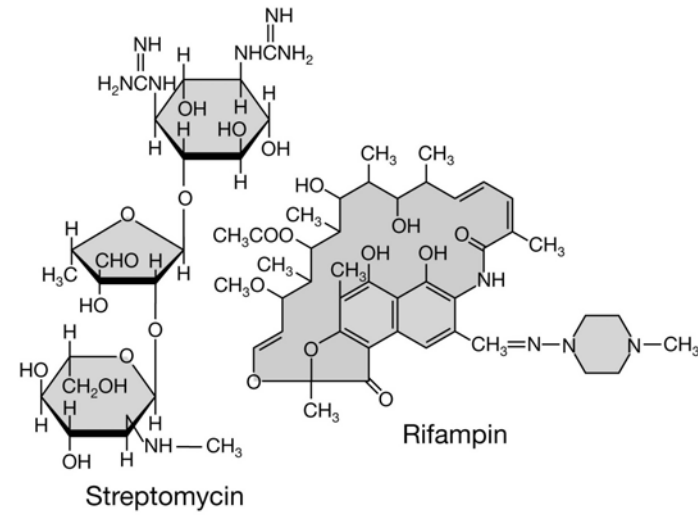


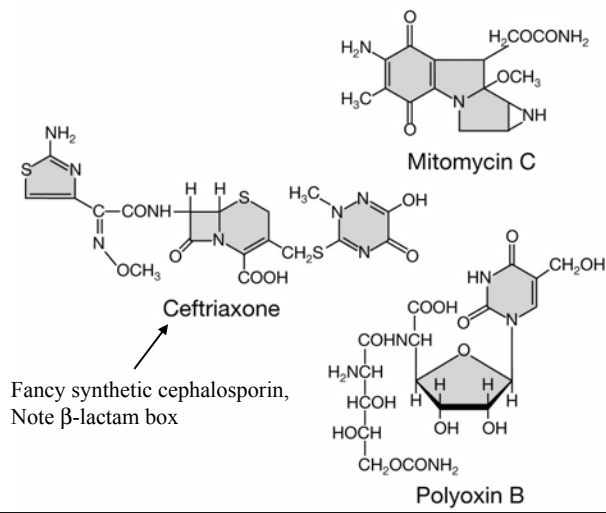
**Classification of Antibiotics:**

1. Inhibit growth – “stat”  
Kill bacterium – “cide”
2. Broad and Narrow spectrum
3. Production Types:  
Natural  
Synthetic  
Semi-synthetic

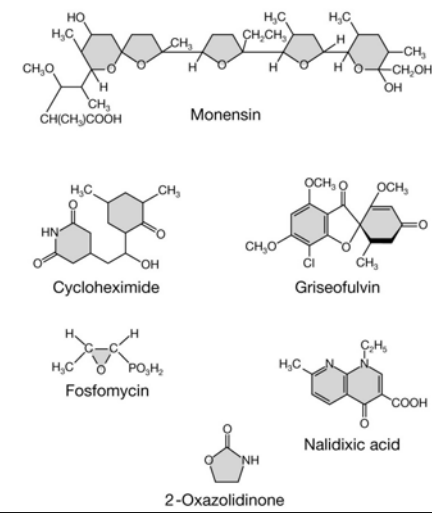
**Representative structure**



**Representative structure**



**Representative structure**







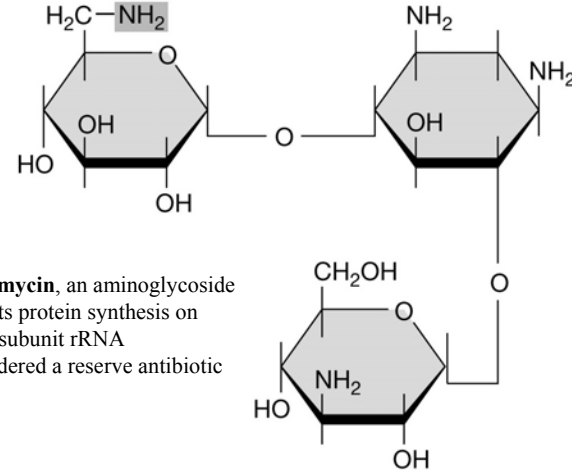
Semi's are made to be acid-stable and more broad spectrum

Difference b/t ampicillin and penicillin is only one amino group.

Designation	N-Acyl group
<b>NATURAL PENICILLIN</b> Benzylpenicillin (penicillin G) Gram-positive activity β-lactamase-sensitive	
<b>SEMISYNTHETIC PENICILLINS</b>	
Methicillin acid-stable, β-lactamase-resistant	
Oxacillin acid-stable, β-lactamase-resistant	
Ampicillin broadened spectrum of activity (especially against gram-negative bacteria), acid-stable, β-lactamase-resistant	
Carbenicillin broadened spectrum of activity (especially against Pseudomonas aeruginosa), acid-stable but ineffective orally, β-lactamase-sensitive	

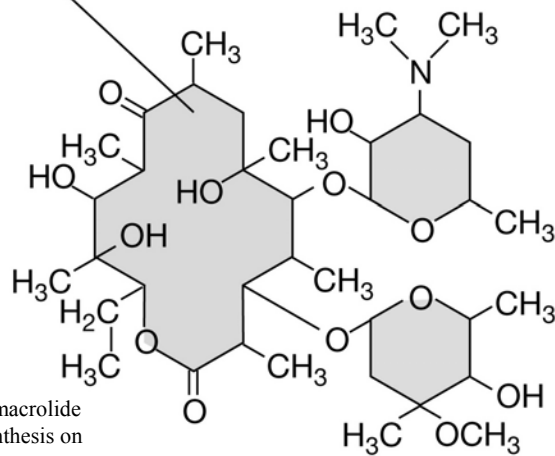
Figure 20.19 The structures of some important penicillins.

N-Acetyltransferase ← R-plasmid born resistance

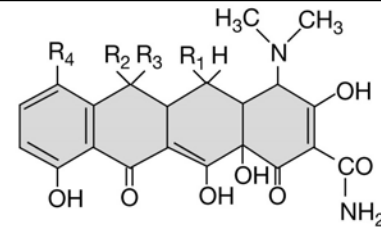


**Kanamycin**, an aminoglycoside  
Inhibits protein synthesis on small subunit rRNA  
Considered a reserve antibiotic

Macrolide ring

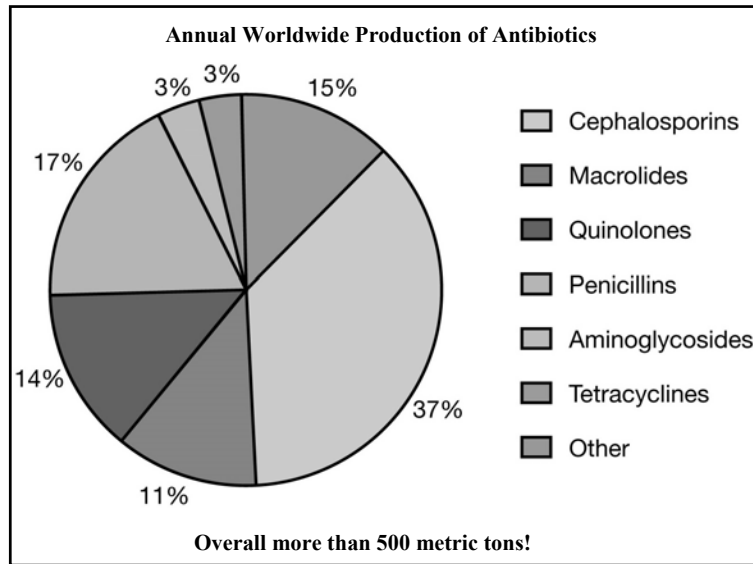


**Erythromycin**, a macrolide  
Inhibits protein synthesis on large subunit rRNA  
Often works when allergic to β-lactams



**Tetracyclines**  
Inhibits protein synthesis on small subunit rRNA  
Along with β-lactams make up the majority used

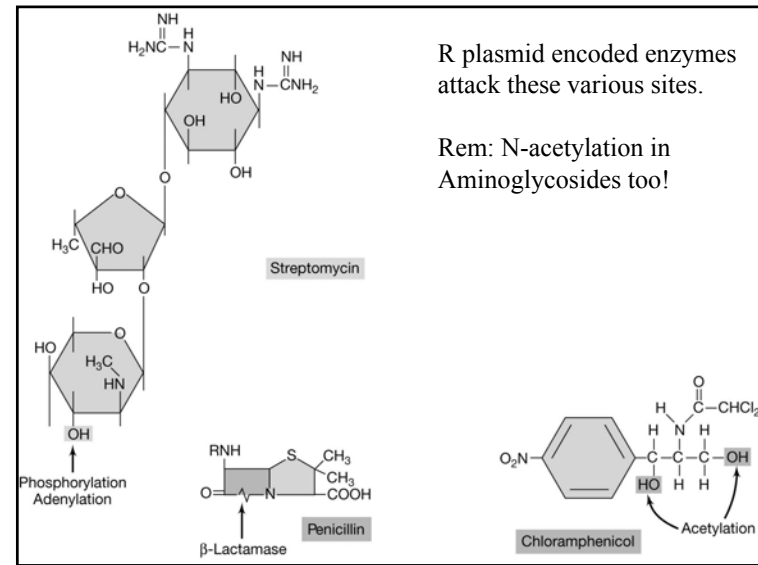
Tetracycline analog	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>
Tetracycline	H	OH	CH <sub>3</sub>	H
7-Chlortetracycline (aureomycin)	H	OH	CH <sub>3</sub>	Cl
5-Oxytetracycline (terramycin)	OH	OH	CH <sub>3</sub>	H

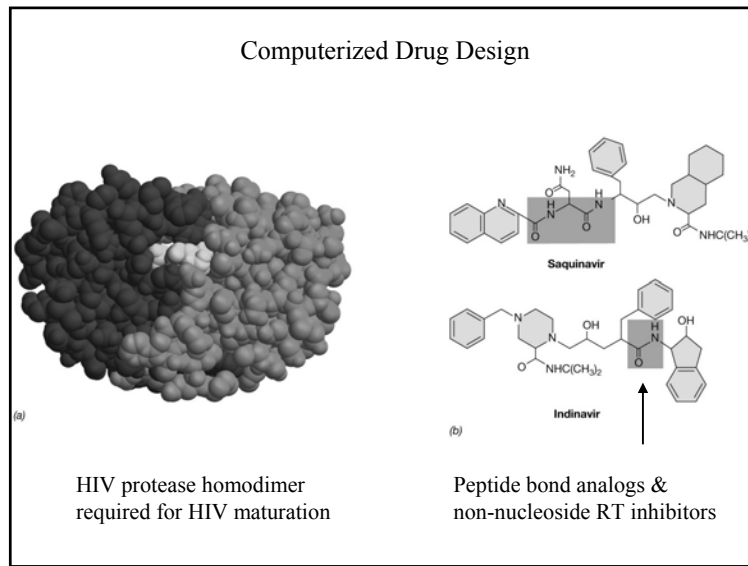
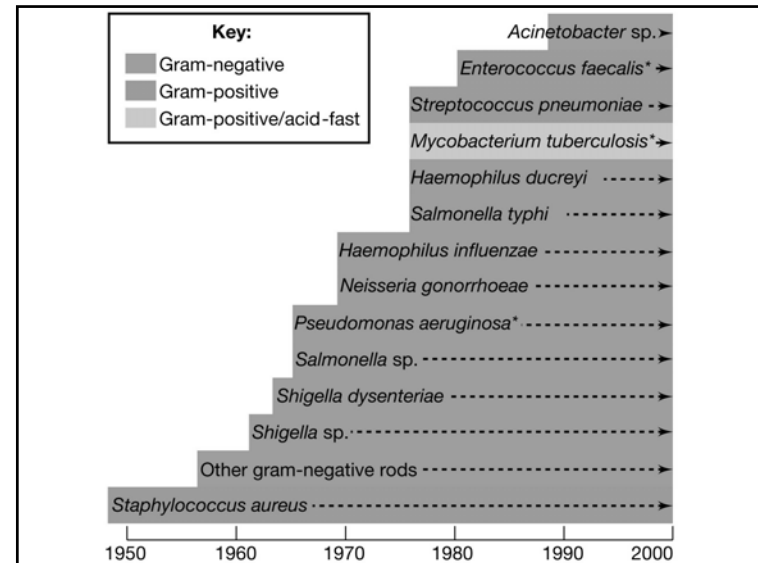
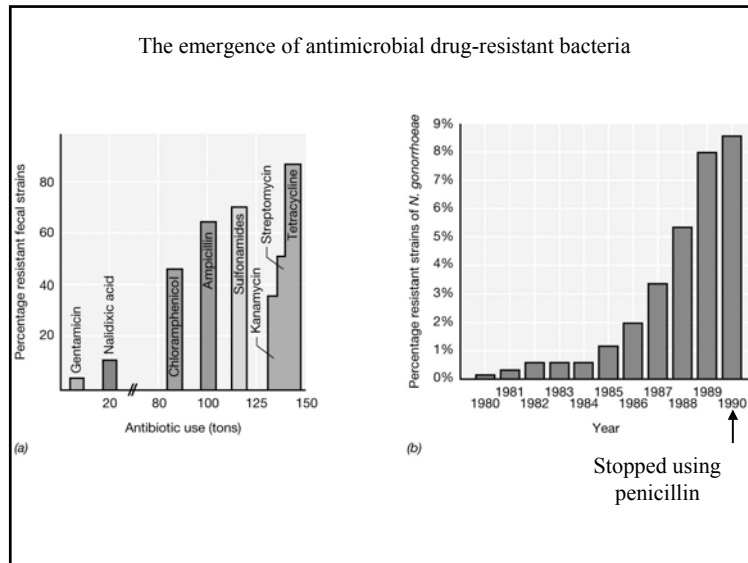


- Mechanisms of Antibiotic Resistance**
1. Lacks structure antibiotic inhibits:  
Mycoplasmas lack a typical cell wall
  2. Impermeable to the antibiotic:  
Gram - bacteria impermeable to penicillin G
  3. Alteration of antibiotic:  
 $\beta$ -lactamase degrades antibiotic e.g., springs open the mouse trap
  4. Modifies the target of the antibiotic
  5. Genetically modifies the pathway that the antibiotic affects
  6. Efflux of the antibiotic:  
Tetracycline gets pumped back out of the cell

**TABLE 20.7** Mechanisms of bacterial resistance to antibiotics

Resistance mechanism	Antibiotic example	Genetic basis of resistance	Mechanism present in:
Reduced permeability	Penicillins	Chromosomal	<i>Pseudomonas aeruginosa</i> Enteric Bacteria
Inactivation of antibiotic (for example, penicillinase; modifying enzymes methylases, acetylases, and phosphorylases; and others)	Penicillins	Plasmid and chromosomal	<i>Staphylococcus aureus</i> Enteric Bacteria <i>Neisseria gonorrhoeae</i>
	Chloramphenicol	Plasmid and chromosomal	<i>Staphylococcus aureus</i> Enteric Bacteria
Alteration of target (for example, RNA polymerase, rifamycin; ribosome, erythromycin, and streptomycin; DNA gyrase, quinolones)	Aminoglycosides	Plasmid	<i>Staphylococcus aureus</i>
	Erythromycin	Chromosomal	<i>Staphylococcus aureus</i>
	Rifamycin	Chromosomal	Enteric Bacteria
	Streptomycin Norfloxacin		Enteric Bacteria
Development of resistant biochemical pathway	Sulfonamides	Chromosomal	Enteric Bacteria <i>Staphylococcus aureus</i>
Efflux (pumping out of cell)	Tetracyclines	Plasmid	Enteric Bacteria
	Chloramphenicol	Chromosomal	<i>Staphylococcus aureus</i> <i>Bacillus subtilis</i>





### Microbial Sources of Antibiotics

<u>Microorganism</u>	<u>Antibiotic</u>
<b>Bacteria:</b>	
<i>Streptomyces</i> spp.	chloramphenicol erythromycin kanamycin rifampin streptomycin tetracyclines
<i>Bacillus</i> spp.	bacitracin polymyxin
<b>Fungi:</b>	
<i>Penicillium</i> spp.	penicillin
<i>Cephalosporium</i> spp.	cephalosporins

### Production of Antibiotics:

Secondary Metabolites produced near the end of a bacterium or fungus life cycle:

1. Formed @ end of stationary phase of growth
2. Not essential for growth or viability
3. Formation depends upon the media, possible over production

