

2.12 Explore an Issue Bacterial Resistance to Antibiotics



CAREER CONNECTION

Quality-control technicians monitor the concentrations of antibiotics in both medications (capsules) and consumer products such as cheese. Certification can be obtained through diploma programs in industrial or manufacturing technology.

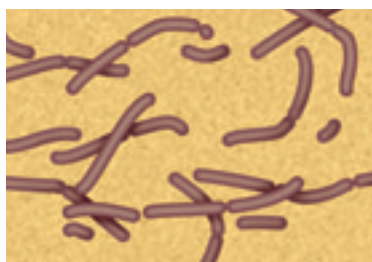


Figure 1
Bacillus cereus, grown with (top) and without (bottom) an antibiotic. Penicillin affects the cross linking within the cell wall, inhibiting growth and division.

Many chemicals, such as cyanide, kill bacteria but also kill human cells. Antibiotics are natural substances that immobilize or destroy microorganisms by attacking metabolic pathways in the bacteria, but not in the host. Fungi or bacteria are used to produce antibiotics. For example, penicillin, an antibiotic derived from the mould *Penicillium notatum*, works by preventing bacteria from constructing a normal cell wall (**Figure 1**). Another antibiotic, streptomycin, works by preventing bacteria from manufacturing proteins, such as the enzymes needed to digest food. Remember that antibiotics are effective only against bacterial infections; they do not destroy viruses.

Antibiotic Resistance

Since the beginning of the “age of antibiotics” in the mid-1940s, researchers have identified more than 2500 naturally occurring antibiotics that can be used to treat infections caused by some of the most dangerous strains of bacteria. However, over the past 50 years, many disease-causing bacteria have slowly developed resistance to antibiotics.

Antibiotic resistance appears to develop from variations within a bacterial population. When the bacteria are first exposed to an antibiotic, the weaker strains of the bacteria are killed. Other members may have slight variations in their genetic material that allow them to survive the antibiotic. These individuals then reproduce and pass on their resistance.

The number of human pathogens now resistant to antibiotics—even the super-antibiotic called vancomycin—is alarming. Drug-resistant strains are claiming lives in hospitals where antibiotic use is high and immune systems are weakened. Some strains of the agent that causes tuberculosis now resist up to seven separate antibiotics.

Viral infections should be treated with fluids and bed rest instead of antibiotics. With bacterial diseases, follow the directions of treatment: use all doses prescribed, and don’t save unused antibiotics for later infections. Keep in mind that antibiotics destroy beneficial bacteria, such as those needed for digestion in the small intestine, as well as harmful bacteria, and that long-term use can suppress the body’s natural defence mechanism against infection.

A recent report estimates that more than 70% of all antibiotics manufactured are used in livestock production in one of three ways: therapeutic doses treat specific diseases; prophylactic or preventive doses reduce the risk of disease or death during production; low doses added to feed rations promote growth. Animals receiving daily low doses of antibiotics such as tetracycline, penicillin, and ciprofloxacin gain as much as 3% more weight than they otherwise would. The reason is unclear, but there is evidence that the antibiotics kill the bacteria that normally thrive in the animals’ intestines, thereby allowing the animals to use their food more effectively. Poultry growers routinely add the antibiotic fluoroquinolone to drinking water to prevent chickens and turkeys from dying from *E. coli* infection, a disease that is picked up from their own droppings.

► Understanding the Issue

1. What is an antibiotic? Define this term and list three examples.
 2. How does antibiotic resistance appear to develop within a bacterial population?
 3. Divide the following list of diseases into two columns under the appropriate headings below: strep throat, common cold, rabies, smallpox, anthrax, mumps, tuberculosis, AIDS, syphilis, botulism, measles, and influenza.
- | Effectively treated with antibiotics | Unaffected by antibiotic treatment |
|--------------------------------------|------------------------------------|
|--------------------------------------|------------------------------------|
4. How could you explain the increase of infections in hospitals by antibiotic-resistant bacteria?
 5. What role do agricultural practices play in the development of antibiotic resistance?
 6. On a blank sheet of paper, design a poster that could be displayed in a doctor's waiting room to warn of the dangers of antibiotic resistance and to advise on the correct use of antibiotics, based on the information in this section.
 7. A mother had some antibiotics left over from fighting a throat infection. She administered them to her young son when he developed a cold. Explain what was wrong with this practice.

► Take a Stand

Should non-therapeutic use of antibiotics in farm animals be banned?

Antibiotic digestive enhancers or growth promoters have been approved and used in agriculture for over 30 years. These products increase productivity by controlling intestinal bacteria. Veterinary drugs are an important part of food animal production and contribute to the high level of health in food animals today. They also provide other benefits related to animal welfare, the economy, environment, and society. Discontinuing the use of antibiotic drugs in hog production (**Figure 2**) would initially decrease feed efficiency, reduce production, and raise consumer prices.

There is increasing evidence that the use of antibiotics in livestock production may contribute to antibiotic resistance. Resistant strains of food-borne bacteria such as *Salmonella*, *E. coli*, and *Campylobacter* can be passed from animals to humans; people infected with these organisms may develop illnesses that do not respond to conventional antibiotic therapy. As well, animal bacteria that do not cause disease in humans can transfer drug resistance to human bacteria. The resulting human illnesses do not respond to conventional antibiotic therapy.

Statement: Non-therapeutic use of antibiotics in farm animals should be banned.

- In your group, research the issue. Learn more about the misuse of antibiotics, new strains of drug-resistant bacteria, and the resurgence of diseases such as cholera and tuberculosis.

Decision-Making Skills

- Define the Issue
- Analyze the Issue
- Research
- Defend a Decision
- Identify Alternatives
- Evaluate

- Search for information in newspapers, periodicals, and CD-ROMs, and on the Internet.



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- Write a list of points and counterpoints that your group considered.
- Decide whether your group agrees or disagrees with the statement.
- Prepare to defend your group's position in a class discussion.
- How did your group reach a decision? What would you do differently a second time?



Figure 2
Antibiotics used in hog food help prevent illness.