AN ANTIMICROBIAL RESISTANCE LEARNING FRAMEWORK FOR CHILDREN AND YOUNG PEOPLE

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GUIDE TO USING THIS RESOURCE

Throughout this resource we will refer to antimicrobial resistance as 'AMR'.

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About this learning framework and who it is for

AMR is a growing concern for everyone. Solutions to face this emerging challenge will require ideas and actions from a wide range of people and significant changes in the way we use antimicrobial medicine to treat infections. Working with children and young people is essential to ensure that people will be able to treat and manage infections and consequently save lives in the future. A good understanding of AMR, its causes, effects and current strategies for mitigation is essential to enable people to engage meaningfully with the challenge and contribute to solutions. This learning framework is a resource for educators, health and research professionals to enable them to develop young peoples' understanding of:

The science behind AMR	**The individual, community and global health risks AMR presents**	**The positive actions they can take to mitigate against AMR**

The framework identifies key learning outcomes appropriate to different age groups that are applicable across a diverse range of settings and learning environments. It can be used as a tool for structuring curricula and learning activities. It is aimed at teachers, educators, research scientists and informal learning providers.

Young AMR leaders and activists

What is antimicrobial resistance and why it is an issue

Our collective overuse of antimicrobial drugs including antibiotics, antivirals and antifungal medicines, is causing one of the most urgent global health problems facing humanity in the 21st century. This overuse of antimicrobials in humans, animals and plants is accelerating the development and spread of drug-resistant infections. Infections become drug-resistant when the microbes that cause them, for example, bacteria, viruses and fungi, adapt and change over time, developing the ability to resist the drugs designed to kill them. One of the most common types of drug resistance is antibiotic resistance.

Drug resistant microbes challenge our ability to treat common infections which can result in longer illnesses, disability and death. Globally, at least 700,000 people currently die every year because of drug-resistant infections. Without action now, this is projected to rise to 10 million annual deaths by 2050. According to the WHO: "without effective antimicrobials for prevention and treatment of infections, medical procedures such as organ transplantation, cancer chemotherapy, diabetes management and major surgery (for example, caesarean sections or hip replacements) become very high-risk."

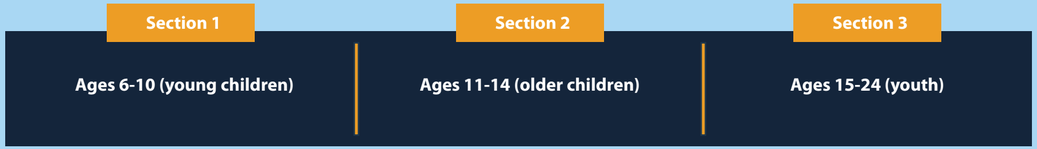
Why a learning framework about AMR

Antimicrobial resistance (AMR) has often been framed as a matter of people making ill-informed choices, culminating in over- and inappropriate use of antimicrobial medicines. In fact, the situation is more complex than this and change is needed at all levels of society, from individual behaviour level to policy level. Children and young people are stakeholders who are often missed from behaviour change initiatives. There are also few effective platforms that bring their voices and insights to the fields of research, science and public health. Their role as social activists is also often overlooked. These disparities are heightened in many low- and middle-income countries, where access to information and civic networks may be limited.

In order to effect change, global health professionals and policy makers need to support educators to help children and young people to develop an understanding of the science behind the issue as well as mitigation skills. This resource has been created for this purpose.

How the framework is structured

The learning outcomes are organised by age groups, following the UNICEF age categories (which are used for statistical and policy purposes). We have put the oldest two UNICEF categories together for this resource.



Following the age-specific sections, we provide information about further resources to support learning activities and a glossary of terms. Each set of outcomes is then categorised as either cause and description of illness, or prevention and treatment of illness as below. This distinction outlines a logical progression from learning about the diseases to learning how to treat and prevent them.

LEARNING OUTCOMES

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Cause and description of illness	For example, 1.1 Explain that some illnesses/infections can be transmitted via small 'bugs' or germs that are passed from person to person through contact	N/A
Prevention and treatment of illness	For example, 1.2 Explain how to prevent illnesses in terms of stopping bugs/germs from being transferred from person to person and apply to behaviour as follows: - washing hands to remove bugs/germs	For example, 1.3 Explain that for some illnesses/ infections (such as (e.g colds, flu, Chickenpox) the body can defend itself and the infection can be resolved without treatment.

How to use the learning framework

Youth project members in Vietnam held a quiz for local children on the topic of bacteria and antibiotics

This framework has been developed to be widely applicable for use in formal and informal learning settings. New AMR-specific learning objectives have been developed for three age ranges: 6-10; 11-14; and 15-24. Levels of conceptual ability for each age group have been derived through an analysis of school curricula across four countries: Kenya, Nepal, Thailand and Vietnam. School science, biology, health education curricula were reviewed for scientific content similar and related to AMR (for example, bugs, bacteria, mutations. The learning framework is a linear progression of learning objectives from one age group to the next with the objectives for the younger age groups providing a foundation for subsequent age groups. The age-appropriate learning objectives have been developed to enable young people to take positive actions to mitigate against antimicrobial resistance. For ages 6-10 the emphasis is on building learners' foundational knowledge for understanding the concept of communicable diseases, or infections as illnesses passed from person to person through small living things or bugs (microbes). Readers who are familiar with biology curricula will note that the conceptual level of difficulty does not exceed the level expected for 18 year-old secondary school students studying Biology. We feel that any level beyond this may be appropriate for undergraduate biological courses, but not essential to enable young people engagement with AMR science. This explains the wide age range for the 15-24 age band.

The age-matched linear nature of this framework enables:

- Teachers and curriculum planners to integrate AMR learning objectives into existing science and biology curricula, or AMR extracurricular clubs
- Teachers and informal educators/researchers to be flexible in moving between age groups where required, for example, in an informal learning session with 15-year-olds who have never attended secondary school, learning objectives from the 11-14 age group may be appropriate, ascending to the higher age group if the facilitator feels this is appropriate
- Age-appropriate learning objectives to be selected to suit age-specific audiences in informal learning settings.

YWG Communication Skills Training in Kenya

We recommend that:

Learning activities should be carefully planned to make learning enjoyable and meet specific learning objectives

Locally appropriate examples, terminology, names and illustrations should be drawn upon to support learning (for example local names for painkillers, or the names of common diseases in the local language)

Locally available materials are drawn upon to support learning

In a school context, it is likely that AMR will be integrated into other curricula such as in science and applied sciences. To help teachers/educators/engagement practitioners to integrate AMR-specific learning outcomes into existing curricula, we have used different coloured fonts to distinguish between new AMR-specific learning outcomes (in black), and **learning outcomes in other curricula (biology, science, health related curricula) which are related to AMR, in brown.** AMR-specific learning outcomes are also shown in the Concise AMR learning framework.

While the learning framework has been successfully piloted by non-teachers (as well as teachers) we recommend that if you have limited or no teaching experience, it would be helpful to consult a trained teacher or the internet for advice on developing learning activities from the AMR specific learning objectives.

Learning vocabulary relating to AMR

YWG Meeting in Session

We have drawn on the following sources to derive and define vocabulary essential to support learning as described by the learning framework: the AMR Dictionary; the Merriam Webster Dictionary; Wikipedia; and science and biology curricula from four countries. Education research * stresses the importance for a deliberate focus on vocabulary in the introduction of new scientific concepts and language for children. Focussing on vocabulary and scientific literacy has been shown to have a positive impact on science achievement. At the beginning of each section a list of key vocabulary is provided, and learning these words is key to achieving the learning outcomes. While this may be challenging for children and young people, introducing (or re-affirming) this vocabulary is important to enable them to use appropriate scientific language to convey and explain ideas. Do make an introduction of new vocabulary and their definitions as a focus, before you introduce activities relating to the learning outcomes. Some familiar words, such as 'cold', have a different meaning in science from everyday life (cold = illness/ cold = feeling cold, cold weather); several studies have shown that these words often cause challenges for learners as they are considered to be of a technical nature. Differentiating these words in the learning process is highly recommended. Words with a different scientific meaning from everyday meaning have been put into italics in the vocabulary lists at the beginning of each section, and a glossary of words is provided in the annex.

Simple steps[1] to support the learning of new words are careful and selection of important scientific words

Giving the learners word definitions they can use and apply. Remember that some words have different meanings in different contexts such as bugs /germs or infection/illness. Use the words that are most appropriate to your locality.

Provide examples of how a word occurs in language and encourage learners to use the word in different settings and applications.

In learning sessions take opportunities to re-use and define words to reinforce their meaning.

[1]These tips are taken from a report called 'Improving Secondary Science' and 'Teach Like a Champion'. They can be found at https://educationendowmentfoundation.org.uk/public/files/Publications/Science/EEF_improving_secondary_science.pdf https://teachlikeachampion.com/blog/active-practice-key-vocabulary/

YAAR! members in Thailand

How this learning framework has been developed

This resource has been developed as part of a project called 'Youth Against Antimicrobial Resistance'. The framework was produced through the collaborative efforts of curriculum experts, science teachers, children and young people (6-24) from Kenya, Nepal, Thailand and Vietnam, health researchers and community engagement professionals from Oxford University Clinical Research Unit in Vietnam and Nepal (OUCRU), Mahidol Oxford Tropical Medicine Research Unit in Thailand (MORU) and KEMRI Wellcome Trust Research Programme in Kenya (KEMRI).

The process of developing this framework involved: discussions and surveys with Kenyan, Nepalese, Thai and Vietnamese children and young people; working with local science teachers to analyse national curricula across four countries for AMR and related learning objectives (including science, biology, health and physical education, technology and agriculture); and developing new AMR specific learning objectives in consultation with local public health and AMR experts and public engagement with health research experts. Following a review by curriculum experts from Kenya, Vietnam and Thailand, the learning framework was piloted by teachers and researchers with children and young people across the four countries in formal educational and informal settings. The framework was subsequently amended according to user experiences and recommendations. You can find out more about this project here [www.youthagainstamr.com].

The development of this learning framework has been supported by Wellcome [https://wellcome.org].

About Wellcome

- Wellcome supports science to solve the urgent health challenges facing everyone. We support discovery research into life, health and wellbeing, and we're taking on three worldwide health challenges: mental health, global heating and infectious diseases.
- We are a politically and financially independent global charitable foundation, funded by a £26.8 billion investment portfolio.
- Our strategy includes grant funding, advocacy campaigns and partnerships to find solutions for today's urgent health challenges.
- Our founder, Sir Henry Wellcome, was a pharmaceutical entrepreneur. Our governance is based on an updated version of his will, in which he left us his wealth, his collection of historical medical items, and our mission to improve health through research.

1. Learning outcomes for ages 6 -10

The learning outcomes in the framework below aim at encouraging children aged between 6-10 years to practice the following behaviours:

- only take medicine following advice from a trained health-worker, doctor or nurse and/or the instructions on the packet
- completing medicine doses as advised by a trained health-worker and/or instructions on the packet

Key vocabulary

1. *bugs/germs*

2. *cold*

3. chickenpox

4. doctor /nurse /clinical officer/trained health worker

5. flies

6. flu/influenza

7. *illness/infection*

8. medicine

9. mosquitoes

10. prevent

11. symptom/signs

12. *transmission*

Words with a different scientific meaning from the everyday meaning have been put into italics. See definitions for these words in the glossary.

AMR LEARNING OUTCOMES

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Cause of illness	1.1 Explain that some illnesses can be transmitted through: - small 'bugs/germs' being passed from person to person through contact (for example, shaking hands, hugging) - water (for example, un-boiled water) - objects (for example, uncooked food, uncleaned utensils) - the air (for example, coughing, sneezing) - mosquitoes when they bite people - flies when they carry germs to food/ drink - the soil entering in cuts and wounds. 1.2 Specify the signs and symptoms of ill-health and sickness: - coughing - sneezing and running nose - high temperature/fever - aches - pains - swelling - redness	N/A

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Prevention and treatment of illness	1.3 Explain how to prevent illnesses/infection in terms of stopping bugs/germs from being transferred from person to person and apply to behaviour as follows: - washing hands with soap removes bugs/ germs - cleaning cuts and wounds with soap removes bugs/ germs - Cleaning cooking utensils with soap removes bugs/ germs - Boiling water and cooking food removes bugs/ germs - Wearing masks and/or coughing into a handkerchief/tissue/elbow prevents bugs/germs from travelling through the air from person to person	1.4 Explain that people can get better from some illnesses/infections (such as colds, flu, Chickenpox in children) without any treatment/medication. 1.5 Explain that some bugs/germs which cause illness can be killed by medicines (tablets, creams, medicinal syrup etc). 1.6 Understand that these medicines should only be taken under the guidance of someone with medical training (doctor or clinician or nurse) and/or following instructions on the medicine packet . 1.7 Understand that one should complete the 'course' of medicine as advised by the doctor, nurse or clinician or trained health worker, to kill all the germs. 1.8 Explain that a consequence of not following proper instructions (for example, not completing the course as instructed) that medicines may not be able to treat ill-health/ infections in the future

[2] In some countries, medicines are sold without their packaging and instruction leaflet. This practice is unrecommended and the best practice is to buy medicine in its appropriate packaging.

2. Learning Outcomes for ages 11-14

The learning outcomes in the framework below aim at encouraging children aged between 11-14 years to practice the following behaviours:

- Only taking Antibiotic medicine following advice from a trained health-worker (doctor or clinician or nurse).
- Completing the medicine dosage as instructed by a trained health worker.
- Avoid using antibiotics for viral infections including non-serious illnesses such as colds.

Key vocabulary


1. antibiotic/antiviral/ antifungal


2. *cell*


3. communicable / non-communicable


4. infection / infectious / non-infectious


5. malaria


6. microbes – bacteria, fungi, virus, amoeba


7. parasite / parasitic


8. symptom/sign


9. *transmission*


10. vaccination

Words with a difference scientific meaning from everyday meaning have been put into italics. See definitions for these words in the glossary.

AMR LEARNING OUTCOMES

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Cause of illness	2.1 Explain, giving examples, the difference between non-communicable diseases and communicable diseases (or infectious/non-infectious). 2.2 Explain that communicable diseases (or infections) pass from person to person via microbes/germs which are small living things. 2.3 Understand, giving examples, that bacteria, viruses, parasites and fungi are microbes which enable infections to spread from person to person. 2.4 Understand that bacteria are microbes (single cell animals) which can cause illness and can be spread from person to person through contact, food, or water (for example, boils, and some sore throat). 2.5 Understand that parasites are tiny living things which can cause illness and can be spread from person to person through: • Parasites in human waste (faeces) being transferred to the mouth through not washing hands properly after going to the toilet	N/A

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Cause and description of illness cont'	• Flies carrying parasites from human waste to food and water • Unclean water, • Unhygienic food, (example: amoeba) or through a vector (for example, malaria passed from person to person by a mosquito) or in the soil (some parasitic worms) Antibiotics cannot be used to treat them. 2.6 Outline that many viruses can cause illness in humans. They are organisms that are too small to be seen with a standard microscope and can spread from person to person in different ways. Some can infect you if you breath/inhale them in (for example, flus, colds, sore throat, Covid-19), others if you ingest them (example: polio virus) and others through body fluids (through sex or infection with contaminated blood – through wound or transfusion fluids or contamination with infected blood) (for example, HIV). Antibiotics cannot be used to treat them. 2.7 Explain that fungi can cause mainly skin infections, (such as athletes' foot and ringworm), and they are treated with an antifungal cream and antibiotics will cannot be used to treat them.	N/A

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Prevention and treatment of illness	2.8 Describe how differences in methods of disease prevention are due to whether the disease in question is infectious/ communicable or non-infectious/ non-infectious. Examples: • Diabetes may be prevented through a healthy diet and exercise • Malaria can be prevented through avoiding being bitten by a mosquito 2.9 Understand that infectious diseases can be prevented through stopping the spread of microbes from one person to the next by: • avoiding contact (such as shaking hands). • boiling water to kill bacteria or amoeba (or other water-borne parasites). • washing hands to remove bacteria, viruses, amoeba, parasites (such as Covid-19, flu, etc). • eating well-cooked food from a clean place and clean dishes, washing fruits	2.10 Specify that for **some** non-serious infectious illnesses (whether caused by bacteria or viruses), the body will recover from the illness without the need for medicine such as antibiotics 2.11 Understand that most infections caused by bacteria can be treated by antibiotics (an example of one that cannot be treated with antibiotic is tetanus) 2.12 Understand that antivirals can be used to treat some viruses and antifungal medicines for fungal infections 2.13 Understand that antibiotics cannot be used to treat illnesses caused by viruses and fungi.

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Cause and description of illness cont'	• wearing a mask to prevent the movement of bacteria and viruses through the air via coughing or sneezing. • coughing and sneezing into a handkerchief/tissue/ elbow to prevent the movement of microbes through the air. • Explain that vaccination enables the body to build up a defence against illness from specific microbes, e.g - Covid-19 vaccines prevent people from becoming severely ill or dying of Covid-19. - The measles, mumps and rubella (MMR) vaccine prevents children from contracting and becoming severely ill with or dying from with measles, mumps and rubella viruses.	2.14 Describe the correct/appropriate use of medicine to treat illnesses as follows: - only take medicine for illnesses when instructed by trained health worker (doctor, nurse, clinician) - one must complete the medicine as directed by trained health worker 2.15 Specify that a consequence of not following a health worker's advice/ instructions when taking medicines is that the medication may become less effective at treating diseases for everyone. 2.16 Explain that when a person becomes infected with some (but not all) microbes they can build protective immunity against future infection after exposure (for example, Chickenpox).

3. Learning outcomes for ages 15 - 24

The learning outcomes below aim at encouraging children aged between 15-24 years to practice the following behaviours:

- Applying locally recommended infection reduction measures as advised by local ministry of health for example: hand-washing; mask wearing; coughing/sneezing into a handkerchief; cleaning cooking utensils; drinking clean water (boiled where necessary); cooking food thoroughly; cleaning cuts and wounds thoroughly; regular exercise; and eating a balanced diet
- Taking appropriate microbial medicines for specific microbes as advised by a doctor/nurse (antibiotics for bacterial infections; and antifungal medicine for fungal infections)
- Avoiding the use of antimicrobial medicines when they are not required (for example, for a cold)
- Minimising the use of antibiotics in agriculture

Key vocabulary


1. antibiotic / antiviral / antifungal


6. infection / infectious / non-infectious


11. superbugs


2. antibodies


7. malaria


12. symptom


3. *cell*


8. microbes - bacteria, amoeba, fungi, virus, parasite / parasitic


13. *transmission*


4. communicable / non-communicable


9. *resistant / resistance*


14. vaccination


5. epidemic / pandemic


10. selection pressure


15. vector-borne / air-borne / water-borne

Words with a difference scientific meaning from everyday meaning have been put into italics. See definitions for these words in the glossary.

AMR LEARNING OUTCOMES

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Cause of illness	3.1 Be able to explain that infections are transmitted as a result of bacteria, viruses, fungi, parasites, or amoeba passing from one person to another, or from the environment or an animal to a person • Specify examples of food and water-borne diseases and their means of transmission (such as typhoid and shigella are food/water-borne bacterial infections) • Specify examples of air-borne diseases and their means of transmission (flus, measles, Covid-19 are air-borne droplets containing viruses) • Specify examples of sexually transmitted diseases and their means of transmission (bacterial such as Gonorrhoea, and viral such as herpes) • Specify examples of vector-borne diseases and their means of transmission (such as malaria and dengue fever where mosquitoes are the vector) • Describe rabies as an example of an infection passed from an animal to humans	N/A

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Prevention and treatment of illness	3.2 Understand that an epidemic is when an infectious/ communicable disease has spread within a region (such as Avian flu in South East Asia) 3.3 Understand that the term pandemic describes when an infectious/communicable disease has spread across the whole world (for example, HIV, Covid-19) 3.4 Understand that some non-communicable diseases can be prevented by maintaining a healthy diet, taking exercise and avoiding alcohol and smoking. 3.5 Explain that the body has a natural way of defending itself from illness, through white blood cells and antibodies. 3.6 Explain that when a person becomes infected, the body can produce specific cells and antibodies to neutralise and kill the microbe/pathogen which has entered the body. 3.7 Explain that following some infections, the body can retain antibodies and cells so that it can defend itself from future infection (for example, children once infected with the varicella-zoster virus that causes Chickenpox generally do not become ill with Chickenpox a second time).	3.11 Understand that medicine comprises a range of drugs which includes: • Painkillers used to reduce pain (for example, paracetamol and Brufen*) • Antimicrobial drugs which are specific to the type of microbe they treat: • Antibiotics: specific antibiotics are used to treat specific bacterial diseases and amoebas, and they work through killing (or stopping the growth of) the bacteria or amoeba, for example, penicillin* can be used to treat bacterial ear infections • Antivirals used to manage and treat viruses because they stop the growth of viruses in the body (for example ARV/ ART use with HIV*) • Antifungal medicine such as clotrimazole, is used to treat fungal infections like thrush or athletes' foot or ringworm*) • Antimalarial drugs (for example Coartem*) can be taken to treat malaria and they work by killing the malaria parasite. 3.12 Define 'antimicrobial resistance' as a microbe's ability to survive treatment with a specific medicine. Stress that microbes become resistant to drugs (neither drugs nor people become resistant)

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Prevention and treatment of illness cont'	3.8 Explain that most vaccines contain killed or modified live microbes that stimulate the body to produce protective cells and antibodies against specific diseases. 3.9 Explain that the cells and antibodies produced naturally or through vaccination, can help prevent people becoming ill without taking medicines. 3.10 Be able to connect ways of preventing communicable/infectious diseases to mode of transmission: • Water-borne: (examples) through hygiene and cleanliness for example, avoiding direct contact, washing hands, cleaning cooking utensils, boiling water, appropriate storage and preparation of food. • Airborne: (examples) through wearing masks, using a handkerchief, washing hands, safe distance. • STIs – referring to local Ministry of Education advice for details of sexual health guidance for young people, for prevention aimed at preventing exposure *to microbes. • Vector-borne (examples) – sleeping under a mosquito net, and indoor residual spraying.	3.13 Define resistant bacteria as bacteria which are not killed by antibiotics, and therefore can lead to infections which are harder to treat. 3.14 Explain the mechanism through which 'antibiotic resistance' develops and spreads: • Specify that bacteria randomly mutate (or change) when they reproduce and occasionally mutations result in bacteria becoming resistant (being able to survive) to an antibiotic • Specify that when bacteria are exposed to antibiotics, the growth of non-resistant bacteria is stopped, but the resistant bacteria continue to reproduce passing the ability to resist antibiotics to the next generation • Explain that application of an antibiotic can put selection pressure on bacteria, driving the evolution of resistant bacteria. Selection pressures are external factors which affect an organism's ability to survive in that environment • Specify that resistant bacteria can be passed on from person to person • Define 'superbugs' (such as MRSA found commonly in hospitals), as bacteria (or other microbe) which are resistant to several antibiotics, and because of this they are hard to treat.

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Prevention and treatment of illness cont'		• Identify the names of some of the more common resistant organisms for each group of microbes, examples of bacteria contributing to the problem of drug resistance in hospitals and in the community include MRSA and *E.coli;* parasites such as plasmodium, which causes malaria, have also evolved drug resistance; viruses can also evolve drug resistance for example, HIV; as can fungi such as Candida *auris*. 3.15 Relate specific human treatment behaviours as favouring the generation of resistant bacteria: • Understand that the use of antibiotics should always be taken under care and supervision of trained health worker. • Specify that antibiotics don't treat illnesses caused by viruses, but when inappropriately used in this way, bacteria are unnecessarily exposed to antibiotics and this can contribute to resistance • Specify that using antibiotics for non-bacterial infections and non-serious illnesses like colds, unnecessarily exposes bacteria in our body to antibiotics and this can contribute to resistance. • Relate some agricultural practices as favouring the generation of resistant bacteria:

* Use locally appropriate names of drugs and infections

	Science/ biology knowledge and understanding that is needed as a foundation for understanding AMR	AMR-specific knowledge and understanding
Prevention and treatment of illness cont'		• Specify that antibiotics are used to protect farm animals from infection and to promote growth • Specify that when, bacteria in animals are exposed to antibiotics, this can contribute to resistant bacteria multiplying, these bacteria can then be ingested by humans • Specify that animals treating with antibiotics can lead to the development of resistant bacteria, which can in torn contaminate meat and spread to humans if consumed without good hygiene.

Youth Against Antimicrobial Resistance

FURTHER RESOURCES

Wellcome: Reframing Resistance – How to communicate about antimicrobial resistance effectively

Wellcome: Reframing Resistance – The Framing Toolkit

UN Time is Running Out – Technical Note on Antimicrobial Resistance

AMR dictionary: https://www.amrdictionary.net/

Examples of resources to support learning activities (check cultural relevance and conceptual level)

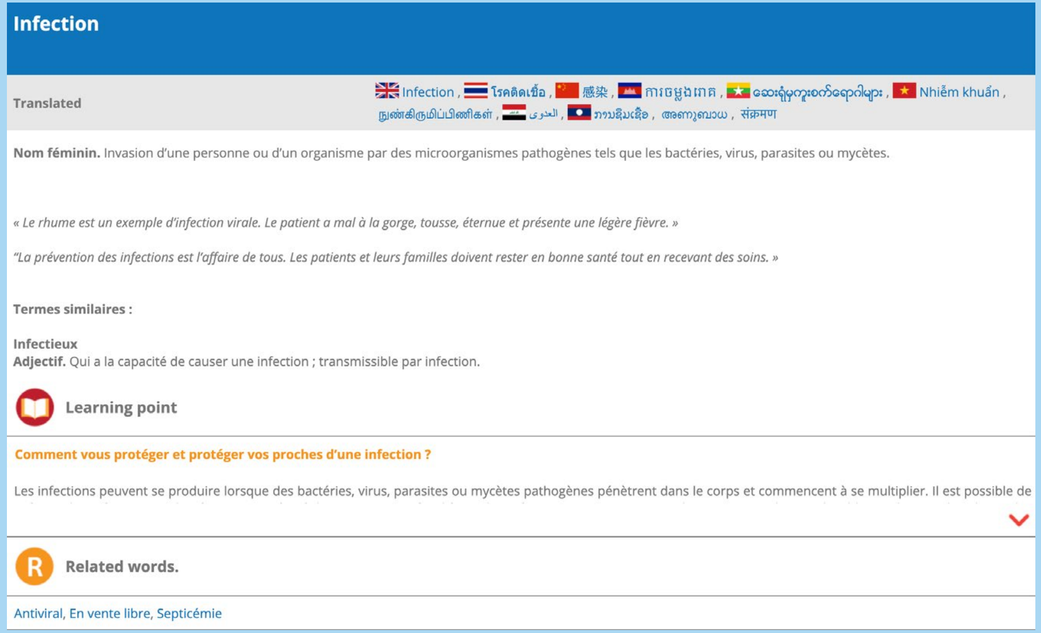
Vision Learning: a science education online resource https://www.visionlearning.com
Free classroom science lesson modules and resources, including an extensive glossary

e-bug: Public Health England's infection prevention and control teaching resources for the educational sector
e-Bug (operated by PHE) is a free educational resource for classroom and home use and makes learning about micro-organisms, the spread, prevention and treatment of infection, fun and accessible for all teachers and students.

Bacteria Combat: a digital antibiotics game
Bacteria Combat is free online digital antibiotics game produced by Game Doctor. It was created to educate teenagers on antibiotic resistance, and involves a card battle game where players try to defeat bacteria using antibiotics.

AMR online dictionary

This online resource called the AMR Dictionary provides definitions of terms related to AMR. You can search by term in the following languages:



GLOSSARY

These are definitions using simple language. More technical definitions can be found in school science text books and some of the resources suggested above.

Amoeba

An amoeba is a type of cell or unicellular organism which has the ability to alter its shape. Some amoebas cause disease, for example dysentery.

Antibiotic

Antibiotic refers to a substance or medicine (for example, penicillin) that kills or inhibits the growth of bacteria. There are many types of antibiotics. Each type works differently. Like other medicines, antibiotics can cause side effects or interact with other medications.

Antibody

A large, Y-shaped protein used by the immune system to identify and neutralize foreign objects such as pathogenic bacteria and viruses.

Antifungal

Substances or medicines that kills or inhibits the growth of fungi.

Antimicrobial

A general term to describe substances or medicines that kills or inhibits the growth of bacteria, viruses, fungi and other microbes.

Antiparasitic

Substances or medicines that kills or inhibits the growth of a parasite. There are many types of antiparasitic, with different modes of actions, against different parasites.

Antiviral

A substance or medicine that kills or inhibits the growth of viruses.

Bacteria

Simple, small living microorganisms that are found everywhere and cannot be seen by the naked eyes. Bacteria are life forms that consist of only a single cell that does not have a nucleus. "Bacteria can multiply rapidly. Once inside our bodies, bacteria can release poisons or toxins that make us feel ill. Diseases caused by bacteria include blood infection, pneumonia, and food poisoning." "Good bacteria, such as those naturally found on our skin or in our guts, can protect us from bad bacteria. Some good bacteria produce vitamins such as vitamin K." "Bacteria are used to produce cheese and yogurt through fermentation. Bacteria are also used for the manufacture of antibiotics and other chemicals."

Bugs/germs

Informal words for microbes which cause diseases including bacteria, viruses, fungi, amoeba, parasites.

Cell

The cell is the basic structural, functional, and biological unit of all known organisms. Cells are the smallest units of life, and hence are often referred to as the "building blocks of life".

Chickenpox

A highly contagious disease caused by the initial infection with an air-borne virus. The disease results in a characteristic skin rash that forms small, itchy blisters, which eventually scab over.

Cold

A viral infectious disease that primarily affects the respiratory mucosa of the nose, throat, sinuses, and larynx. Signs and symptoms may appear less than two days after exposure to the virus. These may include coughing, sore throat, runny nose, sneezing, headache, and fever. People usually recover in seven to ten days.

Communicable

See infection.

Doctor /nurse /clinical officer/trained health worker

Trained medical/health staff with a level of training that includes management of drugs/medicines. I.e. village/commune-level health workers may not receive training about drug management.

Epidemic

The rapid spread of disease to a large number of people in a given population within a short period of time.

Influenza

Influenza is commonly called "the flu", is an infectious disease caused by influenza viruses. Symptoms range from mild to severe and often include fever, runny nose, sore throat, muscle pain, headache, coughing, and fatigue. These symptoms typically begin 1–4 days after exposure to the virus and last for about 2–8 days.

Fungi

A group of organisms that includes microorganisms such as yeasts and molds as well as mushrooms. Sometimes fungi can cause infections in humans.

Illness

see infection.

Infection / infectious / non-infectious*

An infection is the invasion of an organism's body tissues by disease-causing agents, their multiplication, and the reaction of host tissues to the infectious agents and the toxins they produce. An infectious disease, also known as a transmissible disease or communicable disease, is an illness resulting from an infection.

Infections can be caused by a wide range of pathogens, most prominently bacteria and viruses.

Malaria

A mosquito-borne infectious disease that affects humans and other animals with symptoms which typically include fever, tiredness, vomiting, and headaches.

Medicine

A drug (for example, tablet, pill, syrup, cream) used to treat an illness or infection.

Microbe

A living cell, or colony of cells (bacteria, viruses, fungi, amoeba) some of which can cause illness or infection.

Mosquitoes

A family of small flies with a slender segmented body, one pair of wings, one pair of halteres, three pairs of long hair-like legs, and elongated mouthparts. Some species carry diseases like dengue fever and malaria.

Non-communicable

A disease that is not transmissible directly from one person to another including most heart diseases, most cancers, diabetes and chronic kidney disease.

Pandemic

An epidemic of an infectious disease that has spread across a large region, for instance multiple continents or worldwide, affecting a substantial number of people.

Parasite / parasitic

An organism that lives on or inside another organism, the host, causing it some harm, and is adapted structurally to this way of life.

Resistant / resistance

The reduction in effectiveness of a medication such as an antimicrobial or antiviral in treating a disease or condition. The term is used in the context of resistance that pathogens or cancers have "acquired", that is, resistance has evolved.

Selection pressures

Selection pressures are external factors which affect an organism's ability to survive in that environment.

Superbugs

A strain or type of microbes that has become resistant to the majority of current antimicrobials is called a superbug.

Sign/symptom

The observed or detectable signs, and experienced symptoms of an illness, injury, or condition. A sign for example may be a higher or lower temperature than normal, raised or lowered blood pressure.

Transmission

The transfer of bacteria, viruses, fungi etc. directly from one individual to another by one or more of the following means:

- airborne transmission – very small dry and wet particles that stay in the air for long periods of time allowing airborne contamination even after the departure of the host.
- droplet transmission – small and usually wet particles that stay in the air for a short period of time. Contamination usually occurs in the presence of the host.
- direct physical contact – touching an infected individual, including sexual contact
- indirect physical contact – usually by touching a contaminated surface
- faecal–oral transmission – usually from unwashed hands, contaminated food or water sources due to lack of sanitation and hygiene, an important transmission route in paediatrics, veterinary medicine and developing countries.
- vector-borne – an infection which is passed from one individual to another through any agent which carries and transmits an infectious pathogen for instance a parasite or microbes. Mosquitoes are vectors for malaria.

Vaccination

The administration of a vaccine to help the immune system develop protection from a disease.

Virus

A tiny (sub-microscopic) infectious agent that multiplies inside the living cells of an organism. Viruses infect all types of life forms, from animals and plants to microorganisms, including bacteria

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Youth Against
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