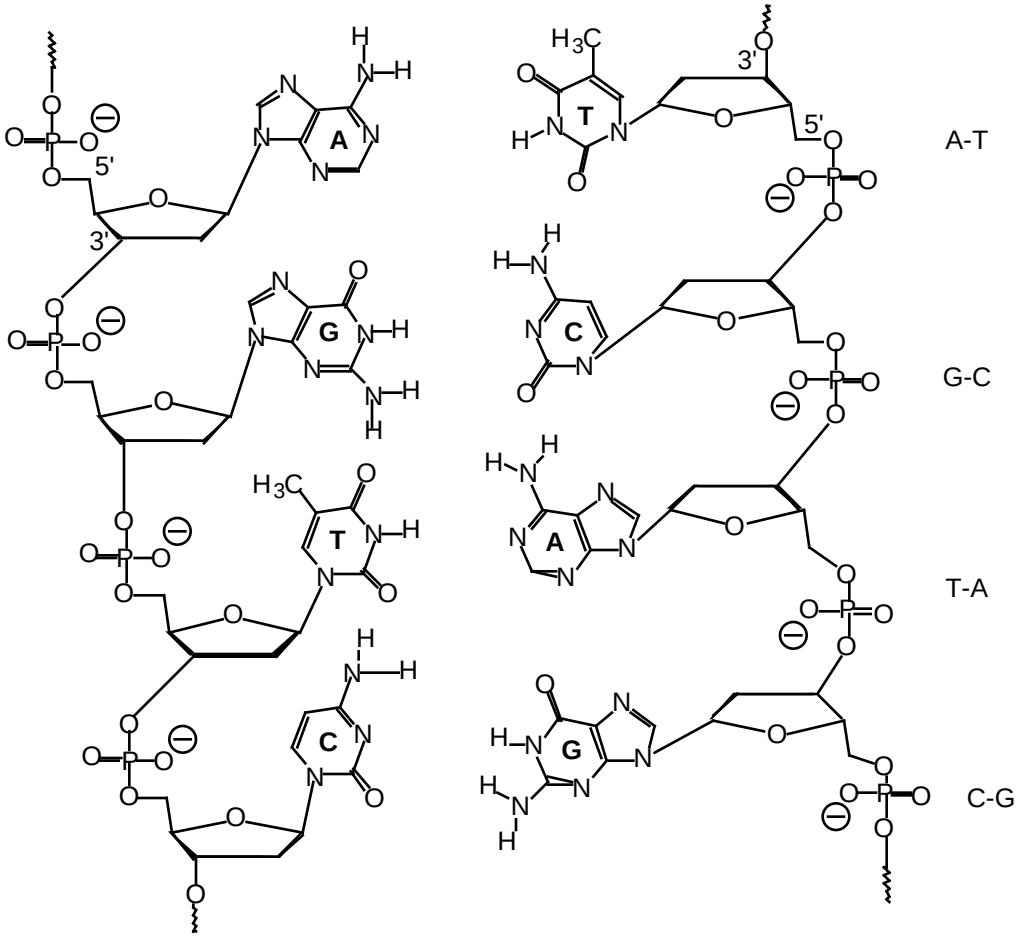
Chemistry 304B, Spring 1999 Lecture 35

Review sessions: Tonight 8 pm Rm 324 FRICK

Exam: Thursday: 7:30 pm McCosh 50

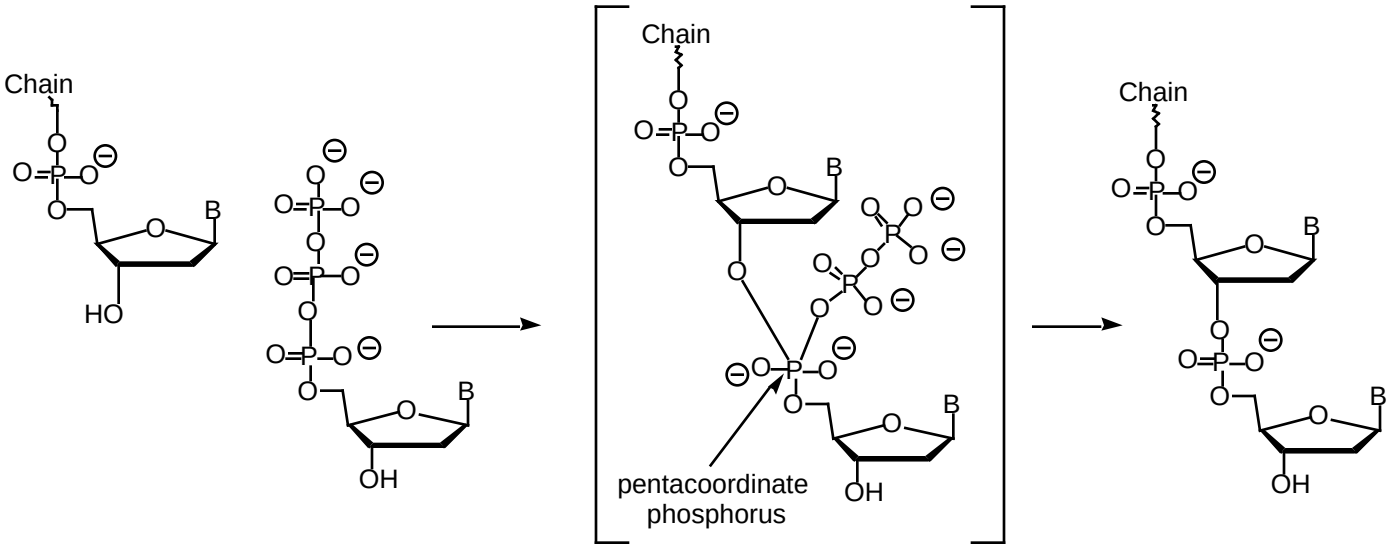
DNA double helix [correction]



Biosynthesis of nucleic acids (replication of DNA)

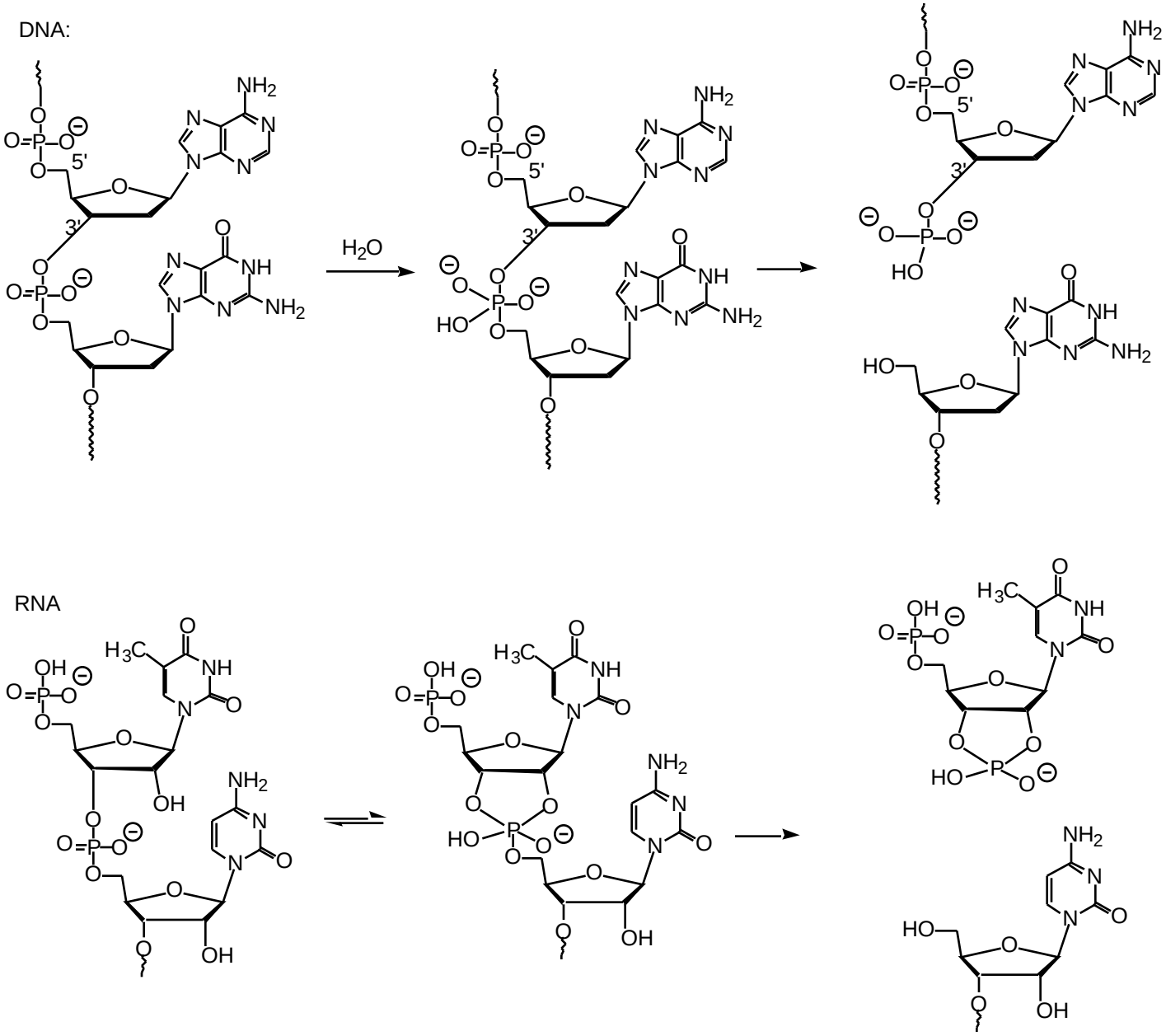
One chain of DNA it turned into the complementary chain by DNA polymerase

[Mechanism: overhead from Handout on Nucleic Acids]



Cleavage of DNA units is the reverse reaction, but with water as the nucleophile.

Instability of RNA:



Protein Synthesis based on the DNA Template:

Two strands of DNA in the double helix: one is "informational" and the other is the "template".
The DNA unwinds and the complementary strand is "transcribed" into RNA (messenger RNA or mRNA).
The mRNA leaves the nucleus of the cell, and is "translated" into protein.
Transcription is like replication: RNA polymerase operating on a DNA strand with RNA nucleotides as the starting materials.

Translation requires the "lining up" of the amino acids corresponding to each unit of the triplet code (codon):
Three nucleic acid bases correspond to one AA.

[With 3 nucleic acids, 64 possibilities.
Therefore redundance: one AA can correspond to more than one set of three nucleic acids.]

Each AA is connected to a transfer RNA [overhead] via the enzymes AMINOACYL-tRNA SYNTHETASE

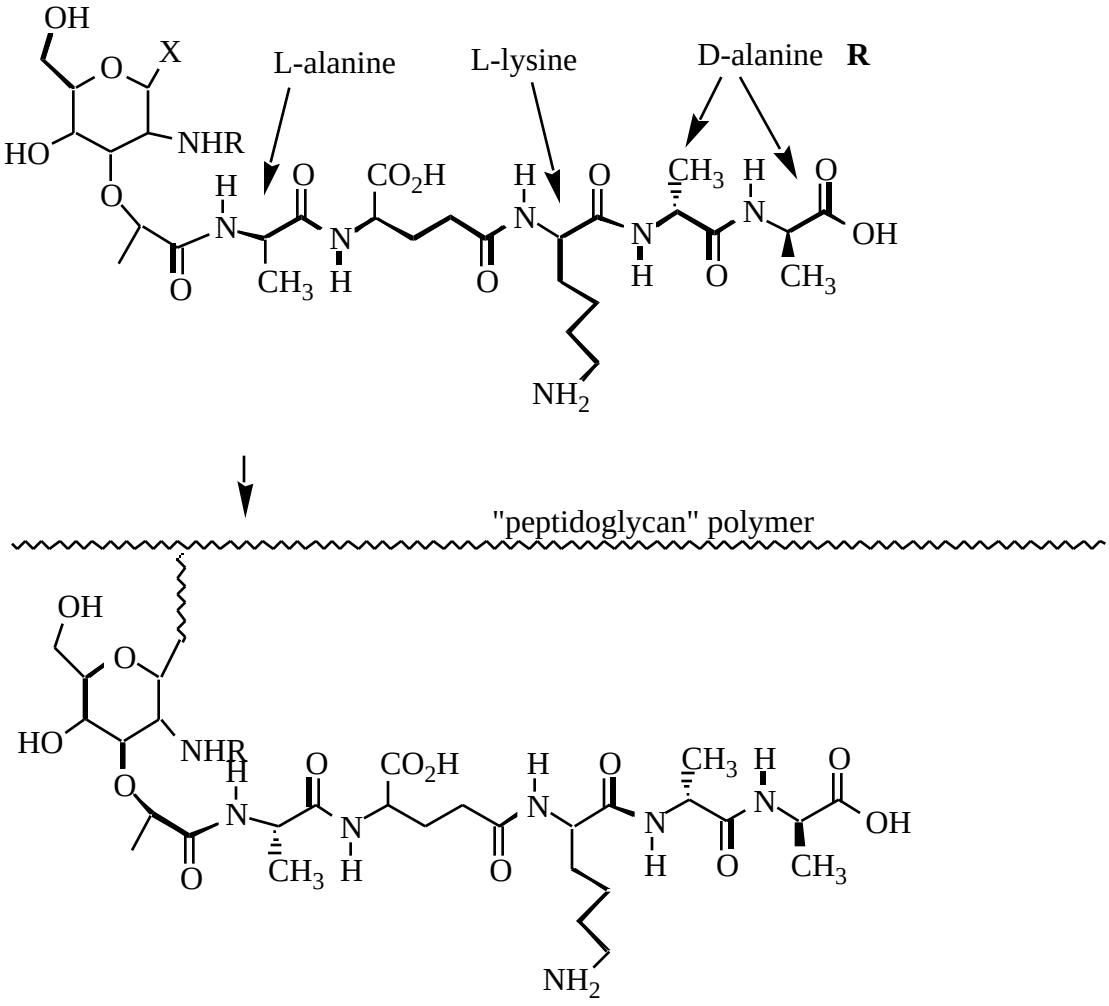
The tRNAs line up along the mRNA chain by the usual H-bonding between bases [overhead]

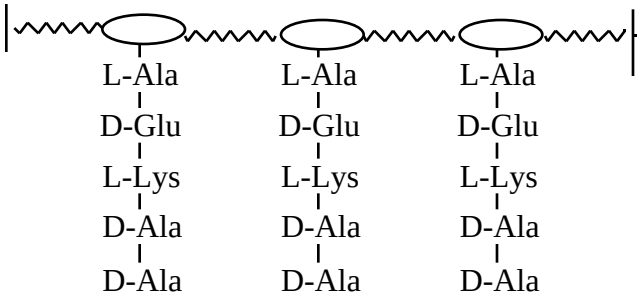
Amide bond formation is induced, and then the next tRNA lines up and the chain is extended.

[Many intricacies not specified here--start and stop signals, exons and introns, etc]
Just focus on the chemistry of H-bonding association to set up covalent bond formation.

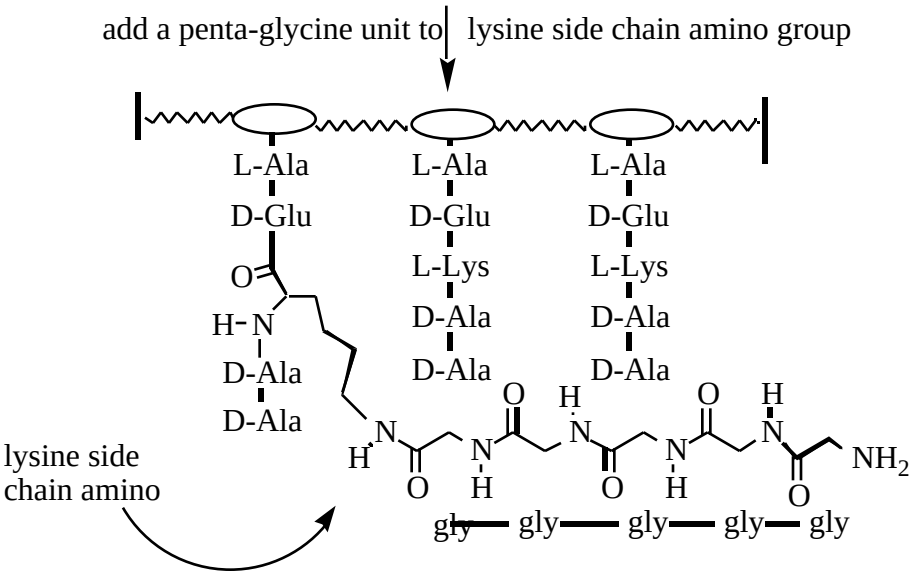
Bacterial Cell Wall Synthesis and Penicillin

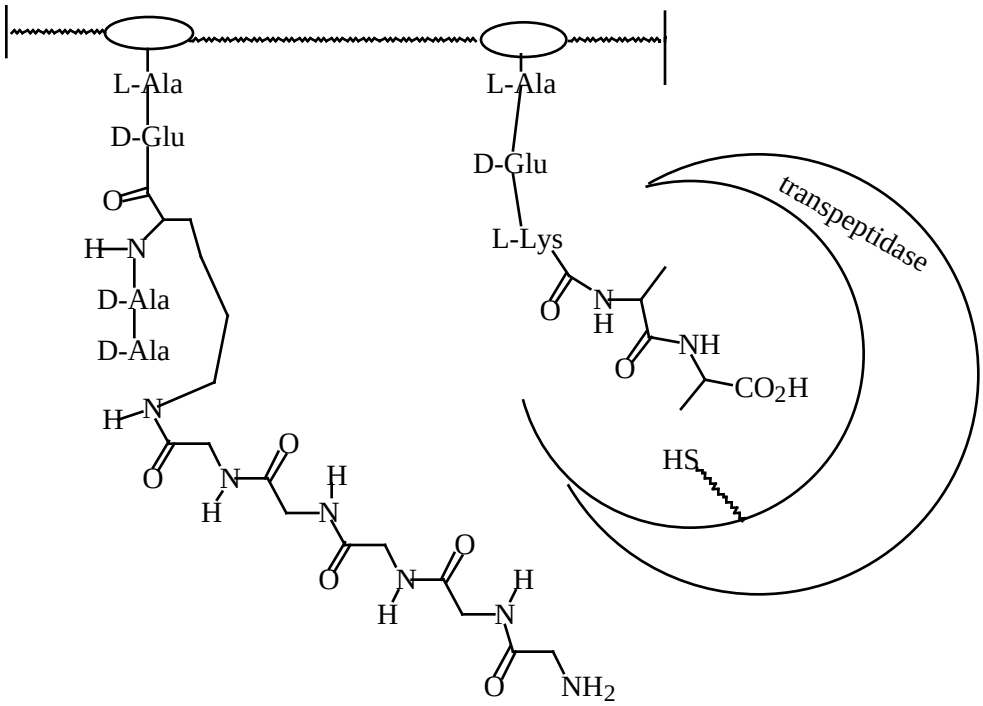
Bacteria have rigid cell walls comprised of sugar units and polypeptide units linked into a long polymer

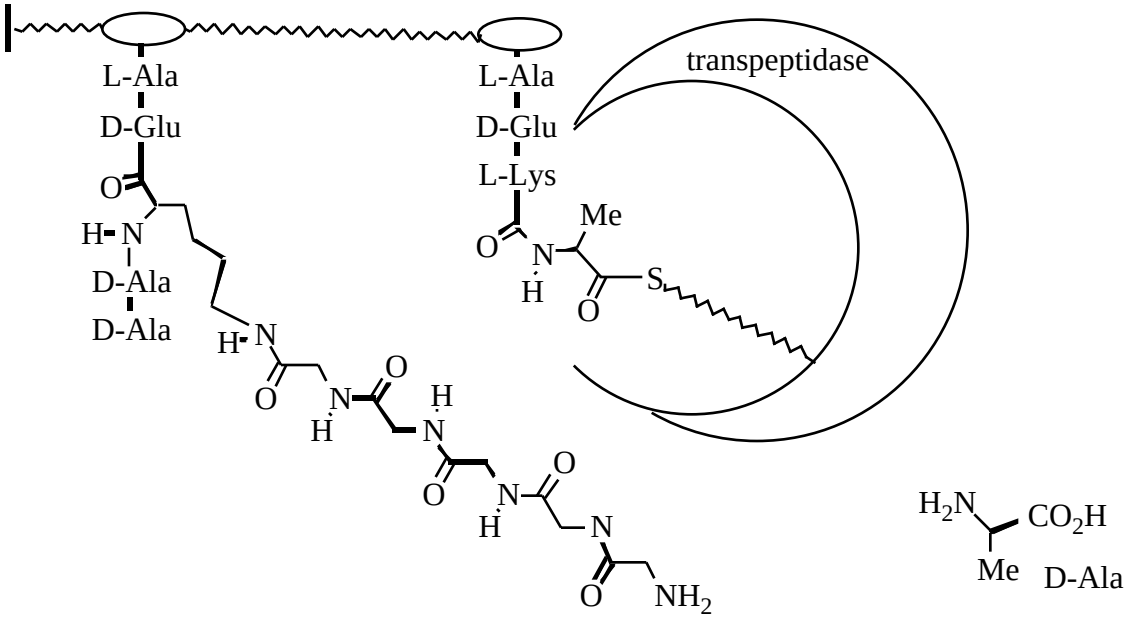


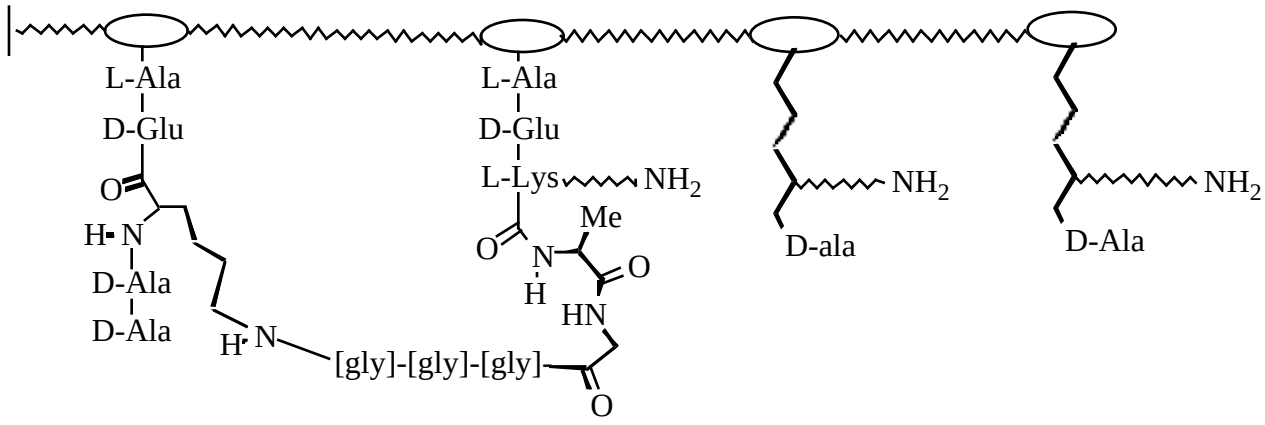


long polymer with pentapeptide side chains in developing bacterial cell wall

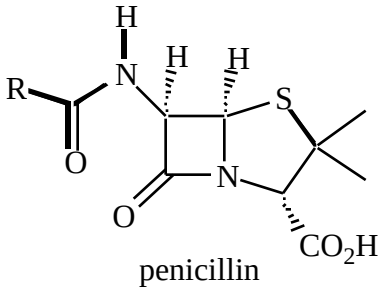





L-Ala
D-Glu
L-Ala
D-Glu
L-Lys
transpeptidase
Me
D-Ala
D-Ala
S
H_2N
CO_2H
Me
D-Ala
NH_2


L-Ala
D-Glu
L-Ala
D-Glu
L-Lys
NH_2
Me
D-Ala
D-Ala
[gly]-[gly]-[gly]
NH_2
D-ala
NH_2
D-Ala

Now: Penicillin



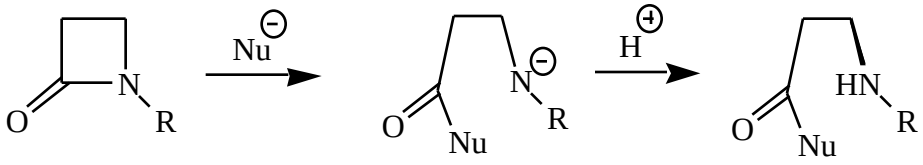
penicillin

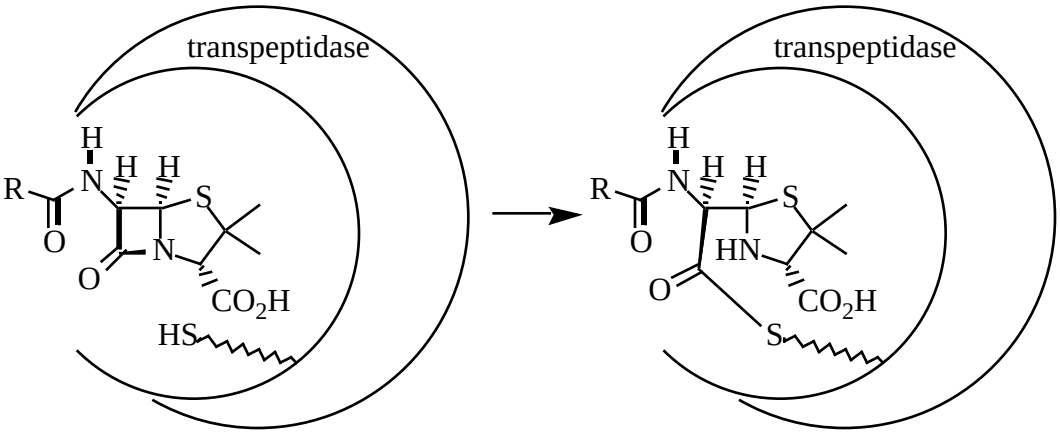
different R groups,
different penicillin analog

Can mimic the D-Ala-D-Ala end of the cross-linking peptide chain.

[picture of penicillin and D-ala: On notes handed out]

Transpeptidase gets confused and binds to penicillin--then what?





Irreversible binding of penicillin to active site of transpeptidase takes the enzyme out of action.

Mammalian cells have no D-Ala-D-Ala in proteins; no enzyme to recognize penicillin no effect

Penicillin can be used in large doses with out significant toxic effects

(except for some specific immune responses)