Explore an Issue: Antibiotic-Resistant Bacteria

Teacher Resource

Curricular Links: SBI3U
Ontario
Time: 60 minutes

Suggested Answers

1. What is an antibiotic? Define this term and list three examples.

   A chemical substance, either natural sources or synthetic, that treats infections by destroying or inhibiting the bacteria that cause them. Examples include: Penicillin, Erythromycin, and Streptomycin (Answers will vary).

2. How does penicillin work? Is this the only method for eliminating bacteria?

   Penicillin works by inhibiting the enzyme that catalyzes the formation of cross-links between cell wall strands. As a result, bacteria cell walls become weak and vulnerable thus killing the bacteria. Other antibiotics, like erythromycin, block the bacteria's growth or reproduction.

3. The figure on page 2 points to an apparent void in antibiotic development. Why do you think this is?

   Students should come to the conclusion that today's economic and prescribing climate has led many pharmaceutical companies to sidestep the antibiotics market in favour of drugs that target chronic conditions and lifestyle concerns.

4. How does antibiotic resistance appear to develop within a bacterial population?

   Some bacteria develop mutations that may offer resistance to antibiotics. Bacteria may acquire resistance from other bacteria by transferring small pieces of DNA called plasmids. Certain bacteria develop the ability to neutralize the antibiotic before it can harm them, others can change the antibiotic attack site so it cannot affect the function of the bacteria, and still others can pump the antibiotic out of the cell or prevent the antibiotic from getting into it.

5. Why should I be worried about antibiotic resistance?

   Antibiotic resistance is now a worldwide public health problem. Antibiotics are less effective at treating serious infections. Someone with an infection that is

resistant to a certain medicine can pass that resistant infection to other people, including family members, and coworkers. In this way, a hard-to-treat infectious disease can threaten whole communities. This can be especially dangerous for young children, the elderly, and people with weakened immune systems (e.g. individuals already in the hospital or chronically ill) who are more vulnerable.

6. Use the Internet, your textbook, this article or other sources of information to divide the following list of diseases into two columns under the appropriate headings below: strep throat, common colds, urinary tract infections, chickenpox, anthrax, mumps, tuberculosis, AIDS, syphilis, botulism, whooping cough, measles, foot and mouth disease, influenza.

Effectively treated with antibiotics	Unaffected by antibiotic treatment
strep throat	*common colds*
urinary tract infections	*chickenpox*
anthrax	*mumps*
tuberculosis	*AIDS*
syphilis	*whooping cough*
botulism	*measles*
	foot and mouth disease
	influenza

7. From these graphs, do you think antibiotic usage and the percentage of strains resistant to antibiotics are related?

The graphs reveal a correlation between usage of antibiotics and an increase in resistant strains. Use of antibiotics creates selection pressure on the bacterial populations exposed to the antibiotics, thus leading to the evolution of resistance.

Literature cited

- Levin, B.R. & R.M. Anderson. 1999. The population biology of anti-infective chemotherapy and the evolution of drug resistance: more questions than answers, in S.C. Stearns (ed.) Evolution in Health & Disease. Oxford University Press, Oxford.
- Nissinen, A., P. Grönroos, P. Huovinen, E. Herva, M. Katila, T. Klaukka, S. Kontiainen, O. Liimatainen, S. Oinonen, & P.H. Mäkelä. 1995. Development of ?-lactamase-mediated resistance to penicillin in middle-ear isolates of Moraxella catarrhalis in Finnish children, 1978-1993. Clincal Infectious Diseases 21: 1193-6.
- Silver, L. L. (2011). Challenges of Antibacterial Discovery. *Clinical Microbiology Reviews*, *24*(1), 71–109. doi:10.1128/CMR.00030-10
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