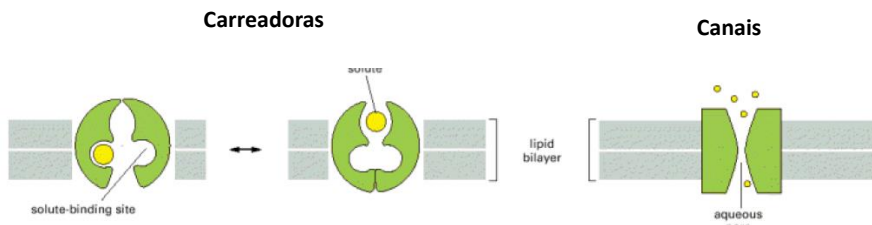
❖ Proteínas Transmembranas:

❖ 2 tipos:

- **Carreadoras**: se liga ao soluto.



- **Canais**: formam um poro aquoso na membrana

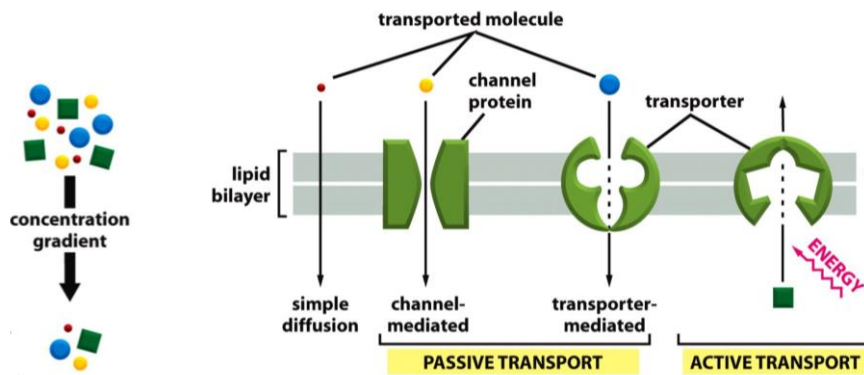


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Transporte Passivo e Ativo

❖ **Transporte Passivo** (ou difusão facilitada)- Canal e Carreadoras

❖ **Transporte Ativo** - Carreadoras

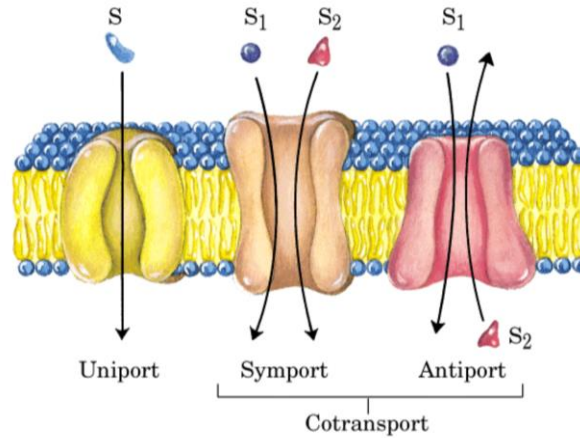


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Tipos de Carreadores

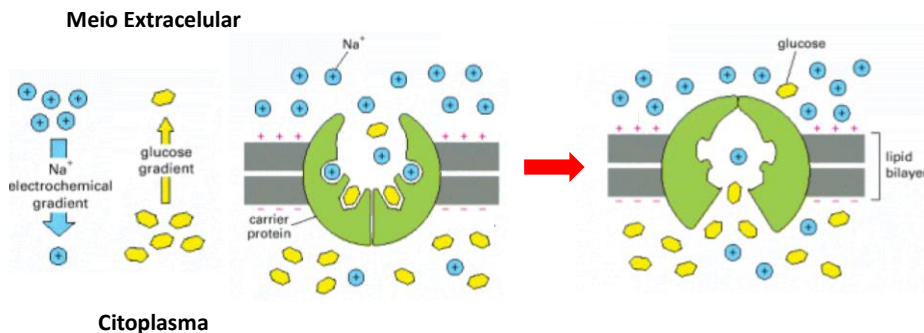
- ❖ **Uniporte:** Apenas uma molécula é transportada
- ❖ **Transportadores acoplados:** moléculas diferentes são co-transportadas (**Simporte** e **Antiporte**)



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Transporte Acoplado

- ❖ Molécula 1- a favor do gradiente (tipicamente íons)
- ❖ Molécula 2- contra o gradiente



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Íons na célula

Tabela: Concentração de íons dentro e fora da célula

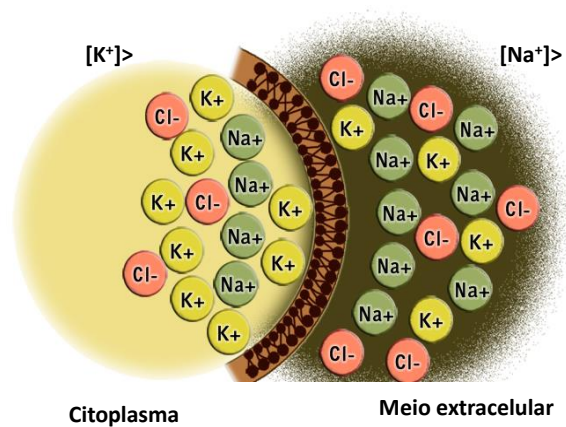
| COMPONENT | INTRACELLULAR CONCENTRATION (mM) | EXTRACELLULAR CONCENTRATION (mM) |
|------------------|---|---|
| Cations | | |
| Na ⁺ | 5-15 | 145 |
| K ⁺ | 140 | 5 |
| Mg ²⁺ | 0.5 | 1-2 |
| Ca ²⁺ | 10 ⁻⁴ | 1-2 |
| H ⁺ | 7 × 10 ⁻⁵ (10 ^{-7.2} M or pH 7.2) | 4 × 10 ⁻⁵ (10 ^{-7.4} M or pH 7.4) |
| Anions* | | |
| Cl ⁻ | 5-15 | 110 |

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Íons na célula: Na⁺ e K⁺

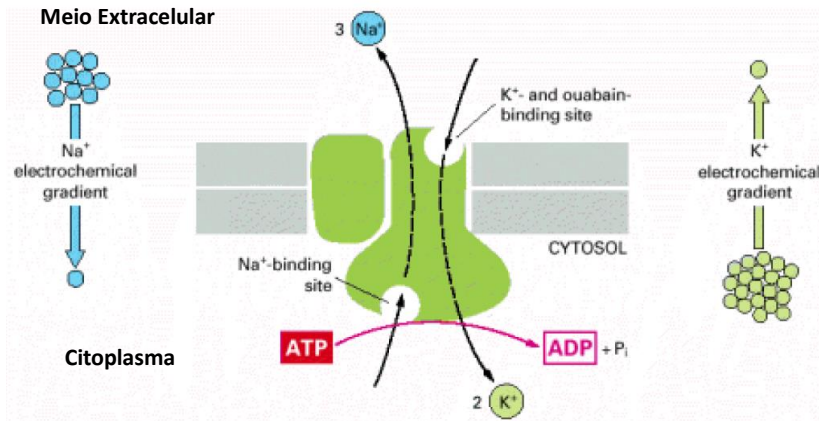
❖ Como a célula mantém esta diferença de concentração?



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Exemplo: Bomba de Na⁺ e K⁺

- ❖ Transportador **antiporte**
- ❖ 3 Na⁺ para fora e 2 K⁺ para dentro



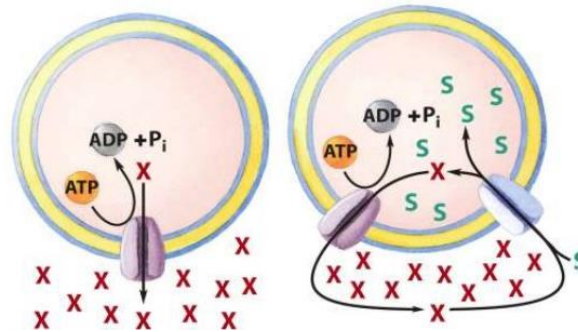
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Transporte Ativo

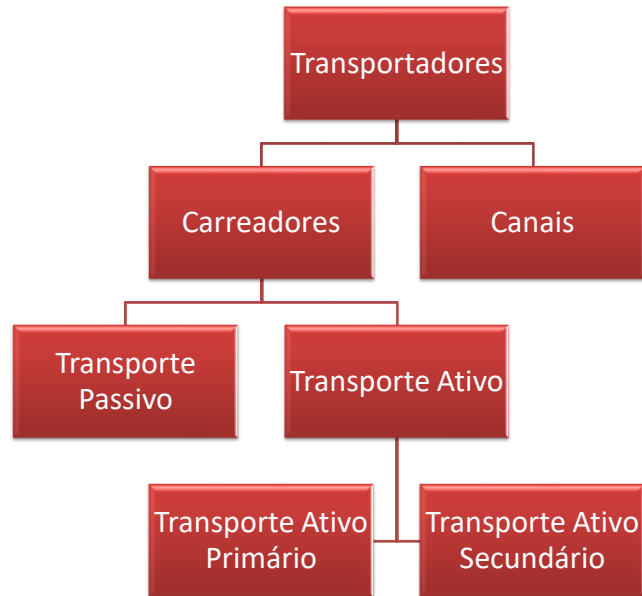
Transporte Ativo Primário

Transporte Ativo Secundário



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Proteínas Transportadores de Membrana



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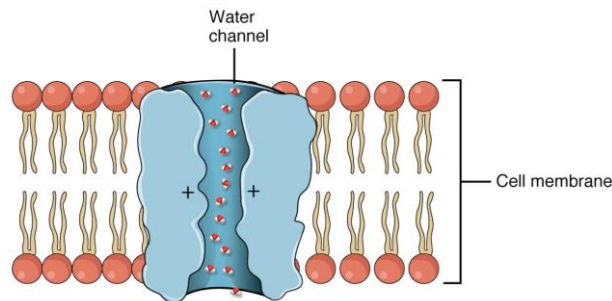
Proteínas Canais

❖ **Transporte por Canal:** a favor do gradiente de concentração. Forma um poro aquoso na membrana

❖ **Exemplo:**

Canais de Água: Aquaporina

Velocidade de Transporte da
Água : 10^9 S^{-1}

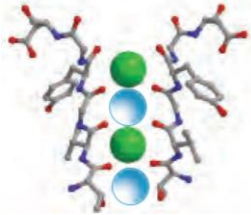


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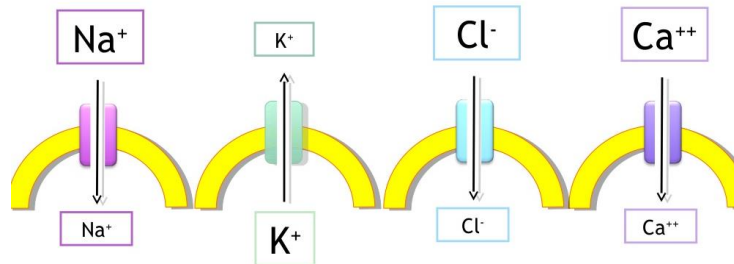
Canais Iônicos

❖ **Canais Iônicos:** Permitem movimento rápido de íons pela membrana

❖ **Seletivos!**



Velocidade de Transporte pelo canal 10^7 a 10^8 íons/s

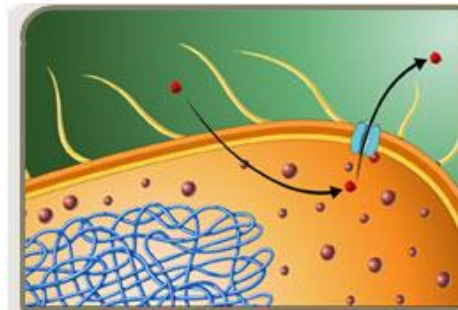


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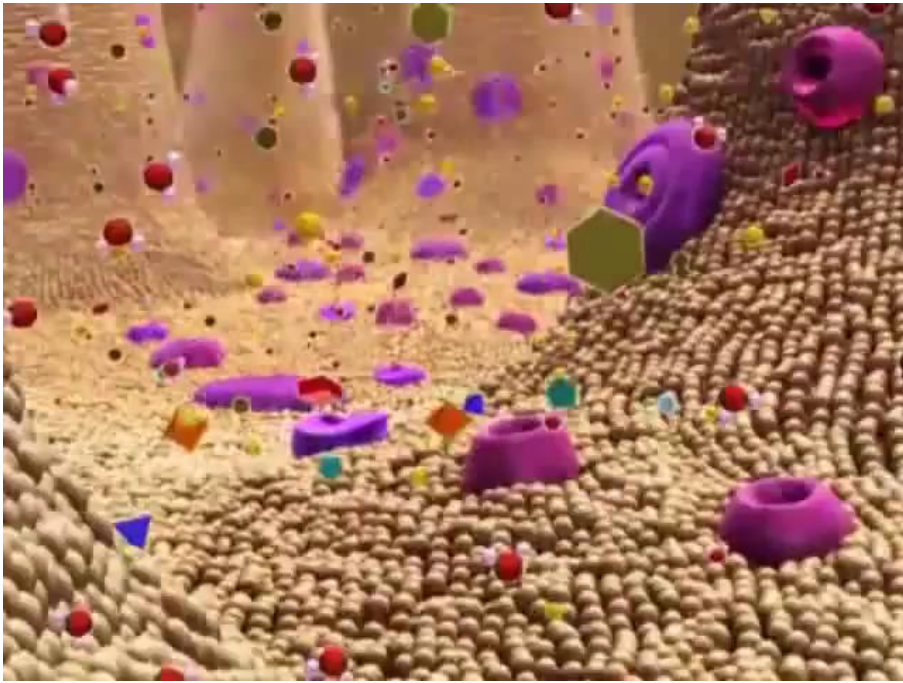
Exemplos: Resistência a Antibióticos

- ❖ **Tetraciclina:** inibidor da síntese proteica em procariotos.
- ❖ **Bomba de efluxo de Tetraciclina:** Um dos mecanismo de resistência a Tetraciclina.

Bactéria Resistente:



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