European Commission

LESSON 2

PROTECT AND PREVENT

This second lesson focuses on prevention strategies for tackling antimicrobial resistance (AMR). It builds on the knowledge acquired in Lesson 1 about microbes and how bacteria and viruses work.

LESSON 2

Dives into effective prevention strategies to combat antimicrobial resistance, emphasising the importance of responsible antibiotic use, robust hygiene practices, and vaccinations.

Students will explore how these measures help reduce the spread of resistant bacteria and protect both individual and community health. The lesson expands on the One Health approach, examining practical ways students can contribute by advocating for prevention of antimicrobial resistance.

By the end of the lesson, students will be equipped with practical knowledge and skills to implement effective prevention measures in their daily lives, preparing them for further exploration in Lesson 3, which focuses on the responsible use of antibiotics.

LESSON INTRODUCTION

ANTIMICROBIAL RESISTANCE: SUPERHEROES VS SUPERBUGS

!Ouch! Sounds scary, right? Well, that's exactly what **antimicrobial resistance (AMR)** is all about. Basically, microorganisms (those tiny, sometimes harmful things that make us sick) are developing super-powers that make them resistant to antimicrobials (the medicine that usually zaps them). This means infections become harder to treat, leading to longer illnesses (including higher healthcare costs), and even death (!!!).

Antimicrobial resistance is a BIG problem; It is estimated that more than 35 000 people die each year in the EU/EEA as a direct consequence of an infection due to bacteria resistant to antibiotics. The annual cost of antimicrobial resistance in EU and European Economic Area (EEA) countries is nearly €11.7 billion. More than half of this — €6.6 billion — comes from extra health expenditure from treating resistant infections and their consequences. The remaining €5.1 billion is related to economic losses due to reduced participation in the workforce (e.g. premature loss of life or reduced productivity due to long sick leaves).

At the same time, a rise in drug resistance in animals could lead to painful, untreatable illness and cause an 11% drop in livestock production, jeopardizing livelihoods and food security.

[1] https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6951

[2] Organisation for Economic Co-operation and Development (OECD). Fighting antimicrobial resistance in the EU/EEA. Embracing a One Health approach. Paris: OECD; 2023. Available at: https://www.oecd.org/health/health-systems/antimicrobial-resistance.htm

[3] https://www.weforum.org/agenda/2024/04/why-stemming-the-rise-of-antibiotic-resistance-would-be-the-achievement-of-the-century/

THAT'S LIKE HAVING A GIANT, INVISIBLE MONSTER MUNCHING ON EVERYONE'S HEALTH AND WALLETS!

The good news is that just as superbugs have strength in numbers, so do we! We can Beat the Bug through the One Health Approach — by working together towards a common goal: To ensure effective antibiotics for all those in need... Combating antibiotic resistance would be the global achievement of the century.

Let's join forces as the doctors, veterinarians, farmers, and environmental scientists of today and those of tomorrow. And even if you are not one of those, you can still play a role!

HERE'S WHAT WE CAN DO:

1 LEVEL UP OUR GAME

Discover what makes us sick, know our Bs from our Vs (bacteria from viruses), learn how infections spread, and which medicine works to fight each of them.

2 SPREAD THE WORD

Talk to our friends and family about antimicrobial resistance and what we can do. Knowledge is power!

3 BE SMART ABOUT ANTIBIOTICS

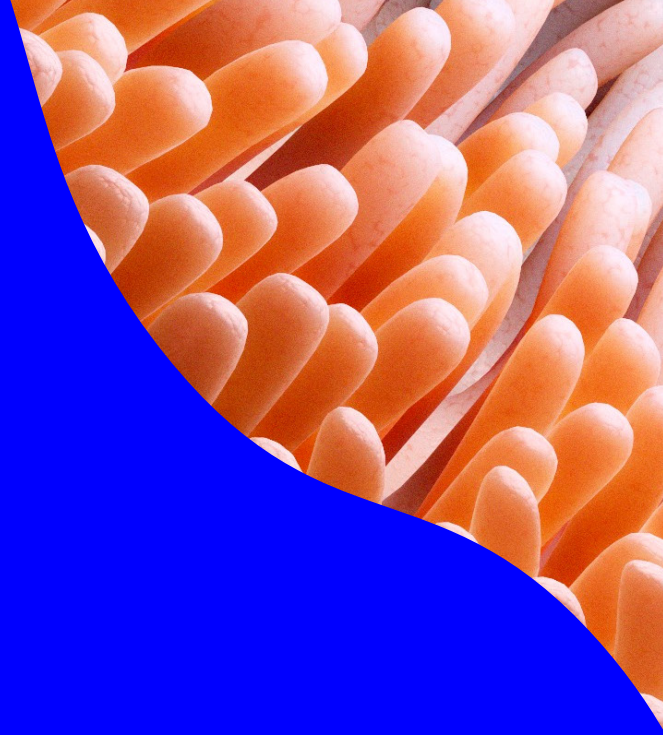
Only take them when prescribed by a doctor, and never share them with others. Let's not give the superbugs

more training!

4 GET DOWN WITH THE ONE HEALTH APPROACH

Understand how everyone needs to get involved in initiatives to combat antimicrobial resistance.

REMEMBER, ANTIMICROBIAL RESISTANCE IS A SERIOUS ISSUE, BUT BY WORKING TOGETHER, WE CAN DEFEAT IT. LET'S WRAP THIS UP...



LESSON 2 OVERVIEW

PROTECT AND PREVENT

Recap and ready for action

In Lesson 1, we dived into the microscopic world to discover the microbiome, the vast, diverse community of microorganisms that live in us and on us. We focused on the two main players: bacteria and viruses, pinpointing their differences and understanding their crucial roles in our lives and health.

In Lesson 2, we'll explore practical ways to prevent antimicrobial resistance and to protect our health, communities and the environment to counter the escalation of antimicrobial resistance and reverse some of its worst impacts caused by overuse and misuse of antibiotics.

This lesson is packed with activities that will help students become health defenders, fighting superbugs and stopping the spread of infections through everyday good practices. Discover the power of teamwork as we explore how working together at home, at school, and on the move can help us spread good practices, not microbes!

IT'S TIME TO TURN OUR KNOWLEDGE INTO ACTION.

LESSON 2 OVERVIEW

Learning Objetives

BY THE END OF THIS LESSON, STUDENTS WILL:

- **Understand the importance of hand hygiene:** Discover that washing our hands with soap and warm water is the most effective way to reduce and prevent infections.
- **Learn how bacteria spread:** Learn how Salmonella and E. coli, bacteria are transmitted and how to prevent them from contaminating food, surfaces, and hands. Understand the importance of proper food handling, cleaning surfaces regularly, and washing hands before eating or after touching raw food and people or animals.
- **Discover the history of handwashing:** Find out how two pioneers — Semmelweis and Nightingale — transformed healthcare almost two centuries ago by driving hand hygiene to stop the spread of harmful bacteria and infections.
- **Identify key handwashing techniques and times:** Get to grips with when and how to wash hands to remove microbes effectively.
- **Learn how to stop the spread of respiratory illnesses:** Explore how good hygiene can defend us against respiratory illnesses like colds, flus, and COVID-19, especially during outbreaks and the winter season.
- **Find out what we can do to fight antimicrobial resistance:** Learn how responsible antibiotic use, proper hygiene, and vaccination can help prevent antimicrobial resistance (AMR) and protect our medicines.
- **Learn about the power of personalised medicine** and why some things aren't made to be shared!
- **Understand the One Health approach:** We all have a role to play in working together to prevent diseases spreading, manage antibiotic use, and protect human, animal, and environmental health.

GET SET TO FIGHT BACK

We'll use engaging activities, informative presentations, and interactive discussions to solidify students' understanding. Participation is crucial. So, get ready to encourage questions and share thoughts.

RESOURCES REQUIRED

- Agar plates
- Plate labels
- Warm water and soap
- Sellotape
- Marker pens
- Paper towels
- Experiment sheets
- Access to a warm, dark place for storage
- Drawing paper and pens and/or tablets
- Access to internet and computers/tablets (optional)
- Examples of One Health campaign materials (posters, flyers, etc.)

SUGGESTED PLAN

1. Start the lesson with a 45-minute presentation on how hand hygiene saves lives, which should cover the following:

a. How microbes live on our bodies and how we pick them up every time we touch something.

b. What happened before we washed our hands regularly.

c. A brief history of hand washing.

d. The science behind how soap works on bacteria and viruses.

e. How to wash hands, the technique, for how long, with what and why it's important to wash them as soon as you come inside from being outside to prevent bringing germs in with you.

2. Shift focus to respiratory hygiene. Explain how respiratory illnesses are spread and how to stop them in their tracks:

a. How respiratory illnesses like colds, flus, and COVID-19 are primarily transmitted through respiratory droplets from coughs and sneezes.

b. The importance of respiratory hygiene in preventing the spread of these diseases, especially in crowded envi ronments like classrooms

c. How to properly cover our mouth and nose when coughing or sneezing, either with a tissue or our elbow. The importance of disposing of used tissues promptly to prevent the spread of germs.

d. Vaccines: How they work and why they're crucial to protect our health and communities.

e. The use of masks and gloves as an extra measure to prevent the spread of respiratory illnesses, particularly during outbreaks, in crowded environments like public transport, or in vulnerable settings like hospitals and nursing homes. Emphasise that neither is a replacement for good hygiene but both work as extra precautions in addition to all of the above.

3. **Activity 1**
4. **Activity 2**
5. **Activity 3**

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ACTIVITIES

Here's a sneak peek at the activities planned:

ACTIVITY 1

HAND HYGIENE CHALLENGE:

Explore how bacteria grow and see how effective hand hygiene can keep them in check.

ACTIVITY 2

SAYONARA SUPERBUGS!

Test your antimicrobial resistance knowledge with a quiz and see if you can outsmart the superbugs!

ACTIVITY 3

DESIGN A ONE HEALTH CAMPAIGN.

Create a campaign to promote responsible antimicrobial resistance practices in your community.

EDUCATIONAL MATERIAL

HAND HYGIENE 101

Remember the microbes we studied in Lesson One? Beneficial bacteria protect us from harmful — or malevolent— bacteria that can cause illness. Some bacteria can lead to infections. For example, Salmonella and Escherichia coli (E. coli — who we said a brief hello to in lesson one) cause food poisoning and spread by touching or eating contaminated food. and water. Both can cause gastrointestinal issues — although they work a bit differently.

Salmonella is a common cause of foodborne illness, leading to symptoms such as diarrhoea, fever, and tummy cramps. It is typically spread through contaminated food products like poultry, eggs, and raw produce. When we eat something that's infected with Salmonella, the bacteria invade the intestinal lining and cause inflammation, leading to the symptoms of infection. Salmonella is becoming increasingly resistant to antibiotics, making infections harder to treat.[4]

E. coli has many strains that are harmless—but not all of them. Certain strains, like Shiga toxin-producing E. coli (STEC), can cause severe foodborne illness. E. coli is naturally found in our intestines and those of animals, but harmful strains can contaminate food and water supplies. Infections can lead to severe stomach cramps, diarrhoea, and vomiting. Monitoring and controlling the spread of resistant E. coli strains is a huge deal for public health.[5]

Both Salmonella and E. coli show us the importance of food safety practices, including appropriate hand hygiene and cooking methods, to prevent infection and control the spread of these bacteria.

[4] https://www.efsa.europa.eu/en
[5] https://www.ecdc.europa.eu/en

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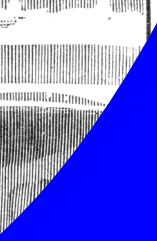
CIRKUS
Vorsichts-
Maß
Thalia
Abgekochtes
Wasser
Sicherheits Comit
Altstadt.

CHOLÈRA



Washing your hands is one of the best ways to protect yourself from malevolent bacteria and prevent their spread to others. Regularly lathering up and scrubbing helps remove bacteria we pick up from our surroundings, such as at home, school, in the garden, playing with animals, or preparing food. Remember: Wash your hands:

- Whenever you go inside from outside, especially when you get home or to school.
- Before, during, and after preparing food.
- After using the lavatory.
- After exposure to animals or animal waste.
- After coughing, sneezing, or blowing your nose.
- If you're ill or have been around ill people,

A BRIEF HISTORY OF HAND HYGIENE (OR LACK OF IT)

Handwashing has been underrated for centuries, despite historical events that should have made it pretty clear.

Trivialisation of handwashing goes back centuries. There are many examples of epidemics caused by poor hand hygiene:

Ancient Athens: Decimated by a plague during the Peloponnesian War in 430 BCE, likely typhoid fever (Salmonella typhi).
Medieval Europe: The Black Death in the 14th century wiped out nearly a third of Europe's population, partly due to poor hygiene practices.
England: In the 19th century, outbreaks of cholera were common due to contaminated water and lack of handwashing.

MEET THE HANDWASHING HEROES

In 1847, a Hungarian doctor named Ignaz Semmelweis showed that if doctors and nurses washed their hands, they could dramatically reduce the number of mothers dying from «childbed fever» in the hospital. By using a special chlorinated lime solution for hand washing, the death rate in the maternity wards dropped from 13% to 2% or less. [6] Even though many doctors didn't believe him at first, Semmelweis' discovery proved how important hand-washing is to stop the spread of infections. His work paved the way for the modern practices that keep hospitals clean and safe.

A few years later, during the Crimean War, an Italian nurse named Florence Nightingale changed healthcare forever. She saw that many soldiers were dying from infections because hospitals were dirty. Nightingale made sure everyone washed their hands and kept the hospitals clean, which saved many lives. Her focus on hygiene and sanitation helped create the vstandards for modern nursing and showed how crucial handwashing is for patient care. [7]

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[6] Raju, T. N. (1999). Ignac Semmelweis and the etiology of fetal and neonatal sepsis. Journal of Perinatology, 19(4), 307-310. Retrieved from PubMed Central.

[7] Gill, G. (2004). Nightingale in Scutari: Her Legacy Reexamined. Journal of the American Medical Association, 291(17), 2137-2138. Retrieved from JAMA Network.

A CLEAN REVOLUTION

Soap has been keeping us clean for thousands of years. It was invented by the ancient Babylonians and Egyptians, who discovered that mixing animal fats with wood ash created a substance that could wash away dirt and grime — even if they didn't fully understand the science behind it.

Fun fact: The ancient Romans used a blend of urine and volcanic ash to clean their clothes before they discovered soap — they surely intimidated their enemies with their smell as well as their strength!

In Europe, soap took off during the Middle Ages, with soap-making centres becoming fashionable across France, Spain and Italy. Cities like Marseille, Venice, and Savona became famous for producing it. By the 19th century, soap had become a game-changer for hygiene and health and a household staple across Europe, as industrial advancements made it more affordable and accessible.

Fun fact: During World War I, soap shortages led to the development of synthetic detergents — the great grandparents to the cleaning products and disinfectants we use today. Made from petrochemicals and designed to mimic the cleaning properties of soap without relying on natural fats and oils — which were in short supply — they were mainly used for washing clothes and cleaning houses.[8]

LATHER UP FOR CLEAN HANDS

Soap and water are our best tools against germs, but they don't kill them — they kick them out! Soap breaks up oils and dirt on our skin. The molecules in it have two ends: one loves water, and the other hates it.[9] The hydrophilic end attaches to water, and the hydrophobic end attaches to oils. They team up to trap germs and grime, then wash them away when we rinse with water. In the most simplistic terms, soap breaks down the cell membrane barrier of bacteria.

[8] https://cahm.eu/blog/category/the-history-of-soap/
[9] Coiffard L, Couteau C. Soap and syndets: differences and analogies, sources of great confusion. Eur Rev Med Pharmacol Sci. 2020 Nov;24(21):11432-11439. doi: 10.26355/eurrev_202011_23637. PMID: 33215466.

LET'S BREAK IT DOWN

How does soap fight bacteria? There are two types of bacteria: those with a lipid membrane (gram-negative) and those without (gram-positive). The good news is that soap is effective against both.

Gram-negative bacteria: Soap breaks down the fatty layer or "lipid envelope" of these bacteria, wiping them out.

Gram-positive bacteria: These bacteria don't have a lipid envelope, but soap still works by breaking down the oils and dirt on our skin where bacteria live, washing them away. [10]

HOW SOAP FIGHTS VIRUSES

Many viruses, like the flu and coronaviruses also have a lipid envelope. The hydrophobic part of the soap molecule (the end that hates water) latches onto it and breaks apart the virus, making it inactive. The broken pieces of the virus get trapped in tiny soap bubbles called micelles, and are easily rinsed away with water, washing the virus off our skin.

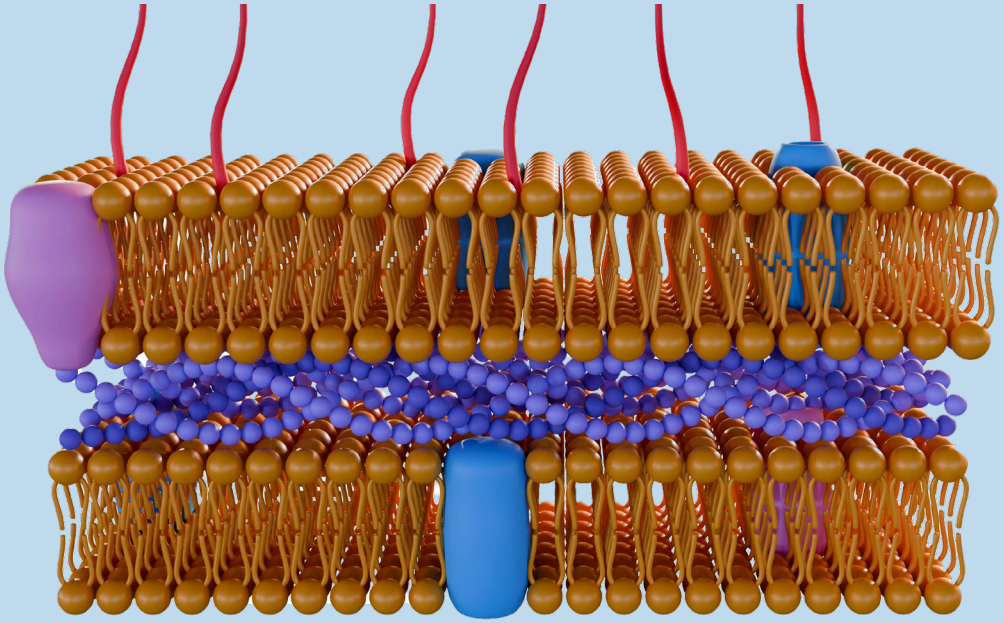
BRING ON THE HEAT

Warm water is the sidekick that makes soap work better. It helps soap lather up and dissolve gunk on our hands. Plus, warm water helps open our pores for a deeper clean and feels nicer, making it more likely you'll scrub for the recommended minimum of 20 seconds!

MASTER THE TECHNIQUE

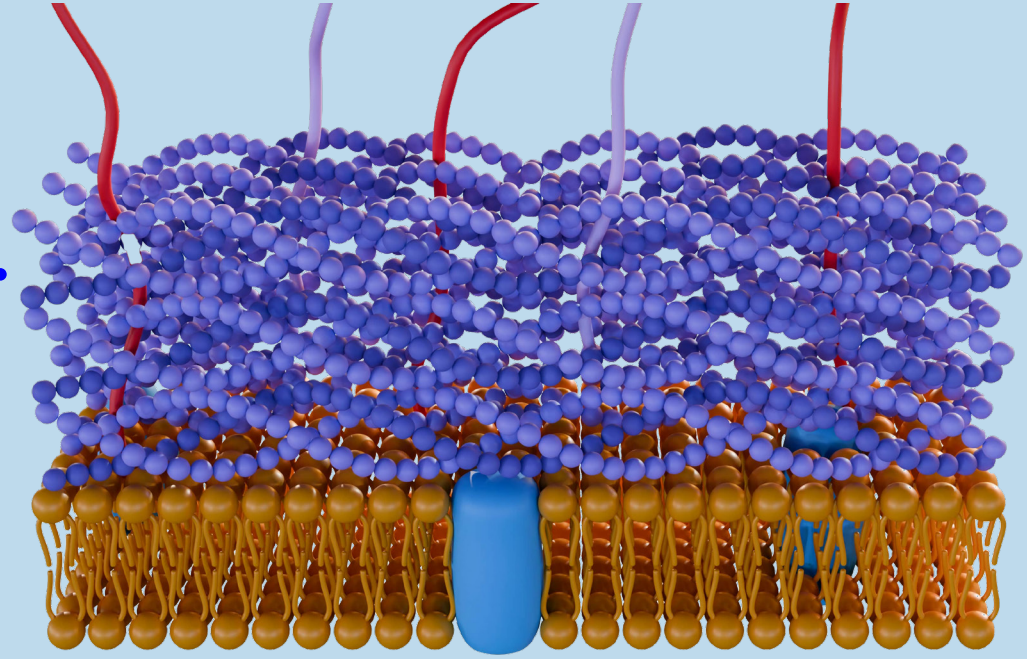
Scrub all parts of your hands with soap and water, and rinse well. We should wash our hands with soap and warm water for at least 20 seconds, which is approximately the time it takes to sing "Happy Birthday" twice. The duration also matters; scrubbing for 15 seconds removes about 90% of microbes, while 30 seconds removes 99.9%, ensuring thorough cleaning. [11] So, suds up and scrub away those germs!

[10] https://www.gavi.org/vaccineswork/why-washing-your-hands-so-important-during-pandemic
[11] Mihalache OA, Borda D, Neagu C, Teixeira P, Langsrud S, Nicolau AI. Efficacy of Removing Bacteria and Organic Dirt from Hands-A Study Based on Bioluminescence Measurements for Evaluation of Hand Hygiene When Cooking. Int J Environ Res Public Health. 2021 Aug 21;18(16):8828. doi: 10.3390/ijerph18168828. PMID: 34444577; PMCID: PMC8394668.



GRAM-NEGATIVE BACTERIA MEMBRANE

GRAM-POSITIVE BACTERIA MEMBRANE



WHAT'S WITH THE GOOEY STUFF?

Most hand sanitisers you see at hospitals and airports are made with about 70% alcohol — ethanol, isopropanol, or n-propanol. They by breaking down the outer layers of bacteria and viruses, effectively killing them. The alcohol in hand sanitisers disrupts the proteins and lipids in germs' outer layers, causing them to fall apart and die. This means they can't make you sick.

Unlike antibiotics, germs can't become resistant to alcohol-based sanitisers because alcohol attacks their essential proteins and membranes. So, they'll keep working effectively.

Besides alcohol, sanitisers contain other ingredients like glycerol, which makes them gel-like and easier to use. It also helps prevent skin from drying out. Other additives might include aloe or vitamin E to keep skin healthy, and fragrances.

Do hand sanitisers really kill 99.99% of germs? This claim is based on lab tests. Real-life situations can affect how well they work. Clean hands make sanitisers more effective, so if your hands are oily or very dirty, it's better to wash them with soap and water first to physically remove dirt and germs.

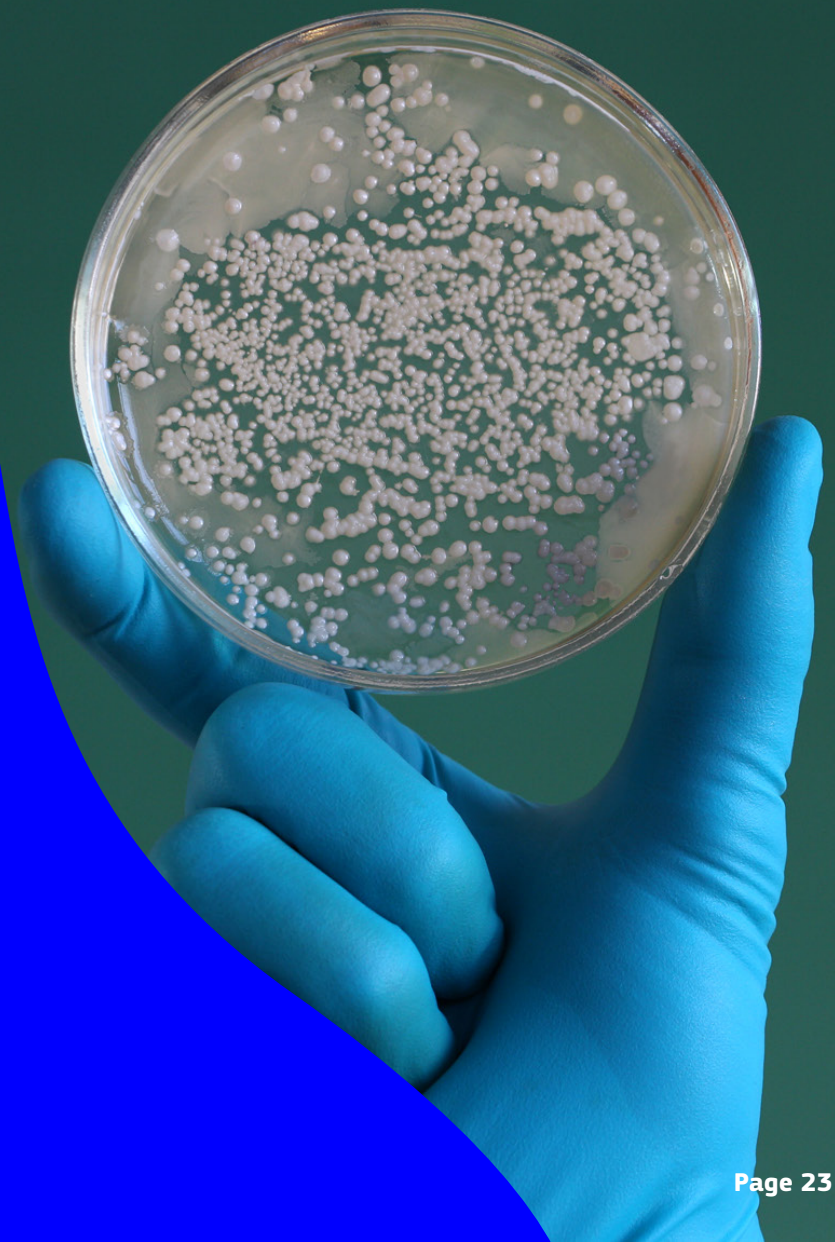
UNCOVERING BACTERIA WITH AGAR PLATES

Agar plates are petri dishes filled with agar–– a jelly-like substance made from seaweed that provides a perfect surface for bacteria to grow on.

Agar plates were discovered in the late 1800s by a German bacteriologist named Julius Richard Petri. He's the guy who invented petri dishes –– shallow, lidded dishes to grow and study bacteria.

Petri's colleague Fanny Hesse suggested using agar as a growth medium because it stays solid at warm temperatures and doesn't melt like gelatine.

Here's how agar plates work: Scientists spread a tiny amount of bacteria on the agar. Then, they cover the dish and let it sit in a warm place. Over time, bacteria multiply and form visible colonies. By observing these colonies, scientists learn a lot about bacteria—like how they grow, what they look like, and which substances (like antibiotics) can stop them.



AGAR PLATES ARE TERRIFIC TOOLS FOR FIGHTING BACTERIAL INFECTIONS AND ENSURING OUR HEALTH. SCIENTISTS USE AGAR PLATES TO STUDY BACTERIAL GROWTH IN ALL KINDS OF COOL WAYS:

Antibiotic testing: Scientists use agar plates to test the effectiveness of antibiotics on different bacteria. They apply antibiotics to the bacteria on the agar plates, and observe which ones inhibit bacterial growth and which do not. This helps them determine the most effective treatment for bacterial infections.

Handwashing studies: Researchers use agar plates to assess the effectiveness of handwashing techniques — for example, they could compare bacterial growth on plates touched by hands washed with warm soap and water to those washed with alcohol-based hand sanitiser or just rinsed in water. This way, they figure out which methods are most effective in reducing bacteria.

Food safety testing: In laboratories, food safety scientists use agar plates to detect bacterial contamination in food products. They apply food samples to the plates so that they can identify harmful bacteria like E. coli or Salmonella. This is important for ensuring food safety and preventing foodborne illnesses.

Environmental sampling: Environmental scientists use agar plates to test for bacterial contamination in water sources, soil, and air. They expose agar plates to these elements, in order to identify and study the presence of bacteria, helping to monitor and improve environmental health.

Effectiveness of cleaning products: Scientists evaluate the effectiveness of different cleaning products by applying them to surfaces and then using agar plates to sample the bacteria before and after cleaning. This determines which cleaning products are most effective in killing or removing bacteria.

Hospital hygiene: In hospitals, researchers use agar plates to test the cleanliness of various surfaces, such as operating tables and medical instruments. By swabbing these surfaces and transferring the samples to agar plates, they can detect and identify any bacterial contamination, ensuring that hygiene standards are maintained.

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[12] Gold NA, Mirza TM, Avva U. Alcohol Sanitizer. 2023 Aug 9. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan–. PMID: 30020626.

[13] Muleba L, Van Wyk R, Pienaar J, Ratshikhopha E, Singh T. Assessment of Anti-Bacterial Effectiveness of Hand Sanitizers Commonly Used in South Africa. Int J Environ Res Public Health. 2022 Jul 28;19(15):9245. doi: 10.3390/ijerph19159245. PMID: 35954594; PMCID: PMC9367797.

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ACTIVITY 1.
INVESTIGATING BACTERIAL GROWTH AND HAND HYGIENE

Let’s explore bacterial growth

and the impact of hand hygiene on reducing bacteria.

INTRODUCTION TO AGAR PLATES

Explain that Agar plates contain a nutrient-rich gel that supports bacterial growth. Scientists use these plates to study bacteria and evaluate the effectiveness of cleaning methods.

Ask students to form a hypothesis on how handwashing with soap affects bacterial levels. How might different cleaning agents impact bacterial growth?

PREPARE THE PLATES

Each student receives an agar plate and an experiment sheet. Label one side of the plate «Before washing» and the other side «After washing.»

COLLECT SAMPLES

Students press one hand on the side labelled «Before washing.» Then, wash hands thoroughly with soap and water. Press the same hand on the «After washing» side.

SEAL AND STORE

Seal the edges of the agar plates with tape to prevent contamination. Place them in a warm, dark environment for 48 hours to allow bacterial growth.

RECORD OBSERVATIONS:

After incubation, students should examine the plates. Compare bacterial growth on the «Before washing» and «After washing» sides. Ask them to record the quantity, size, and appearance of colonies on an experiment sheet.

DISCUSSION AND ANALYSIS

Ask students: What differences do you observe between the two sides? Was handwashing effective in reducing bacteria? What factors might affect bacterial growth? How does this experiment highlight the importance of hand hygiene in preventing the spread of infections?

FURTHER EXPLORATION

Discuss other methods for assessing cleanliness and bacterial growth. How might different environmental conditions affect bacterial proliferation?

Safety note: Ensure students do not open the plates after incubation to avoid exposure to potentially harmful bacteria. Dispose of plates safely after the activity.

LET'S TAKE A DEEP BREATH AND LOOK AT RESPIRATORY HYGIENE

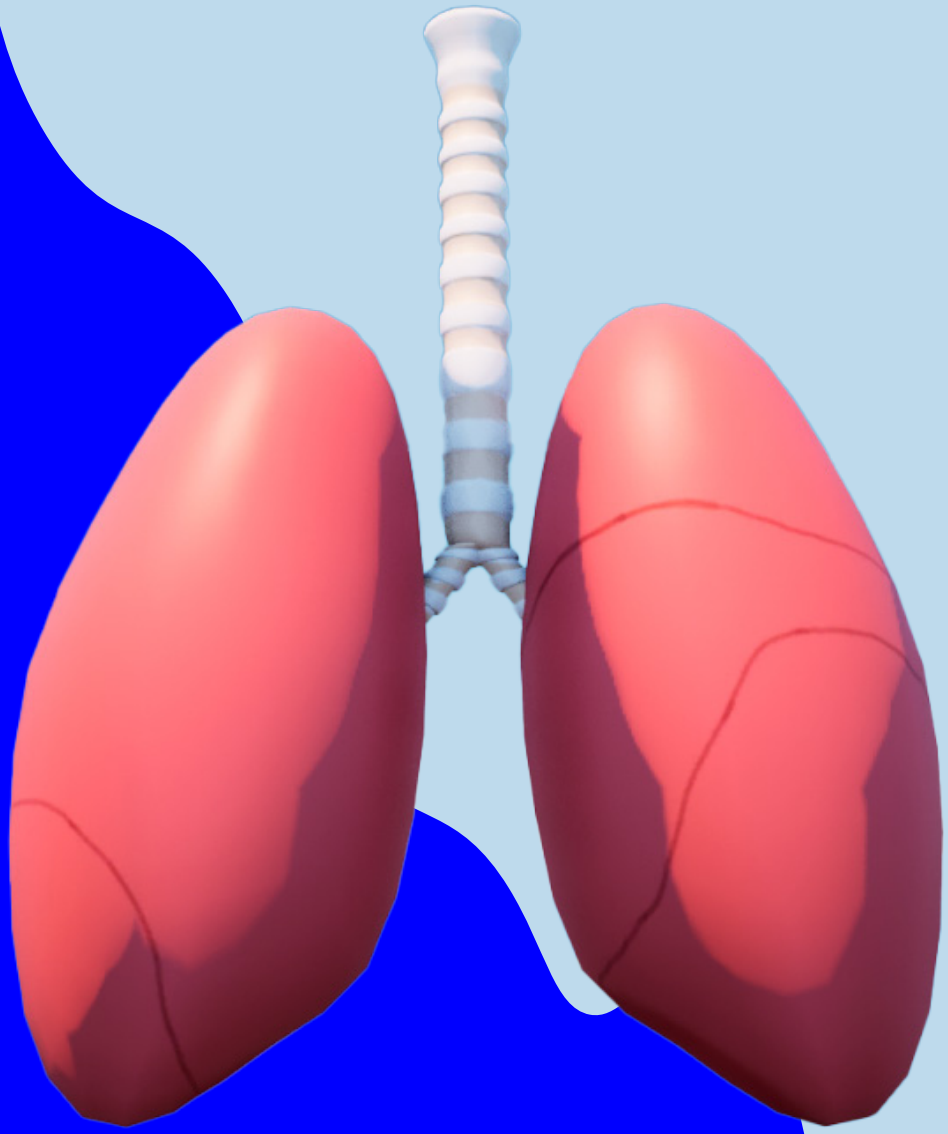
Colds, flus, and coronavirus are highly contagious respiratory illnesses mainly transmitted through droplets from coughs and sneezes or contact with contaminated surfaces. While most droplets fall within close proximity to individuals, smaller droplets can travel further and linger in the air. Sneezing is the body's way of expelling harmful microbes, but it can spread viruses over a significant distance. Good respiratory hygiene, especially during the winter season and outbreaks, is crucial for preventing the spread of infection.

CATCH IT. BIN IT. KILL IT!

«Catch it»: Cover your mouth and nose with a tissue or your upper sleeve when coughing or sneezing.

«Bin it»: Dispose of used tissues immediately to prevent spreading infection.

«Kill it»: Wash your hands thoroughly with soap and water or use hand sanitizer after disposing of tissues.



MASTERING RESPIRATORY HYGIENE

Keep germs to yourself by covering your sneeze or cough with a tissue.

During outbreaks, stick to the basics: wash your hands often, cover your mouth and nose when you cough or sneeze, and consider wearing a mask — especially in crowded places and around old or vulnerable people.

Vaccines are super important because they help stop the spread of serious illnesses like the flu and others that affect your lungs and breathing. Getting vaccines on time is key to staying healthy and preventing diseases from getting stronger. When you get vaccinated at the right time in your life, you not only protect yourself but also help keep your friends and family safe by stopping diseases from spreading. It's like building a shield of protection around yourself and your community. Keeping up with vaccinations ensures that illnesses don't spread and helps keep diseases from becoming more severe or widespread.

Vaccines work by training your immune system to recognise and fight off specific germs, reducing the chances of getting sick and preventing the spread of diseases.

Most vaccines introduce a small, harmless part of a germ to help the immune system recognise and fight the real germ if encountered later. But some vaccines, like mRNA vaccines — some of the COVID-19 vaccines — don't use the actual germ, they provide instructions to your cells to make a part of the germ, which then triggers an immune response.

Respiratory Health Checklist

- Germs travel through sneezes, coughs, and touch so cover up!
- After sneezing into your hands, wash them ASAP.
- No tissue? Sneeze into your elbow.
- Tissues are heroes — use them to catch those sneezes and then throw them away.
- Don't forget to wash up after sneezing into your hands!
- Get your shots!

[14] https://vaccination-protection.ec.europa.eu/lifelong-approach-vaccination_en

ACTIVITY 2: SAYONARA SUPERBUGS

Knowledge is power. Test the antimicrobial resistance knowledge and prevention strategies students have learned in Lessons 1 and 2 with this myth-busting quiz.

1. Teens rarely get the flu because their immune systems are always strong enough to prevent infections.

Answer: *False — Anyone can get knocked down by new or stronger bugs. Stay sharp!*

2. When you're prescribed antibiotics, it's best to stop taking them a day or two after you feel better, so your system doesn't build up tolerance.

Answer: *False: Finish the full course of antibiotics as prescribed by your doctor, even if you're feeling better. Stop early and bacteria can hang around and get stronger.*

3. Simply washing your hands with soap and warm water after touching animals works to kill bugs.

Answer: *True: Animals can carry germs that might make you sick. Washing up after petting unfamiliar creatures lowers the risk — especially before preparing food. Your own pets share your germs, so they're less likely to make you sick.*

4. Food safety practices, like washing fruits and vegetables are important but they don't help prevent illnesses that might need antibiotics.

Answer: *False: Washing fruits, cooking meat well, and keeping raw foods separate helps stop foodborne bugs.*

5. Respiratory infections spread through coughing and sneezing.

Answer: *True — When people cough or sneeze, they launch tiny germ-filled droplets into the air. Breathing these in can make you sick too. Keep your distance and cover your mouth. If you are sick – stay at home.*

6. Helpful bacteria are called pathogenic because they live on and in our bodies without doing us any harm, and harmful bacteria are called commensal because they can cause diseases.

Answer: *False: Friendly bacteria are «commensal» because they live in*

and on us without causing any harm. Bad bacteria are «pathogenic» because they're troublemakers causing sickness.

7. The microbiome refers to the collection of bacteria and other microorganisms that live in and on our bodies.

Answer: *True: The microbiome is a gang of bacteria, viruses, and other tiny organisms living in and on us, playing big roles in keeping us healthy.*

8. There are 5 main classes of microbes which include bacteria, viruses, fungi, mites and protozoa.

Answer: *False: There are four types: mites are not a microbe, they are multicellular organisms that can be seen with the naked eye, while microbes cannot be seen by the naked eye.*

9. Antibiotics can crush a virus like colds and flu, and most coughs.

Answer: *False: Antibiotics give bacterial infections the boot. Colds, flu, and most coughs are caused by viruses that antibiotics can't touch.*

10. Bacteria are single-celled living organisms.

Answer: *True: Bacteria are tiny single-celled living things that eat, and multiply just like us.*

11. Vaccines work by introducing a small, harmless part of a germ into the body to help the immune system recognise and fight the real germ later.

Answer: *True, but with some exceptions. Most vaccines introduce a small, harmless part of a germ to help the immune system recognise and fight the real germ if encountered later. But some vaccines, like mRNA vaccines, don't use the actual germ, they provide instructions to your cells to make a part of the germ, which then triggers an immune response.*

12. Regardless of what we know, the resistance will eventually take over and antimicrobial medicine is living on borrowed time.

Answer: *False: Together, we've got the power to keep medicine strong. By boosting hygiene practices, we can prevent infections and reduce the need for antibiotics. By reducing the misuse of antibiotics—like only using t hem when prescribed by a doctor and never using them for viral infections— we can help prevent bacteria from becoming resistant and help ensure that antibiotics remain effective and continue to save lives.*

WHAT WE CAN DO TO FIGHT ANTIMICROBIAL RESISTANCE TODAY

We can all help to reduce the effects of overuse or misuse of antibiotics by being responsible in how we use them and by working together to prevent the spread of harmful bacteria in our homes, schools and communities.

TAKE YOUR DOCTOR'S ADVICE

Your doctor will probably need to do a test to find out if you need antibiotics or not. Don't worry, it's normal! It's the best way for a doctor to differentiate between bacteria and viruses and prescribe the best antibiotic for you.

USE ANTIBIOTICS THE RIGHT WAY

When you're prescribed antibiotics, always finish your full course, even if you're feeling better. This way, you kill all the bacteria and stop resistance from developing. Never share them or save them.

WASH YOUR HANDS AFTER TOUCHING ANIMALS

Humans and animals share many things—but infections shouldn't be one of them. Animals and humans can infect each other, animals can infect us, and we can infect them, and then infections keep getting passed to other animals and humans and before we can say "what a cutie", antimicrobial resistance gets out of hand. While you and your pets usually have the same flora, animals you don't live with probably don't. Washing your hands after touching them helps keep those bugs from spreading.

Zoonoses are diseases and infections naturally transmitted between people and vertebrate animals. Around 60% of emerging infectious diseases are zoonoses. Over 30 new human pathogens have been detected in the last three decades, 75% of which have originated in animals. [15]

KEEP YOUR FOOD SAFE

Make sure that meat is cooked thoroughly, don't let raw and cooked foods touch, and always wash your fruits and veggies — and your hands! These steps can prevent foodborne illnesses that might need antibiotics and contribute to antimicrobial resistance.

[15] https://www.who.int/initiatives/tripartite-zoonosis-guide

EVERYTHING IS CONNECTED

Antibiotics are used a lot—to cure ourselves or treat infections in the animals we eat. If we overuse or misuse them they start losing their superpowers. The germs they're meant to fight are becoming resistant. Antibiotics even end up in our water supply. When we take them, our bodies use some, but the rest can pass through us and into the environment through wastewater. The same goes for animals. So, using antibiotics wisely in humans and animals is super important to keep them working.

But there's more to the puzzle! Good infection prevention and control in places like hospitals also plays a big role. When healthcare settings are careful about how they use antibiotics, it helps keep germs from becoming resistant.

Now, here's where everything connects. The One Health approach shows us how everything in our world is like a giant circle where what happens in one part affects the whole. Just like how climate change impacts plants, animals, and even us, antimicrobial resistance also spreads through this circle.

Imagine this circle like a web, with each part connected to another. When humans and animals use fewer antibiotics and healthcare settings are careful, it means less resistance overall. This helps keep our medicines strong and ready to fight germs when we really need them.

Fewer antibiotics in the environment equals less resistance! Use antibiotics only when a doctor prescribes them and finish the entire prescription, even if you feel better. Spread the word about using antibiotics wisely to your friends and family. By working together, we can keep antibiotics working well for everyone.

ONE HEALTH, MANY HELPERS

Remember the One Health approach we discovered in Lesson 1? It aims to protect our health by connecting and protecting human, animal, and environmental health and we all have a role to play through:

1. Responsible antibiotic use: Only using antibiotics when necessary and as prescribed by healthcare professionals to help prevent bacteria from becoming resistant to these medicines.

2. Preventing infections: By improving hygiene practices, getting vaccinated, and maintaining strong biosecurity measures, we can stop infections from spreading and reduce the need for antibiotics.

3. Monitoring and tracking: Scientists are working track where and how antimicrobial resistance develops, and to understand and address the problem effectively.

4. Research and development: Ongoing research is focusing on finding new treatments and improving the use of current antibiotics to combat resistant bacteria.

5. Education and awareness: Public campaigns are raising awareness about the risks of antimicrobial resistance and the importance of proper antibiotic use.

6. Antibiotic stewardship: Programmes are guiding the responsible use of antibiotics among doctors, veterinarians, and farmers to ensure they are used effectively.

7. Environmental protection: Environmental experts are analysing how antibiotics enter the environment to promote safe disposal practices.

8. Rules and regulations: Governments are creating and enforcing regulations to control antibiotic use and reduce resistance.

9. Global cooperation: Countries and organisations are working together to share information and coordinate efforts to tackle antimicrobial resistance on a global scale.

ACTIVITY 3: GET WITH THE PROGRAMME! DESIGN A ONE HEALTH CAMPAIGN

We can contribute to the One Health Approach by designing a campaign to promote responsible practices.

1. INTRODUCTION

Recap the One Health Approach and its key components: responsible antibiotic use, preventing infections, monitoring and tracking, research and development, education and awareness, antibiotic stewardship, environmental protection, rules and regulations, and global cooperation.

Discuss how these elements work together to combat antimicrobial resistance (AMR) and why each aspect is important.

2. GROUP BRAINSTORMING

Divide students into small groups. Ask each group to choose one of the One Health elements to focus on (e.g., responsible antibiotic use, preventing infections).

Each group should brainstorm ways to address their chosen element in a campaign. Encourage them to think about creative ways to educate their peers, families, and community members.

3. DESIGN THE CAMPAIGN

Have each group create a campaign to promote their chosen element. They can design posters, flyers, or a digital campaign using available technology. Their campaign should include:

- A catchy slogan or message.
- Key information about their focus area.
- Tips or actions people can take.
- Visuals that make their message engaging and clear.

4. PRESENTATION AND FEEDBACK

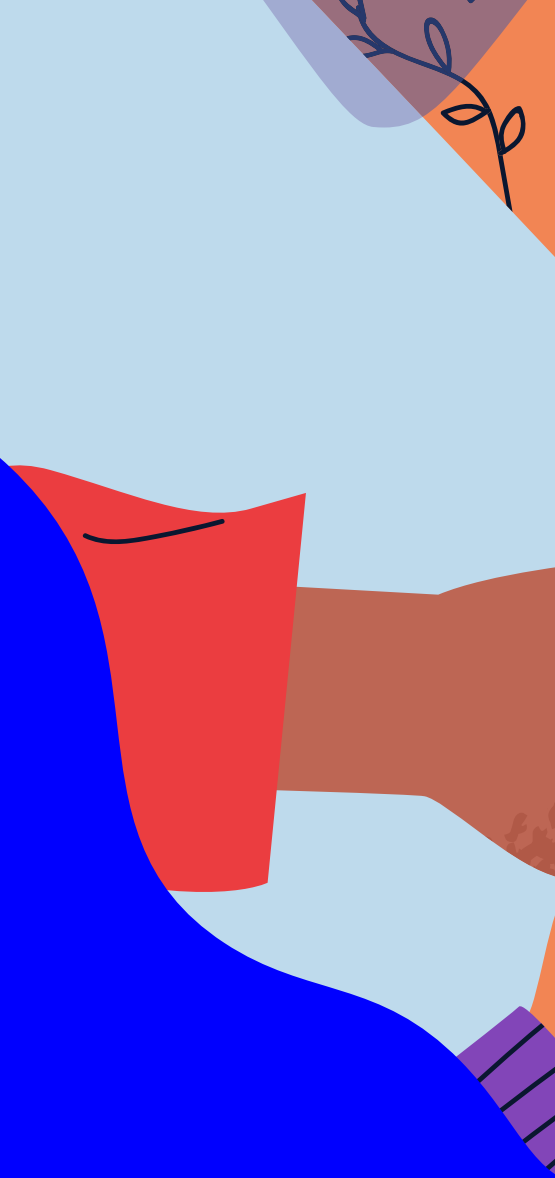
Each group presents their campaign to the class. After each presentation, have a brief discussion and provide constructive feedback.

Discuss how the campaigns can help spread awareness and encourage positive actions in their community.

European Health Union

REFLECTION

Conclude with a reflection on how students can incorporate One Health practices into their daily lives and the impact they can make by working together to prevent antimicrobial resistance.



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