1. **Header:**

# **Title**: Principles of Selective Ion Transport in Channels and Pumps

**Why did I read this paper:** To understand about transporter specificity

# **Source:** http://science.sciencemag.org/content/310/5753/1461/tab-pdf

**Year of published: 2005**

1. **Summary of abstract**
   * The transport of ions across the membranes of cells and organelles is a prerequisite  
     for many of life’s processes.
   * Transport often involves very **precise selectivity for specific ions**.
   * four of the most abundant ions in biology: sodium, potassium, calcium, and chloride
   * Recently, atomic-resolution structures have been determined for channels  
     or pumps that are selective for sodium, potassium, calcium, and chloride
     + From these structures we can begin to understand the principles of selective ion transport in terms of the architecture and detailed chemistry of the ion conduction pathways
2. **Outstanding points**

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| Ion pumps | Ion channel |
| * Transport ions against their electrochemical fradient by coupling the “uphill” transport process to an energy source such as ATP hydrolysis or the “downhill” movement of another ion or substrate molecule. | * Passive * Simply catalyzing the downhill movement of ions, in many cases at very high ion conduction rates. |
| * Both have the ability to transport ions in a selective manner. Ion selectivity is crucial to the operation of ion-transport proteins | |

* + Nature has come up with many different solutions to overcome the energy barrier to allow an ion to cross the membrane.
  + Proteins’ architectures and shapes and how their shapes are related to the passageway across the membrane bilayer:
    - In some case, protein creates a proteinacious passageway spanning approximately the thickness of the entire membrane bi-layer
    - In other cases, the protein create aqueous cavities or vestibules (channel opening into another), some of which reach more than halfway across the bilayer
      * In these proteins, ions and substrates reach selectivity filters or binding sites deep within the membrane by simple diffusion through the aqueous solution
  + Ion selectivity
    - Most transport proteins need to get certain ions across the membrane while at the same time excluding others
      * Such ion selectivity can be extremely precise
      * Ion selectivity between similar ion such as Na+ and K+ requires the ion pathway to have specific binding sites over at least part of its length.
        + These binding sites allow a transport protein to “feel” ions to ensure that only the right ones can pass
        + Of course, for an ion to be felt, it has to be dehydrates (at least partially if not completely) and dehydration costs energy.

Binding sites therefore have to compensate for the energetic cost of dehydration by providing favourable compensatory interactions with the ion

Selectivity results when this energetic compensation is more favourable for one type of ion than for another, relative to the energy of dehydration

Studies over the past 50 years on synthetic and naturally occurring ion-binding small molecules have established the basic rules of ion selectivity within small molecules: 2 factors: the atomic composition and the sterochemistry (e.e., size) of the binding site

* + Relationship between Channels and Pumps
    - By author’s assumption: Pumps = group of active transport proteins = the ion pumps + ion exchangers
    - In consideration for chemical principles of ion discrimination: channels and pumps and be grouped into a single collection
    - In consideration for architectural priciples of transport proteins, each of them has unique structural aspect: protein shapes. Their unique protein shapes are related to the need for channels to conduct ions rapidly and for pumps to move ions against an electrochemical gradient

1. **Lesson learned from the papers**
2. **Terms translated to Vietnamese**

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| **Term** | **Translated** |
| organelles | Bào quan |
| **Passageway** across the membrane bilayer | Hành lang… |
| To draw from something= Take, bring or pull out from… |  |
| aqueous cavities | Lỗ hổng có nước |
| vestibule | channel opening into another |
| continuum | Thảm thực vật liền |
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1. **Facts**
2. **Novel knowledge**
3. **Other notes**