# Type I Secretion Systems (T1SS)

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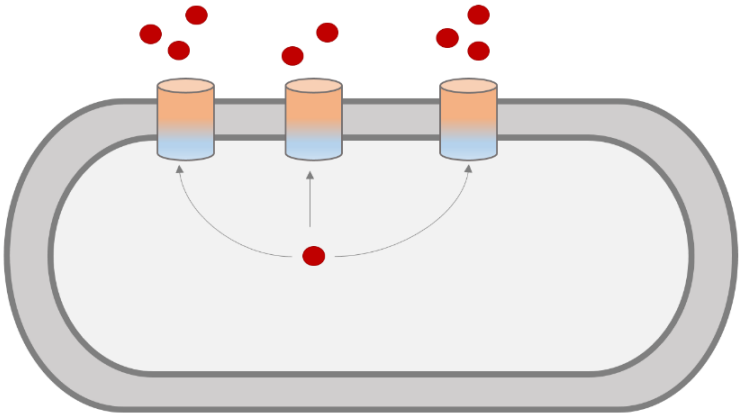


T1SS in Gram-negative bacteria

**Bacteria and their relationship with the environment**

Bacteria play fundamental roles in a wide range of ecosystems and are very much in touch with their environment. Their ability to adapt and survive in different environmental conditions is extraordinary. Some ways in which bacteria interact with their environment are: participating in biogeochemical cycles, establishing symbiotic relationships with other organisms, degrading organic matter or acting as pathogens, and affecting human and environmental health. To carry out these functions, microorganisms have developed various strategies, including the secretion of substances into the environment.

**Secretion**

Secretion is the process of transporting effector molecules, such as proteins, enzymes or toxins, from the inside of the cell to the outside, where they carry out their varied functions that are essential for prokaryotic organisms to interact with the environment around them. In particular, Gram-negative bacteria possess multiple mechanisms for transporting these molecules, termed Type I to Type VI Secretion Systems. Here, we describe the Type I System (T1SS).

**What is T1SS and what is its function?**

T1SS is a channel that allows a wide variety of Gram-negative bacteria to secrete proteins into the extracellular space. This system is involved in various physiological responses, such as adaptation to the environment, and contributes to the virulence of certain pathogens. The T1SS is referred to as the "simplest" representative of secretion systems, considering that it is composed of only three membrane proteins.

**In what organisms can it be found?**

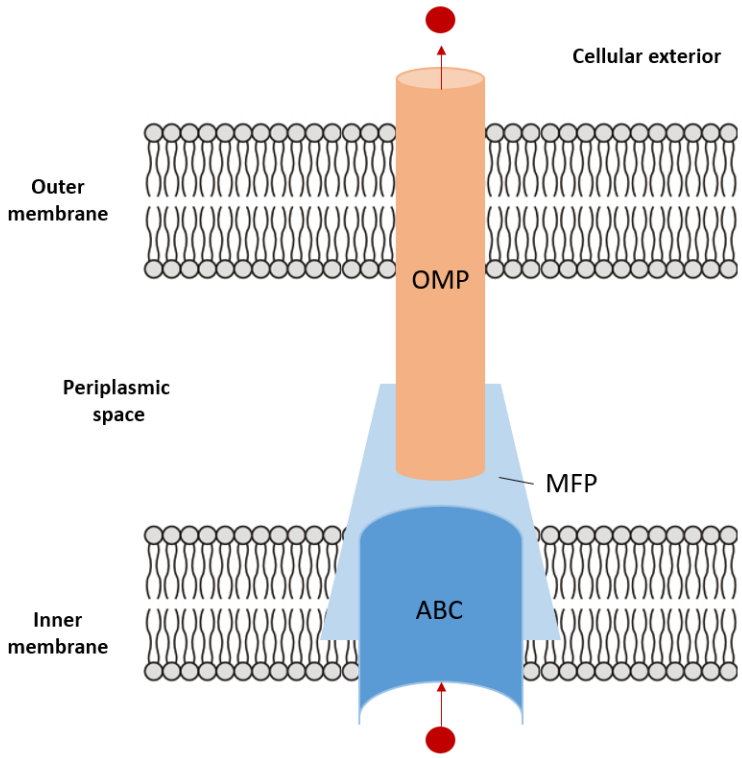
Unlike Gram-positive bacteria, which possess only one biological membrane, Gram-negative bacteria are composed of two membranes (inner and outer). This double envelope poses a real challenge for the transport of molecules in and out of these microorganisms. To solve this problem, these bacteria have developed different secretion systems to infect, multiply and survive, including the T1SS.

**Channel Structure**

TISS is composed of:

- An inner membrane protein with ATPase activity (to obtain energy from ATP, the cellular currency of energy) belonging to the ABC superfamily.
- An outer membrane protein, OMP.
- A membrane fusion protein, MFP, which is a periplasmic protein that connects the inner membrane ABC protein to the outer membrane protein OMP.

The assembly of these three proteins forms a continuous translocation channel from the cell interior to the exterior.




Structure of T1SS

**How does it work?**

The specific proteins for this channel (substrate) are secreted across the two membranes in a single step and without intermediaries. This organisation allows the secretion of compounds directly from inside the bacterium into the extracellular medium.

The substrate recognises the ABC protein, which interacts with the MFP protein, which is responsible for recruiting the OMP component. Substrate binding to the ABC protein is necessary for the assembly of the channel. In addition, the process needs energy, so the cell will use ATP molecules.

**How does the cell make it?**

The bacteria make the necessary channel parts according to the instructions of the genes. In addition, proteins and molecules that will be secreted are also translated from the genes. Once all the components have been synthesised, they will be ready for use when needed.

**What is it for?**

Type I Secretion Systems are widespread in Gram-negative bacteria and, thanks to the one-step expulsion of a wide variety of proteins, they serve a variety of purposes, including:

- ✓ The acquisition of nutrients, for example, the secretion of proteins capable of capturing iron molecules needed by bacteria.
- ✓ The survival of bacteria. To this end, T1SS is responsible for the secretion of "adhesin" proteins, which are involved in the formation of biofilms, i.e. communities of microorganisms attached to a surface to increase bacterial resilience and resistance to environmental stresses.
- ✓ Infections, for example, the release of virulence factors (toxins) that cause damage of host cells and tissues.