

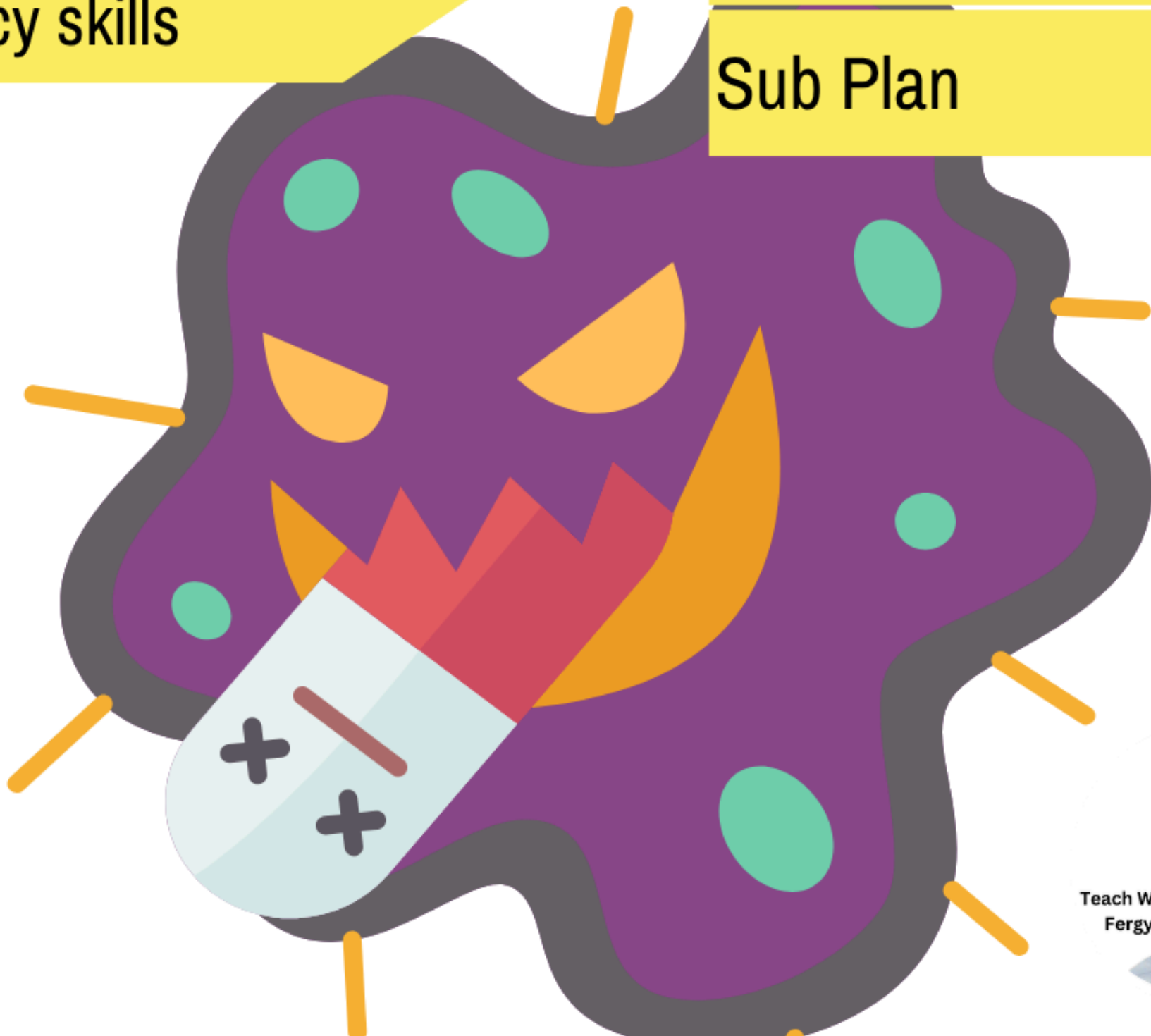
ANTIBIOTIC RESISTANCE

GRADE 8 & UP READING

Improve students' literacy skills

Science Applicability

Sub Plan



Reading Comment

“

Extremely satisfied - Great resource to work on student reading comprehension and it tied into the topic I was teaching. My students have been struggling with reading and I've been incorporating more reading into my lessons. Thank you for the resource.

”

SCROLL
to take a look inside!

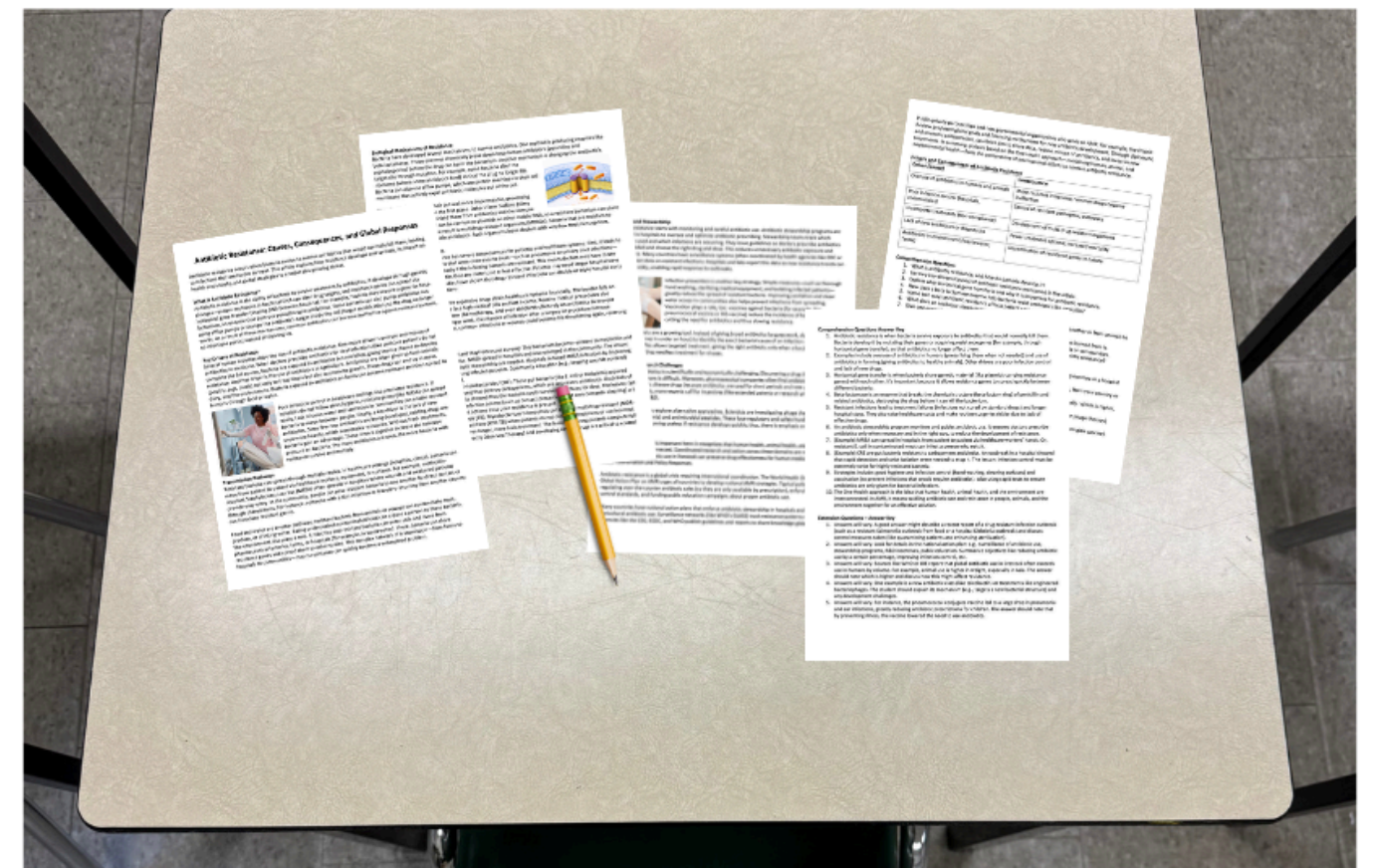


THE PROBLEMS YOU FACE

- Limited time to teach **scientific literacy** and strengthen students' reading and analysis skills.
- Need meaningful **extension activities** to engage fast-moving learners.
- Difficulty creating effective last-minute **sub plans** that still support student learning.

CLASSROOM READY

- Questions and Answer Key
- **No Prep, Ready-to-Use:** Print or assign digitally with Google Docs, Microsoft Word, and PDF formats for flexible classroom use
- **Includes Varied Question Types:** Knowledge, thinking, connecting, application, and open-ended questions.



What Will Your Students Learn?

READING COMPREHENSION ARTICLE & QUESTION BUNDLE

Article with
Comprehension
Questions

Grade 8 and Up

Print & Digital

- What Is Antibiotic Resistance?
- How Bacteria Evolve and Adapt
- Mutation and Natural Selection
- Horizontal Gene Transfer
- Overuse and Misuse of Antibiotics
- Transmission Pathways (Hospitals, Community, Agriculture, etc.)
- Case Studies (MRSA, CRE, Drug-Resistant Tuberculosis)
- Infection Prevention and Control
- Rapid Diagnostic Testing

Comprehension Questions

1. What is antibiotic resistance, and how do bacteria develop it?
2. List two key drivers (causes) of antibiotic resistance mentioned in the article.
3. Explain what horizontal gene transfer is and why it is important for antibiotic resistance.
4. How does a beta-lactamase enzyme help bacteria resist antibiotics like penicillin?
5. Name two ways antibiotic resistance affects patient care or public health.
6. Why is antibiotic stewardship important?
7. Give an example of how antibiotic resistance can spread from one person to another or from an animal to a person.
8. Explain how antibiotic resistance can spread from one country or region to another.
9. List two ways antibiotic resistance can be prevented or controlled.
10. Write a short paragraph about the importance of antibiotic resistance.

Extension Questions

1. What is Antibiotic Resistance?
2. Antibiotic resistance is the ability of bacteria to survive treatment by antibiotics. It develops through genetic changes: random mutations in bacterial DNA can alter drug targets, and resistance genes can spread via horizontal gene transfer (sharing DNA between bacteria). For example, bacteria may acquire a gene for beta-lactamase, an enzyme that destroys penicillin-type antibiotics. Some bacteria can also pump antibiotics out using efflux pumps or change the antibiotic's target inside the cell (target modification) so the drug no longer works. As a result of these mechanisms, common antibiotics can become ineffective against resistant bacteria, so infections persist instead of clearing up.
3. Key Drivers of Resistance
4. Several human activities drive the rise of antibiotic resistance. One major driver is overuse and misuse of antibiotics in medicine. When doctors prescribe antibiotics for viral infections (like colds) or patients do not complete the full course, bacteria are exposed to antibiotics but not killed, giving them a chance to develop resistance. Another driver is the use of antibiotics in agriculture. Antibiotics are often given to farm animals (poultry, pigs, cattle) not only to treat illness but also to promote growth. These drugs can end up in meat, dairy, and the environment. Bacteria exposed to antibiotics on farms can become resistant and then spread to humans through food or water.



Poor infection control in healthcare settings also promotes resistance. If hospitals do not follow strict hygiene, resistant germs (like MRSA) can spread bacteria to move between people. Finally, a key driver is the lack of new used more heavily, which accelerates resistance. Without fresh treatments, bacteria gain an advantage. These drivers together increase the selective resistance survive and multiply.

Transmission Pathways

Resistant bacteria can spread through multiple routes. In healthcare settings (hospitals, nursing homes), bacteria often move from patient to patient via healthcare workers. For example, MRSA often spreads in hospitals. Bacteria can also spread from one person to another through direct contact, such as touching or kissing. Bacteria can also spread through the air, such as when a person coughs or sneezes. Bacteria can also spread through food and water, such as when a person drinks contaminated water or eats food contaminated with bacteria. Bacteria can also spread through the environment, such as when a person touches a contaminated surface and then touches their face.

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Your Reading

Antibiotic Resistance: Causes, Consequences, and Global Responses

Antibiotic resistance occurs when bacteria evolve to survive antibiotics that would normally kill them, leading to infections that are harder to treat. This article explains how resistance develops and spreads, its impact on health and society, and global strategies to combat this growing threat.

What is Antibiotic Resistance?

Antibiotic resistance is the ability of bacteria to survive treatment by changes: random mutations in bacterial DNA can alter drug targets, and horizontal gene transfer (sharing DNA between bacteria). For example, beta-lactamase, an enzyme that destroys penicillin-type antibiotics. Some bacteria use efflux pumps or change the antibiotic's target inside the cell (translating the drug's effect). As a result of these mechanisms, common antibiotics can become ineffective, and infections persist instead of clearing up.

Key Drivers of Resistance

Several human activities drive the rise of antibiotic resistance. One major driver is the overuse of antibiotics in medicine. When doctors prescribe antibiotics for viral infections, bacteria are exposed to antibiotics but not resistance. Another driver is the use of antibiotics in agriculture. Antibiotics are used on livestock (poultry, pigs, cattle) not only to treat illness but also to promote growth and prevent disease. Bacteria exposed to antibiotics on farms can spread to humans through food or contact.



Poor infection control in healthcare settings, such as hospitals, can contribute to the spread of antibiotic resistance. Bacteria can easily move between people, especially in crowded settings. Infection control measures, such as hand hygiene and isolation of infected patients, are crucial to prevent the spread of resistant bacteria.

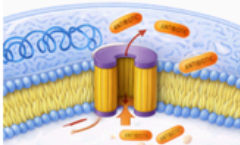
Transmission Pathways

Resistant bacteria can spread through multiple routes. In healthcare settings, bacteria can be transmitted from patient to patient via healthcare workers, equipment, or the environment. In the community, bacteria can spread through contact with infected individuals, animals, or the environment. For example, bacteria can be found in soil, water, and food. Bacteria can also spread through the air, such as in the case of tuberculosis.

Food and water are another pathway: resistant bacteria from animal products, such as meat and dairy, can be consumed. The environment also plays a role. Antibiotics and resistant bacteria can be found in soil, water, and air. Bacteria can also spread through the air, such as in the case of tuberculosis.

Biological Mechanisms of Resistance

Bacteria have developed several mechanisms to survive antibiotics. One method is producing enzymes like beta-lactamases. These enzymes chemically break down beta-lactam antibiotics (penicillins and cephalosporins) before the drug can harm the bacterium. Another mechanism is changing the antibiotic's target site through mutation. For example, some bacteria alter the ribosome (where some antibiotics bind) so that the drug no longer fits. Bacteria can also use efflux pumps, which are protein machines in their cell membrane that actively expel antibiotic molecules out of the cell.



Some bacteria can make their cell wall more impermeable, preventing antibiotics from entering in the first place. Others form biofilms (slimy coatings on surfaces) that shield them from antibiotics and the immune system. These adaptations can be carried on plasmids or other mobile DNA, so a resistant bacterium can share these traits with others. The result is multidrug-resistant organisms (MDROs): bacteria that are resistant to several or even most available antibiotics. Such organisms leave doctors with very few treatment options.

Public Health Consequences

The rise of antibiotic resistance has severe consequences for patients and healthcare systems. First, it leads to treatment failures. Infections that were once easy to treat—such as pneumonia or urinary tract infections—can become persistent or deadly if the infecting bacteria are resistant. This means doctors may have to use second- or third-line antibiotics that are more toxic or less effective. Patients may need longer hospital stays and more intensive care. Studies have shown that drug-resistant infections can double or triple hospital costs compared to treatable infections.

Longer hospital stays and more expensive drugs strain healthcare systems financially. The burden falls on patients as well: families may face high medical bills and lost income. Routine medical procedures also become riskier: surgeries, cancer chemotherapy, and even childbirth often rely on antibiotics to prevent infections. If antibiotics no longer work, the chances of infection after a surgery or procedure increase dramatically. In the worst case, common infections or wounds could become life-threatening again, reversing decades of medical progress.

Case Studies

- MRSA (Methicillin-resistant Staphylococcus aureus):** This bacterium became resistant to methicillin and other common antibiotics. MRSA spread in hospitals and also emerged in the community. The lesson: strict hygiene and antibiotic stewardship are needed. Hospitals reduced MRSA infections by improving hand washing and isolating infected patients. Community education (e.g., keeping wounds covered) also helped limit spread.
- Carbapenem-resistant Enterobacterales (CRE):** These gut bacteria (like E. coli or Klebsiella) acquired enzymes (carbapenemases) that destroy carbapenems, which are last-resort antibiotics. Outbreaks of CRE in intensive care units showed that the bacteria could survive on surfaces for days. The lesson: fast identification and strict infection control (such as contact precautions and environmental cleaning) are vital, since few treatment options exist once resistance is present.
- Drug-resistant Tuberculosis (TB):** Mycobacterium tuberculosis can become multidrug-resistant (MDR-TB) or extensively drug-resistant (XDR-TB) when patients do not complete treatment or use incorrect drugs. Resistant TB requires longer, more toxic treatment. The lesson: ensuring patients complete full courses of antibiotics (Directly Observed Therapy) and developing new TB drugs are critical to control resistance.

Surveillance and Stewardship

Combating resistance starts with monitoring and careful antibiotic use. Antimicrobial stewardship programs are implemented in hospitals to oversee and optimize antibiotic prescribing. Stewardship programs ensure that antibiotics are used only when needed and choose the right drug and dose. This reduces unnecessary antibiotic use and helps slow resistance. Many countries have surveillance systems (often coordinated by the World Health Organization) that collect data on resistant infections. Hospitals and labs report this data to help identify trends and respond quickly to outbreaks.



Infection prevention is another key strategy. Simple measures like hand washing, sterilizing medical equipment, and ensuring access to clean water in communities also help prevent the spread of resistant bacteria. Vaccination plays a role, too: vaccines against bacteria like pneumococcal vaccine or Hib vaccine reduce the need for antibiotics and thus slowing the development of resistance.

Rapid diagnostic tests are a growing tool. Instead of giving broad-spectrum antibiotics, rapid tests (sometimes in under an hour) can identify the exact bacterial cause of an infection. This allows for targeted treatment: giving the right antibiotic to the right patient, confirmed and avoiding needless treatment for viruses.

New Drugs and Research Challenges

Developing new antibiotics is scientifically and economically challenging. Without harming humans is difficult. Moreover, pharmaceutical companies find it less profitable than chronic disease drugs because antibiotics are used for short courses. To address this, many experts call for incentives (like extended patent protection) to encourage antibiotic R&D.

Meanwhile, researchers explore alternative approaches. Scientists are investigating phages (viruses that infect bacteria) and antimicrobial peptides. These face regulatory challenges but also risks becoming useless if resistance develops quickly; thus, the need for careful stewardship.

The One Health concept is important here: it recognizes that human health, animal health, and the environment are interconnected. Coordinated research and action across these sectors, such as reducing antibiotic use in livestock, can preserve drug effectiveness and prevent the spread of resistance.

Antibiotic resistance is a global crisis requiring international coordination. The Global Action Plan on AMR urges all countries to develop national AMR strategies, regulate over-the-counter antibiotic sales (so they are only available by prescription), and fund public education campaigns about proper antibiotic use.

Many countries have national action plans that enforce antibiotic stewardship and surveillance. Surveillance networks (like WHO's GLASS) track resistance trends. Agencies like the CDC, ECDC, and WHO publish guidelines and reports to share best practices and coordinate global responses.

Public-private partnerships and non-governmental organizations also work on AMR. For example, the O'Neill Review proposed global goals and financing mechanisms for new antibiotic development. Through diplomatic and scientific collaboration, countries aim to share data, reduce misuse of antibiotics, and invest in new treatments. In summary, policies based on the One Health approach—combining human, animal, and environmental health—form the cornerstone of international efforts to contain antibiotic resistance.

Drivers and Consequences of Antibiotic Resistance

Driver (Cause)	Consequence
Overuse of antibiotics in humans and animals	More resistant infections; common drugs become ineffective
Poor infection control (hospitals, communities)	Spread of resistant pathogens; outbreaks
Incomplete treatments (non-compliance)	Development of multi-drug-resistant organisms
Lack of new antibiotics or diagnostics	Fewer treatment options; increased mortality
Antibiotics in environment (wastewater, farms)	Dissemination of resistance genes in nature

Comprehension Questions

- What is antibiotic resistance, and how do bacteria develop it?
- List two key drivers (causes) of antibiotic resistance mentioned in the article.
- Explain what horizontal gene transfer is and why it is important for antibiotic resistance.
- How does a beta-lactamase enzyme help bacteria resist antibiotics like penicillin?
- Name two ways antibiotic resistance affects patient care or public health.
- What does an antibiotic stewardship program do?
- Give one example of how resistant bacteria can spread from one person to another or from animals to people.
- Briefly describe one case study (MRSA, CRE, or drug-resistant TB) and a lesson learned from it.
- List two strategies for preventing the spread of resistant infections in hospitals or communities.
- What is the One Health approach, and why is it mentioned in relation to antibiotic resistance?

Extension Research Questions

- Find a recent news report of an outbreak of a “superbug” (e.g., drug-resistant gonorrhea or a hospital outbreak of CRE). Summarize what happened and how it was addressed.
- Research a national strategy or action plan on antibiotic resistance (for example, from your country or WHO). What are its main goals and measures?
- Look up current data on antibiotic use per person in humans versus animals globally. Which is higher, and what are the implications?
- Identify a new antibiotic or alternative treatment (such as a drug in clinical trials or phage therapy) being developed to combat resistance. How does it work?
- Investigate a vaccine that has helped reduce antibiotic use (e.g., pneumonia or meningitis vaccine). How did the vaccine impact antibiotic prescribing or resistance?

Questions Answer Key

Antibiotic resistance is when bacteria survive exposure to antibiotics that would normally kill them. Bacteria develop it by mutating their genes or acquiring resistance genes (for example, through horizontal gene transfer), so that antibiotics no longer affect them. Overuse of antibiotics in humans (prescribing them when not needed) and use of antibiotics in farming (giving antibiotics to healthy animals). Other drivers are poor infection control in healthcare settings and the lack of new drugs. Antibiotic resistance is when bacteria share genetic material (like plasmids carrying resistance genes) with each other. It's important because it allows resistance genes to spread quickly between bacteria. Beta-lactamase is an enzyme that breaks the chemical structure (beta-lactam ring) of penicillin and other antibiotics, destroying the drug before it can kill the bacterium. Antibiotic resistance leads to treatment failures (infections not cured by standard drugs) and longer hospital stays. They also raise healthcare costs and make routine surgeries riskier due to lack of effective drugs. Antibiotic stewardship program monitors and guides antibiotic use. It ensures doctors prescribe antibiotics only when necessary and in the right way, to reduce the development of resistance. MRSA can spread in hospitals from patient to patient via healthcare workers' hands. Or, E. coli in contaminated meat can infect a person who eats it. CRE are gut bacteria resistant to carbapenem antibiotics. An outbreak in a hospital showed that detection and strict isolation were needed to stop it. The lesson: infection control must be strict for highly resistant bacteria. Antibiotic resistance includes: good hygiene and infection control (hand washing, cleaning surfaces) and rapid tests (to prevent infections that would require antibiotics). Also using rapid tests to ensure antibiotics are only given for bacterial infections. The One Health approach is the idea that human health, animal health, and the environment are interconnected. In AMR, it means tackling antibiotic use and resistance in people, animals, and the environment together for an effective solution.

Answers – Answer Key

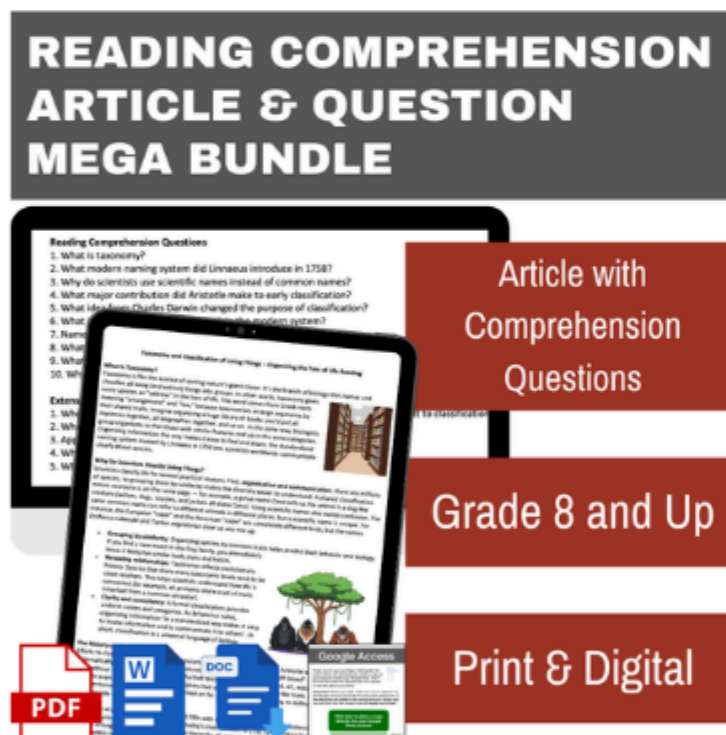
Answers will vary. A good answer might describe a recent report of a drug-resistant infection outbreak (e.g., resistant Salmonella outbreak from food or a hospital Klebsiella outbreak) and discuss measures taken (like quarantining patients and enhancing sterilization). Answers will vary. Look for details in the national action plan: e.g., surveillance of antibiotic use, antibiotic stewardship programs, R&D incentives, public education. Summarize objectives like reducing antibiotic resistance, improving infection control, etc. Answers will vary. Sources like WHO or OIE report that global antibiotic use in livestock often exceeds human use by volume. For example, animal use is higher in weight, especially in Asia. The answer should note that resistance is higher and discuss how this might affect resistance. Answers will vary. One example is a new antibiotic class (like teixobactin) or treatments like engineered phages. The student should explain its mechanism (e.g., targets a new bacterial structure) and potential challenges. Answers will vary. For instance, the pneumococcal conjugate vaccine led to a large drop in pneumonia cases, greatly reducing antibiotic prescriptions for children. The answer should note that, during illness, the vaccine lowered the need to use antibiotics.

Comprehension and Extension Questions with Answer Key



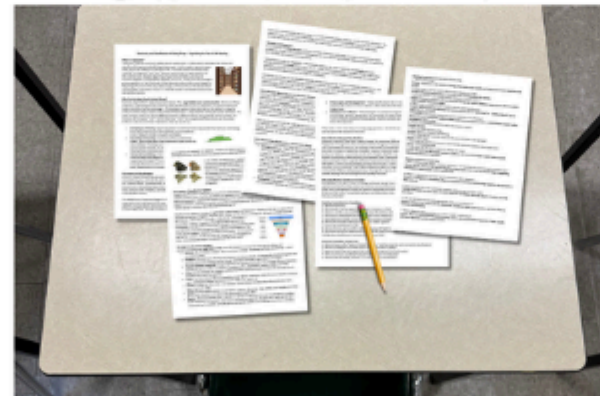
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★★★★★ Extremely satisfied - It is a good supplemental activity either for review and at the same time introducing some concept. I also use this for sub plan. It is well presented, organized and interesting.

★★★★★ Extremely satisfied - This a great resource. I used this for a sub plan. It was fun and engaging for my students.

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