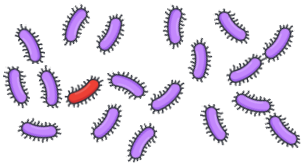
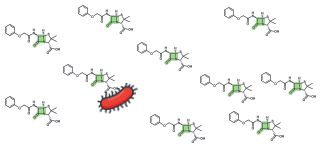
TOPIC: ANTIMICROBIAL RESISTANCE

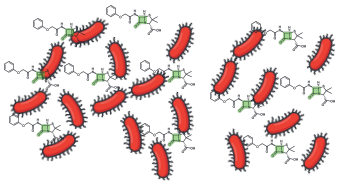
Antibiotic Resistance



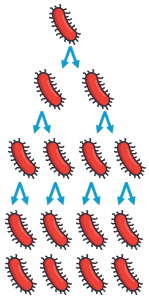
- Antibiotic Resistance: mechanisms that make antibiotics less effective.
  - Resistance is _____ for when antibiotics are used.
  - Antibiotics don't _____ resistance.
  - Resistance is _____ (antibiotic resistance _____).



- Resistance genes (like antibiotics) exist in _____.



Spread of Antibiotic Resistance



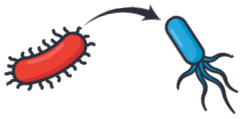
- Resistance can _____ in different ways.

Vertical Transmission: _____.

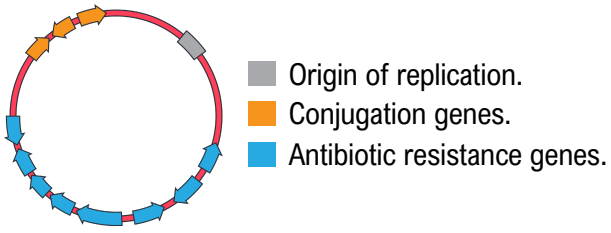
- Reproduction of _____ strains and death of _____-resistant strains = rapid spread.

Horizontal Transmission: transformation, _____.

- Mobile genetic elements (e.g. _____) can spread resistance genes across _____.
- Many plasmids collect _____ resistance genes conferring resistance to _____ drugs.



- More and more pathogens now have _____-drug resistance.



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Which statement about antibiotic resistance is true?

a) Mutations causing antibiotic resistance are more likely to occur when antibiotics are being used.

b) Horizontal transmission of genetic material can lead to previously susceptible bacteria gaining antibiotic resistance.

c) Bacteria regularly exchange pieces of their bacterial chromosome, spreading resistance during the process of transformation.

d) Antibiotic resistance genes largely did not exist until the broad use of antibiotics starting in the 1940s.

PRACTICE

The process of bacteria temporarily fusing to pass plasmids between them is called:

a) Transformation.

b) Replication.

c) Conjugation.

d) Agglutination.

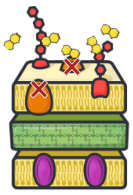
Types of Resistance Mechanisms

◆ There are _____ of antibiotic resistance genes.

- Most code for resistance in one of a few basic ways:

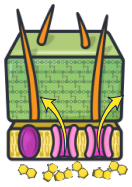
◆ **Decreased Influx**

- E.g., changes to _____ prevent entry of certain antibioti-



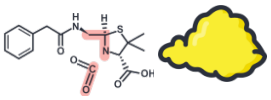
◆ **Rapid Efflux**

- E.g., proteins _____ antibiotics out of the cell



◆ **Enzymatic Inactivation:**

- E.g., beta-lactamase _____ penicillin and related molecules.



◆ **Alteration of Target Site**

- E.g., _____ to ribosomes may inhibit aminoglycoside binding.

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Vancomycin-resistant *Enterococcus* (VRE) can cause dangerous infections and is most often spread in hospital settings. VRE is resistant to vancomycin due to a change in the amino acid sequence in the peptidoglycan precursor molecule, leading to a reduction in the binding efficiency of vancomycin. This mechanism could be described as:

a) Enzymatic inactivation.
b) Rapid efflux.
c) Decreased influx.
d) Alteration of the target site.

PRACTICE

Which of the following resistance mechanisms do you think would be LEAST likely to develop in response to penicillin-type antibiotics in a Gram-positive bacterium?

a) Enzymatic inactivation.
b) Alteration of the target site.
c) Rapid efflux.

PRACTICE

Which of the following resistance mechanisms do you think would NOT result in a lower concentration of the drug inside a cell?

a) Enzymatic inactivation.
b) Alteration of the target site.
c) Decreased influx.
d) Rapid efflux.

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Practices that Lead to the Spread of Resistance

◆ Using antibiotics selects for _____

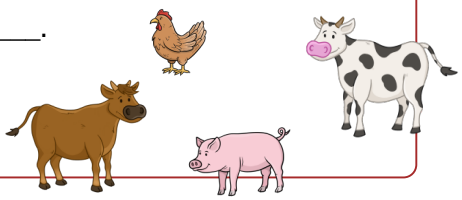
Overuse/ _____ : 256 million antibiotic prescriptions in 2024 (CDC)

- Greater problem in _____ developed healthcare systems.
- Use when unnecessary / against _____ infections.
- Ineffective _____.

Hospitals: hotspots for resistant bacteria and infections

- High concentrations of:
  - Pathogens.
  - _____
  - _____ to select for resistance.
  - Resistance _____.

Agriculture: aids in the health & _____ of animals roughly ___ % of antibiotics use.



- Bacteria transferred through runoff from animal _____.
- Risk for horizontal gene transfer of _____.

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How does the use of an antibiotic against viral infections increase the prevalence of resistance to that antibiotic?

a) It leads to the viruses becoming resistant, as viruses can acquire resistance genes by acquiring plasmids.

b) It selects for resistance genes in non-pathogenic bacterial populations, which can later be passed to pathogenic strains.

c) It causes a higher mutation rate in the virus, potentially leading to greater virulence.

d) By killing bacteria, the body is left open to possible superinfection by other viruses.

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Which answer best describes why the use of antibiotics in agriculture is a significant concern for the spread of antibiotic resistance in human diseases?

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a) Antibiotic resistant bacteria in animals regularly become zoonoses and therefore be very difficult to treat.
b) Antibiotics given to animals will be present in our meat, therefore selecting for antibiotic resistant bacteria in our guts after we consume the animal.
c) Because there are no regulations on antibiotic use in animals, farms regularly use large amounts of the most important last-line-of-defense drugs.
d) Because of horizontal transfer, genes that confer antibiotic resistance mechanisms in animals can be passed to human pathogens.