How does bacteria become resistant to antibiotic? What is the evolutionary reasons behind it. Explain with atleast 2 examples.

**Antibiotic resistance**

**Mutation**: When microbes reproduce, genetic mutations can occur. Sometimes, this will create a microbe with genes that help it survive in the face of antimicrobial agents.

**Selective pressure**: Microbes that carry these resistance genes survive and replicate. The newly generated resistant microbes eventually become the dominant type.

**Gene transfer**: Microbes can pick up genes from other microbes. Genes conferring drug resistance can easily transfer between microbes.

**Phenotypic change**: Microbes can change some of their characteristics to become resistant to common antimicrobial agents.

* There are bacterial enzymes that can inactivate antibiotics. One example is β-lactamase that destroys the active component (the β-lactam ring) of penicillin, extremely important antibiotics for treating human infections. In later years, bacteria that produce extended-spectrum β-lactamases, so called ESBL-producing bacteria, have become a major problem. They can degrade a wide spectrum of β-lactam antibiotics, sometimes also the last resort drugs available for infections with these bacteria.
* For example, the bacterium Staphylococcus aureus can acquire the resistance gene mecA(The mecA gene is a gene found in bacterial cells which allows a bacterium to be resistant to antibiotics such as methicillin, penicillin and other penicillin-like antibiotics.) and produce a new penicillin-binding protein. These proteins are needed for bacterial cell wall synthesis and are the targets of β-lactam antibiotics. The new penicillin-binding protein has low affinity to β-lactam antibiotics and is thus resistant to the drugs, and the bacteria survive treatment. This type of resistance is the basis in MRSA (methicillin-resistant Staphylococcus aureus).

In initial stage, lets consider there exists millions of bacteria. When they are exposed to antibiotics, where most of them may perish except some particular genetic mutations. Those mutations carry their fault in DNA for their survival and multiply. Just like Darwin’s theory, all species of organisms arise and develop through the natural selection of small, inherited variations that increase the individual's ability to compete, survive and reproduce.

Acknowledgement

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<https://www.britannica.com/science/antibiotic-resistance>

<https://www.reactgroup.org/toolbox/understand/antibiotic-resistance/resistance-mechanisms-in-bacteria/>