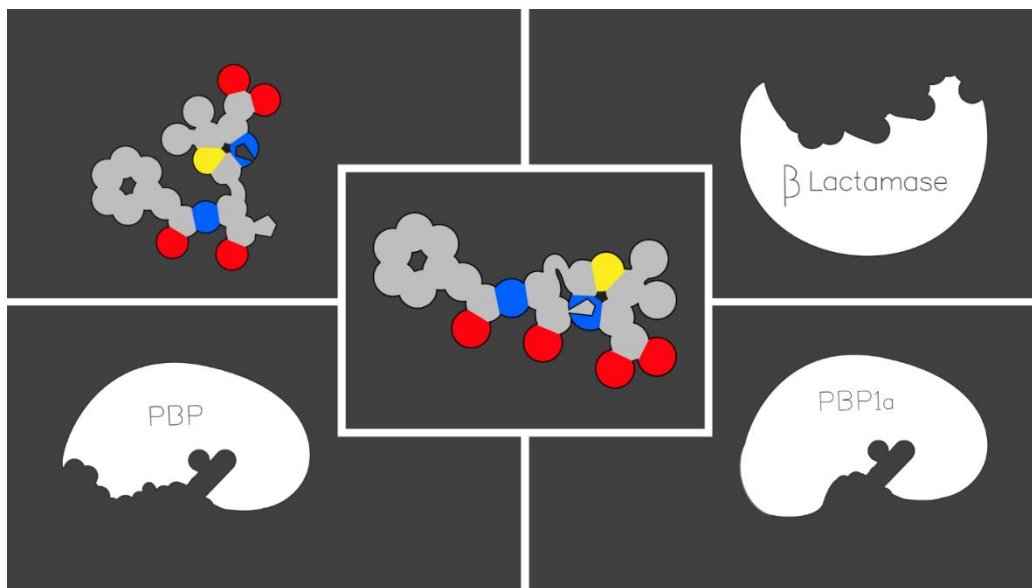


Penicillin and Beta-Lactamase Modeling kit.

The Penicillin and Beta-lactamase modeling kit was designed as an expansion pack for the **Bacterial Membrane Kit** to show how penicillin works and mechanisms of antibiotic resistance in bacteria. While it will work as a stand-alone kit, 3D Molecular Designs strongly recommends using it conjunction with the Bacterial Membrane Kit (specifically with Advanced modeling of Gram-Positive and Gram-Negative Bacteria)

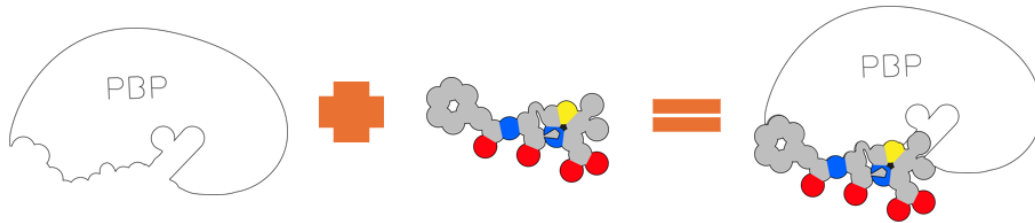


Penicillin is an antibiotic that evolved in yeast to mimic stem peptides of the peptidoglycan. It functions by binding to and inhibiting the crosslinking action of PBP

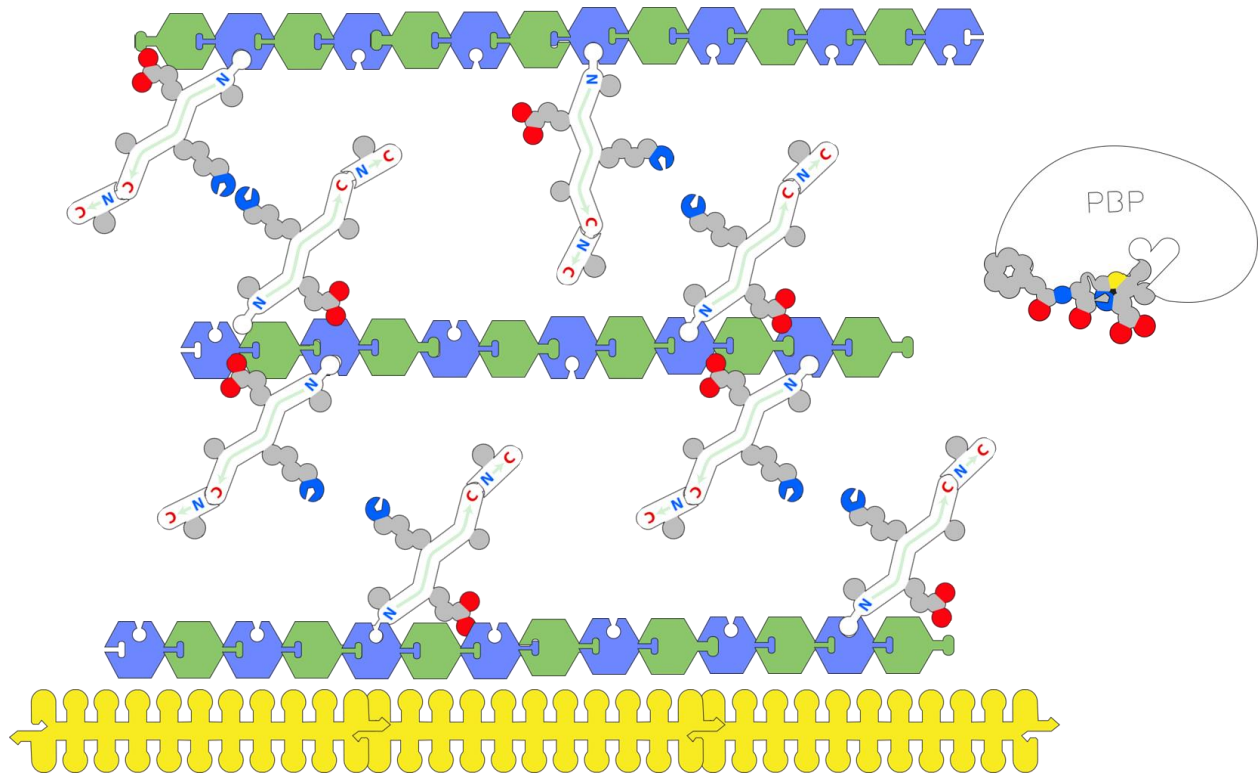
PBP (Penicillin Binding Protein) is a generic name for a family of enzymes that function to crosslink the peptidoglycan layers of a bacterial cell wall.

PBP1a is a variant form of PBP... that has evolved in bacteria to escape inhibition by penicillin.

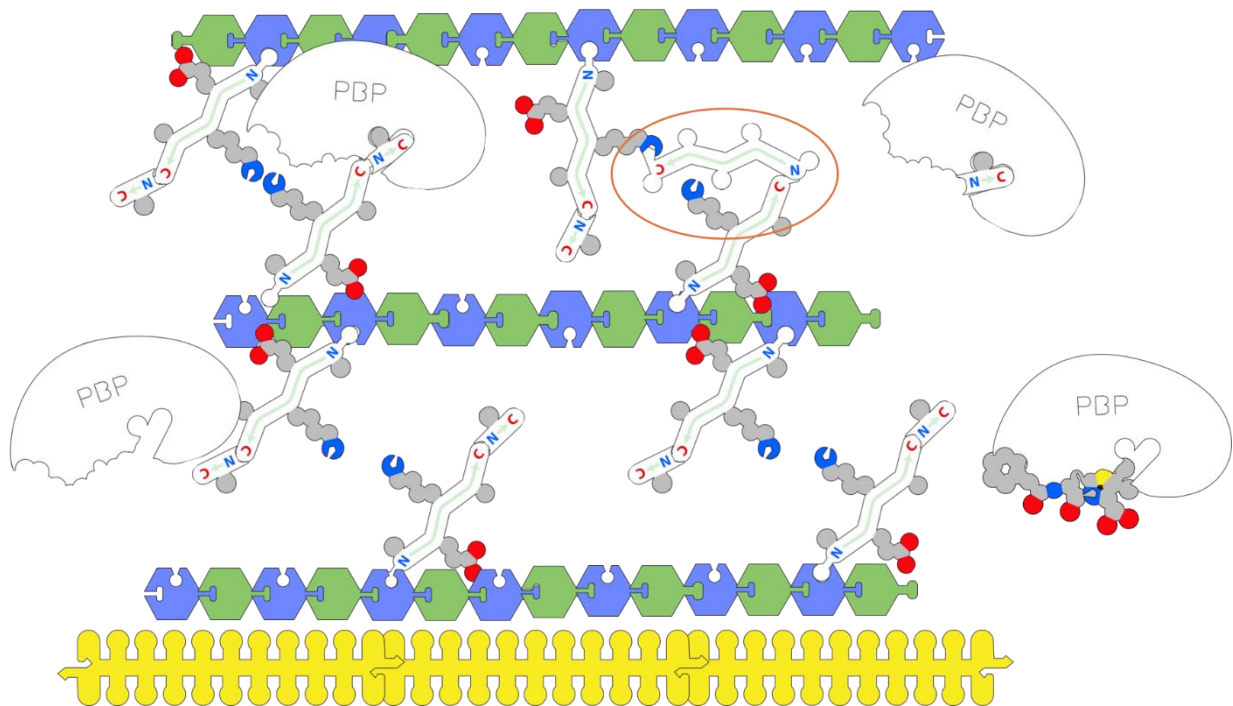
Beta-Lactamase has evolved from a bacterial PBP to intercept penicillin and destroy it before it has a chance to inhibit a PBP.



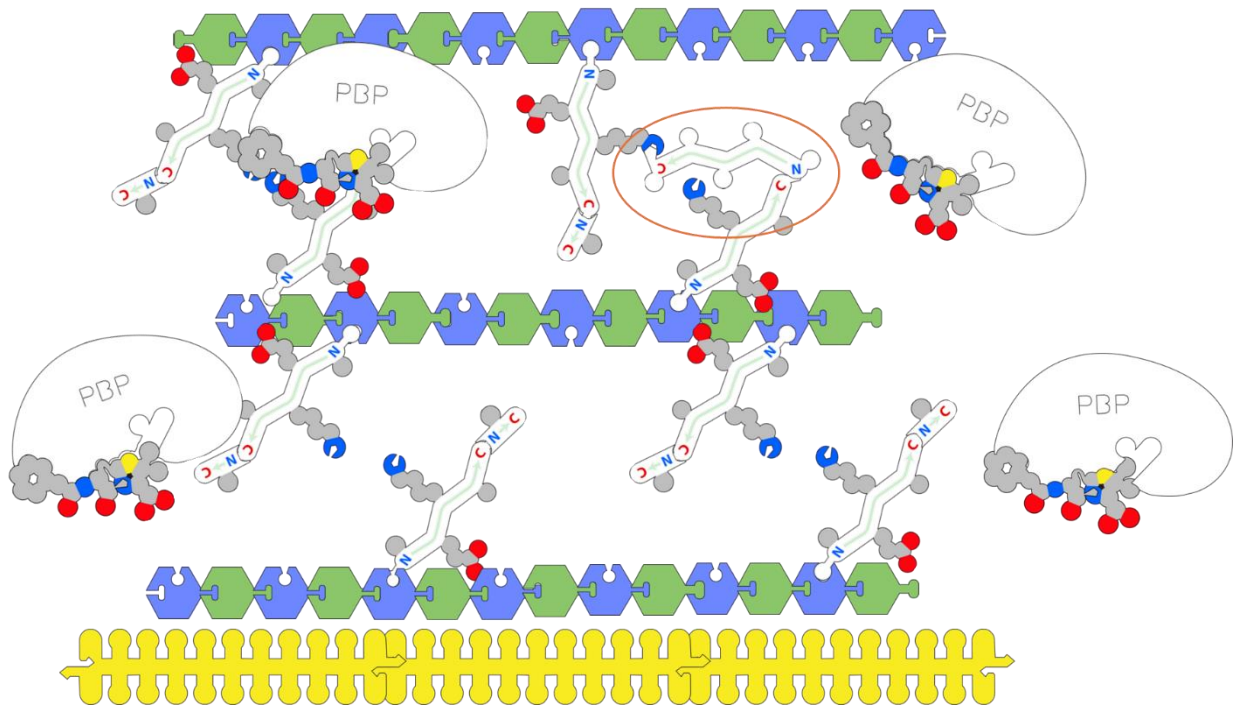
Penicillin binds to the penicillin binding protein (PBP). Penicillin is a D-Ala D-Ala analog that competes for the active site.



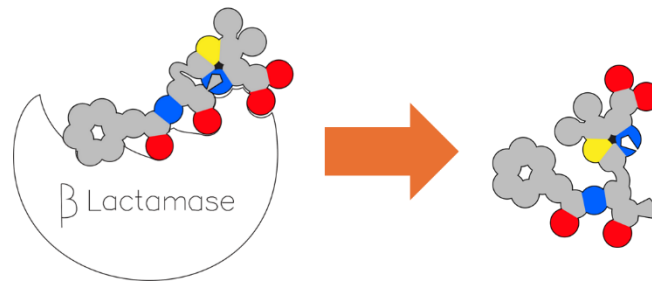
In a Gram-Positive Bacteria, the inactivated PBP will not be able to cleave the terminal D-Ala from the stem peptides, and cross-linkage of the peptidoglycan layer cannot be accomplished. This leads to cell death.



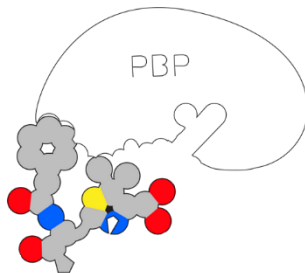
Up regulation of genes allows the bacteria to make more PBP. Even though the Antibiotic is present, there are still many unaffected PBPs that will continue crosslinking the peptidoglycan layer.



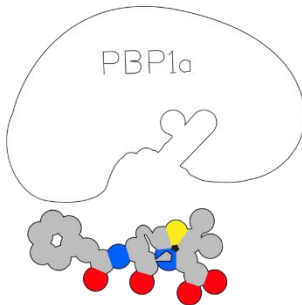
Increase the number of antibiotics, and crosslinking can be prevented again. Use this to model and discuss dose / response relationships.



Some Beta-lactamases evolved from PBP. This allows bacteria to cut the beta-lactam ring found in a number of antibiotics, preventing it from interacting with PBP.

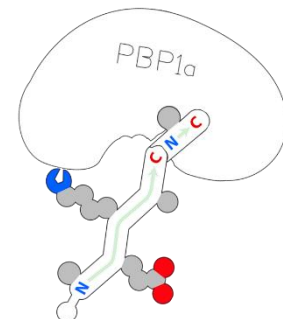


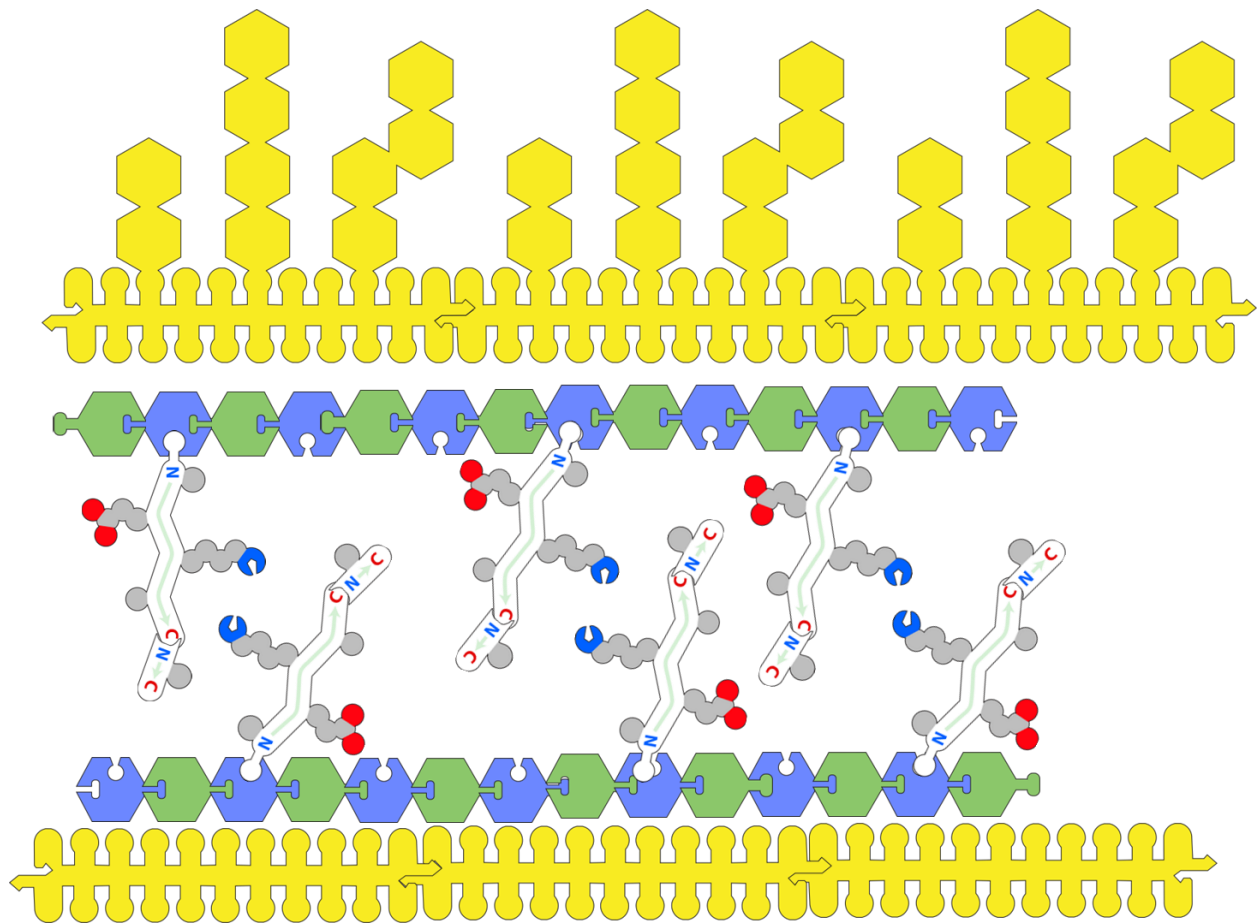
As a result, PBPs are not affected and regular cross linking in the peptidoglycan layer can occur.



Finally, mutations inside the PBP have altered its shape so that it no longer interacts with Penicillin...

But it can still interact with the stem peptides and facilitate cross linking.





Challenge students to model this in a gram-negative bacterium. Identify similarities and differences.