

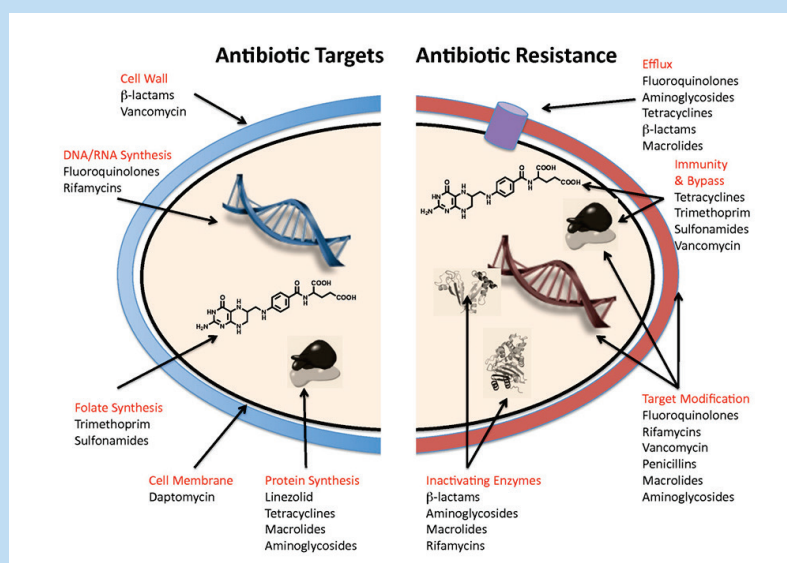
Worksheet 1: Antimicrobial resistance

Microbiology: Discovering antibacterial agents

An antimicrobial is a natural or synthetic substance that kills or inhibits the growth of microorganisms – bacteria (antibacterial), fungi (antifungal), or protozoa (antiprotozoal). Antimicrobials used to destroy or inhibit the growth of microorganisms on living tissue are classified as antiseptics, and antimicrobials used on objects or surfaces are classified as disinfectants.

Antibacterials that can safely be used as medicines to treat bacterial infections are commonly called antibiotics. These work by inhibiting structures or processes that are different in bacteria or are not found in humans, such as cell-wall synthesis, so they selectively kill the infection-causing bacteria and not the patient.

However, since bacteria reproduce so fast, they evolve rapidly in response to environmental pressure, and many have developed resistance to these life-saving medicines. There are several possible mechanisms for antimicrobial resistance, including pumping the antibiotic out of the cells (efflux), modifying the target protein so that the antibiotic no longer binds to it, or breaking down the antibiotic molecule.



Antibiotic targets and mechanisms of resistance

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According to a recent report by the European Medicines Agency (EMA), infections by multidrug-resistant bacteria are estimated to cause 33 000 deaths in the EU every year, with an annual cost due to healthcare expenditures and productivity losses estimated at approximately €1.5 billion.^[4] In fact, the World Health Organization (WHO) has declared that “[Antibiotic resistance is one of the biggest threats to global health, food security, and development today.](#)”

1. Read information provided by your teacher on antibiotic resistance or go to the following webpages:

<https://www.fda.gov/consumers/consumer-updates/combating-antibiotic-resistance>

<https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance>

2. What leads to antibiotic resistance?

3. When should antibiotics be used? Fill out the table provided.

Situation	Antibiotics?	Why?
I don't feel sick, but I'm worried I might get an infection (e.g., a friend of mine is sick).		
I feel sick, but I haven't seen a doctor.		
I have seen a doctor, and I have a viral or fungal infection.		
I have seen a doctor, and I have a bacterial infection, but they don't recommend antibiotics because the infection is mild.		
My doctor recommends that I take antibiotics.		



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4. Aside from resistance, what other consequences are there of taking antibiotics when not necessary (e.g. for a viral infection or mild bacterial infection)?

5. In many countries, it is illegal for pharmacies to sell antibiotics without a prescription from a doctor for these reasons. Is this allowed in your country? Do you agree?

6. Do you know of any other unnecessary uses of antibiotics that could contribute to resistance? (Hint: consider food production.)

7. What about using antibiotics in science experiments: could that lead to antibiotic resistance? If so, what can we do to prevent this?

8. What medical conditions or procedures could become dangerous if we run out of effective antibiotics?
