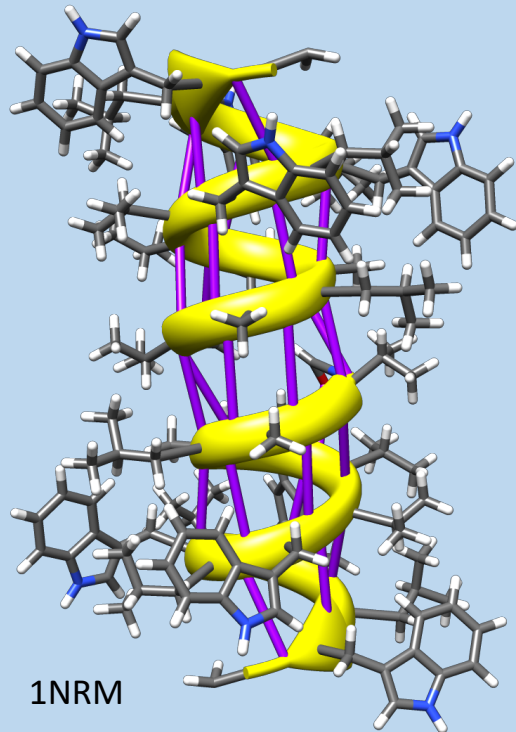
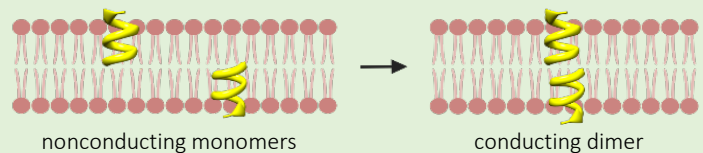


# ANTIBIOTIC PROTEIN



## Gramicidin

- naturally occurring antibiotic protein secreted by the soil bacterium *Bacillus brevis*
- disrupts normal movement of ions across a biological membrane



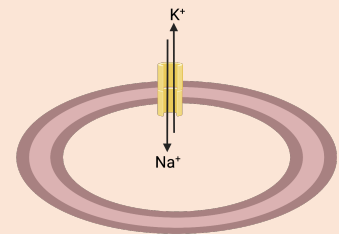
- dimerization within the membrane is required for gramicidin to form a functional channel for ion diffusion<sup>1</sup>

### STRUCTURE

- **dimer**, made of two small polypeptide chains (15 amino acids each)
- each chain forms a **helix**
- helices are connected by **hydrogen bonds**, forming a channel
- hydrophobic (water-fearing) amino acid side chains extend out from the helix backbone and interact with membrane lipids

### FUNCTION

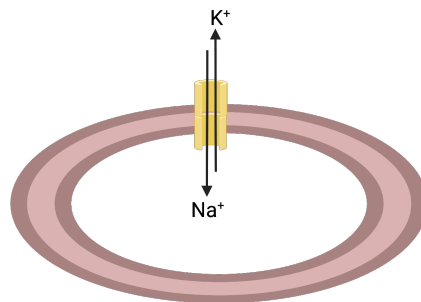
- forms a **transmembrane channel** facilitating diffusion of ions ( $H^+$ ,  $Na^+$ ,  $K^+$ )
- diffusion of ions disrupts the natural ion distribution, causing cell death
- produced by bacteria (*Bacillus brevis*) to destroy competitors (a variety of bacteria and fungi) in the same environment



- diffusion occurs along the concentration gradients of ions
- sodium ions ( $Na^+$ ) flow into the cell, and potassium ions ( $K^+$ ) flow out of the cell

### Application to Human Health<sup>1,2</sup>

- first antibiotic to be manufactured and used clinically
- used as a topical (surface) antibiotic to treat wounds, skin infections, and some eye, nose, and throat infections
- cannot be taken internally because it causes the same effects in human cells as it does in bacteria, causing the cells to break open and die
- may be a useful drug for some types of cancer and research is looking for an effective way to deliver gramicidin to cancer cells without allowing it to kill normal cells



References:

David JM, Rajasekaran AK. (2015) J. Kidney Cancer VHL 2(1):15-24.  
Takada Y, et al. (2020) Nat Commun 11:4935.