MIDLANDS SCIENCE
Stay curious

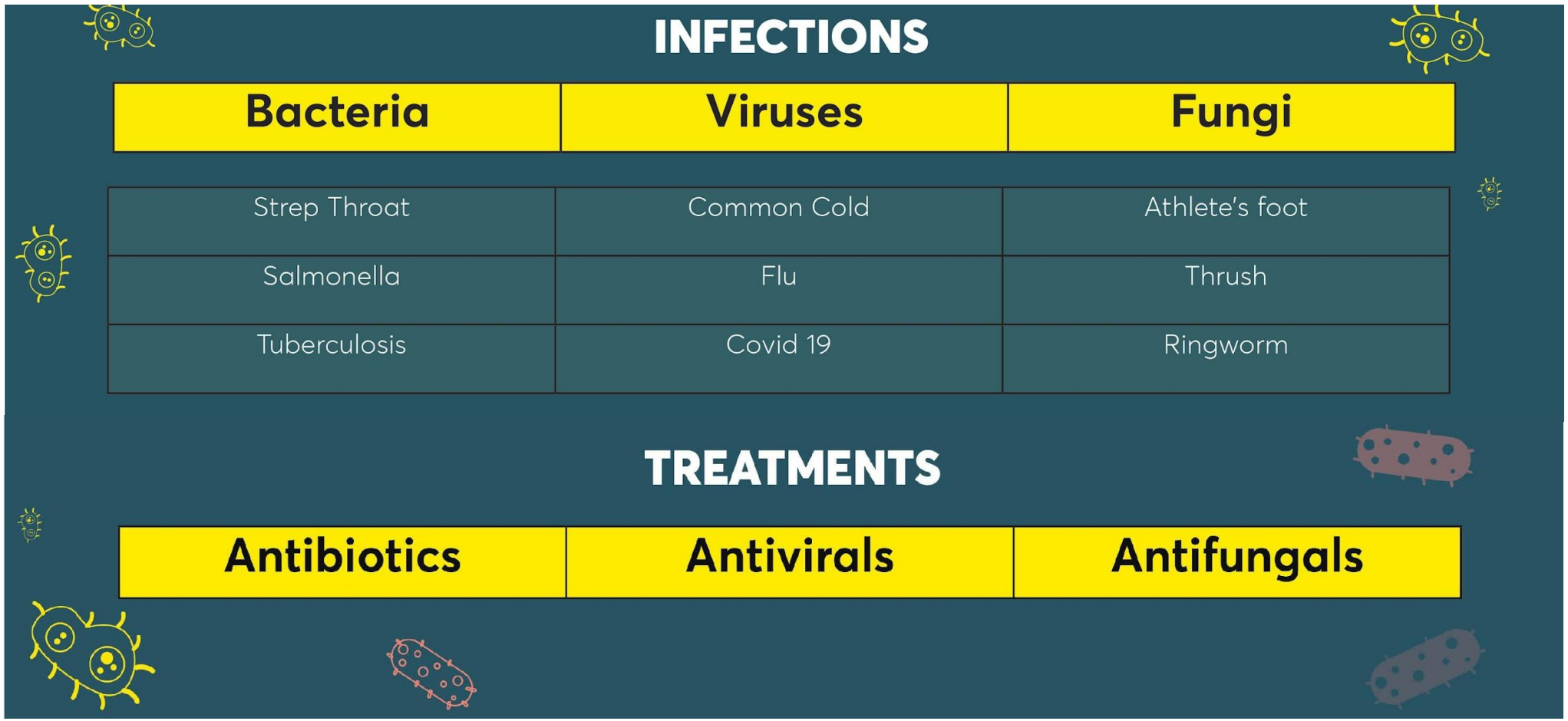
Antimicrobial Awareness

Learning Objectives

Today, we are going to:

- Learn about the history of antibiotics since their discovery
- Learn about the appropriate use of antibiotics and about World Antimicrobial Awareness Week
- Understand the basic science of antibiotics and how antibiotic resistance has developed
- Know about the implications of antibiotic misuse and resistance
- Discuss and reflect on the future of antibiotics in our lives

A quick review of some of the different types of microorganisms that can cause infection and how they are treated:



- Have you ever taken antibiotics?
- What did you need antibiotics for?

What are antibiotics?

- Antibiotics are powerful medicines that can be used to fight bacterial infections.

- **Anti** - means "against" in Greek
- **Biotic** - living things (Bio means "living" in Greek)

- Antibiotics kill or slow the spread of some microorganisms. Microorganisms include bacteria, viruses, and fungi such as mould and mildew.

Don’t forget that bacteria and other microorganisms are our friends too:

- Bacteria help to make cheese and yoghurt
- Yeast help to make bread and alcohol
- Mushrooms are tasty fungi
- Good bacteria in our gut help us break down food and fight infection
- We use microorganisms to help us make important medicines as well…

Antibiotics are an example of those important medicines and they were discovered by accident:

https://www.britannica.com/video/186404/discovery-penicillin-Alexander-Fleming (accessed November 2nd 2021)

What happens to bacteria when you take an antibiotic?

Antibiotics essentially work in one of two ways:

1. **Bactericidal** antibiotics kill bacteria by interfering with the cell wall or cell contents. Penicillin is an example.
2. **Bacteriostatic** antibiotics stop bacteria from multiplying. Tetracyclines are an example.

- Some antibiotics are **broad spectrum** and kill a large range of bacteria. They also kill normal gut bacteria.
- Other antibiotics are **narrow spectrum** and affect only a small range of bacteria.

https://microbiologysociety.org/why-microbiology-matters/what-is-microbiology/microbes-and-the-human-body/antibiotics.html

(accessed November 2nd 2021)

Now let’s do Worksheet 1

- Read the statements on the sheet and sort them into either the :

”Antibiotics do” or the “Antibiotics don’t” column.

Worksheet 1 answers:

1. Antibiotics do kill bacteria (but not all bacteria now)
2. Antibiotics don't treat only mild symptoms
3. Antibiotics don't help treat the common cold (caused by a virus)
4. Antibiotics do stop bacteria growing (but not all antibiotics now)
5. Antibiotics don't kill viruses
6. Antibiotics do treat pneumonia (if it's bacterial!)
7. Antibiotics don't treat hay fever
8. Antibiotics do kill many good bacteria in our body
9. Antibiotics don't treat all bad coughs (many are caused by viruses)
10. Antibiotics do treat strep throats (if required)
11. Antibiotics do treat diseases in animals (but only if they are caused by bacteria)
12. Antibiotics don't treat asthma
13. Antibiotics do help patients who get bacterial infections after surgery (sometimes)
14. Antibiotics do encourage our good bacteria to become resistant to antibiotics
15. Antibiotics don't make people resistant (they make the bacteria resistant)
16. Antibiotics don't treat all sorts of pain

Antibiotics were and still are important medicines but some bacteria have quickly learned how to adapt to become resistant

Antibiotics and the rise of resistant bacteria (sometimes called superbugs!)

https://www.pbs.org/show/its-okay-be-smart/
(accessed November 2nd 2021)

How can bacteria become resistant to antibiotics?

1. Develop methods to breakdown the antibiotic
2. Change their cell surface so antibiotics cannot get in
3. Change their own cell processes so that antibiotics don’t affect them
4. Learn to pump the antibiotic out of their cells

How can bacteria become resistant to antibiotics?

Normal bacteria

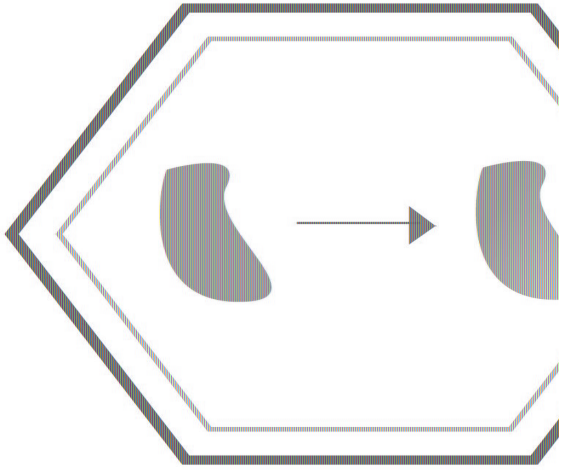
Resistant bacteria

Dead bacteria

Bacteria in the human body. Some are drug resistant.

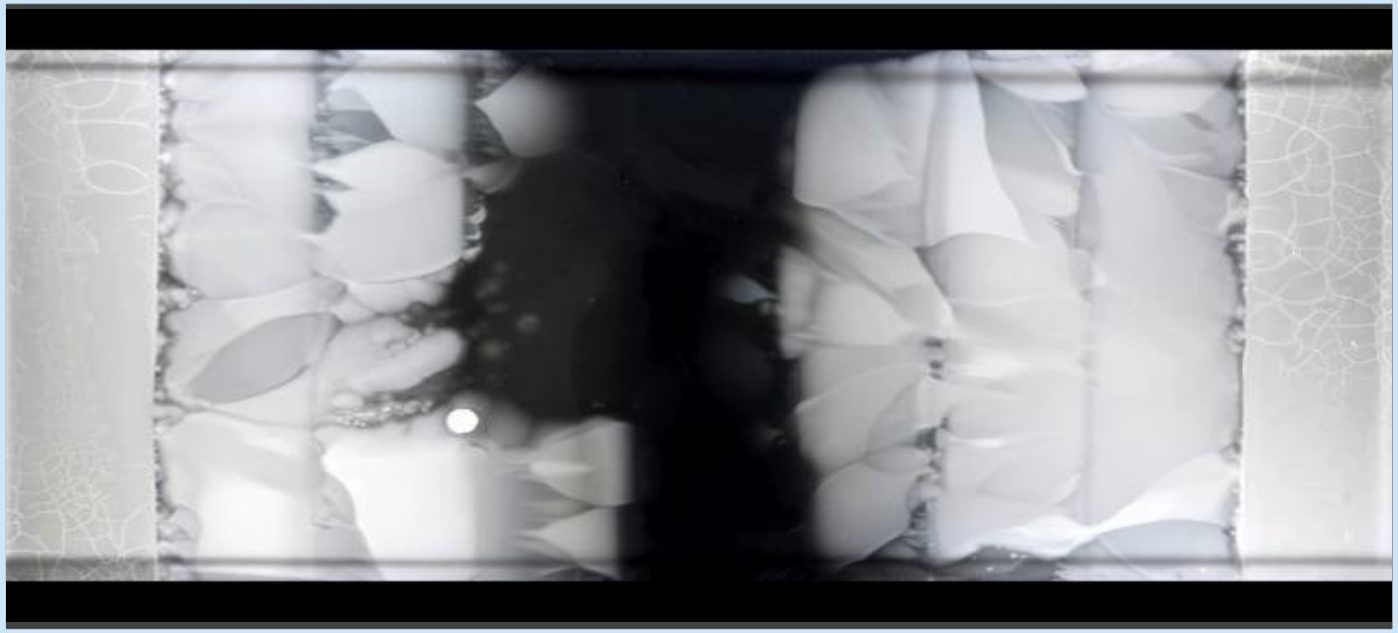
Antibiotics kill bacteria but resistant strains remain

Antibiotic resistant bacteria multiply



Antibiotic resistance spreads

Antibiotic resistance in action in the laboratory:



https://www.youtube.com/watch?v=yybsSqcB7mE
(accessed November 2nd 2021)

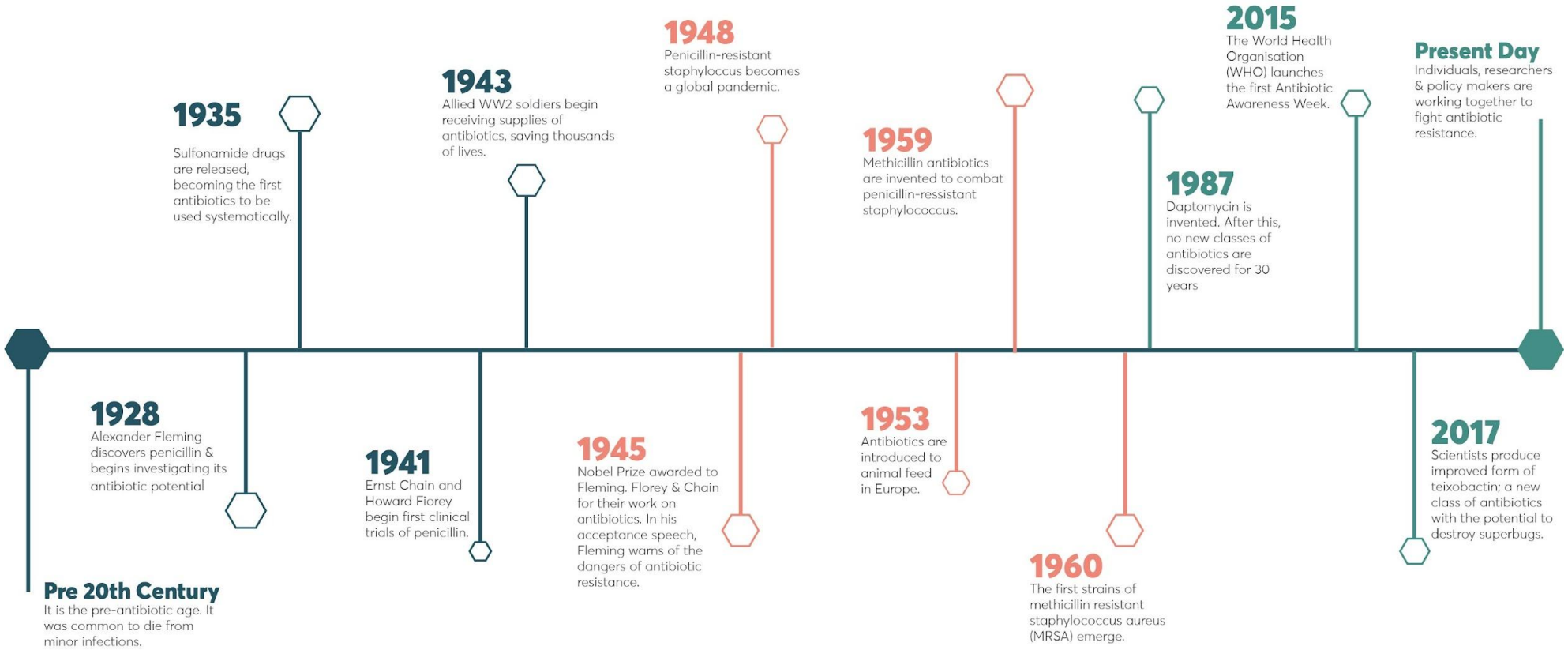
Factors that contribute to antibiotic resistance:

- Unnecessary prescription of antibiotics for viral infections
- Use of antibiotics when they are not needed or not prescribed
- Overuse of broad spectrum antibiotics
- Failure to finish a course of antibiotics as prescribed
- Overuse of antibiotics in animals/agriculture
- Residual antibiotics found in food
- Poor hygiene practices inside and outside of hospitals

Reference:
https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance
(accessed November 2nd 2021)

Antibiotic Timeline

A BRIEF HISTORY OF ANTIBIOTICS AND RESISTANCE



Adapted from https://fems-microbiology.org/eam-a-complex-solution-to-the-amr-crisis-is-possible/
(accessed November 2nd 2021)

The Future:

- There is now concern that some bacteria, called “superbugs” are resistant to all known antibiotics.[1]
- There haven’t been many new antibiotics developed in recent years.[2]
- There are now patients in Ireland who have infections that none of our antibiotics can treat.[3]
- Surveillance helps to track the spread of infections around the world. Just like we did with Contact Tracing during the Covid-19 pandemic.[4]
- Developing new antibiotics is expensive.
- Scientists continue to try to discover new antibiotics.
- Some of the responsibility around appropriate use of antibiotics lies with you…

[1]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4378521/

[2]https://www.bbc.com/news/health-41693229

[3]https://www.irishtimes.com/news/health/antibiotic-resistant-superbugs-pose-existential-risk-to-irish-health-service-1.3985293

[4]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4424431/
(all accessed November 2nd 2021)

How can you help prevent antibiotic resistance?

1. Antibiotics should be the last line of defence NOT the first.
   -Remember: many common infections will get better by themselves with time, bed rest, liquid intake and healthy living.

2. Only take antibiotics prescribed by your doctor.

3. If prescribed antibiotics, finish the course as prescribed.

4. Do not use leftover antibiotics or prescribed for someone else.
   -Remember: different antibiotics work on different bacterial infections.

5. Wash your hands with warm soapy water to prevent the spread of infection.

6. Spread the word!

- Let’s do a True/False Quick Quiz to test and summarise our learning

Answers to True/False Quick Quiz

1. Before antibiotics, people died from simple infections that we can easily treat today.[1]	TRUE
2. Bacteria make alcoholic products like beer and wine.	FALSE
3. Antibiotics were first discovered by Alexander Graham Bell.	FALSE
4. If you haven't ever taken antibiotics, then you can't be a carrier of antibiotic resistant bacteria.	FALSE
5. After taking antibiotics, you could still have antibiotic resistant bacteria living in your gut many years later.[2]	TRUE
6. There are some bacterial infections that are now resistant to all known antibiotics.[2]	TRUE
7. Bacteria can swap bits of their DNA with each other.[3]	TRUE
8. You should think about antibiotic resistance when you ask for antibiotics for a sore throat or ear ache.[4]	TRUE
9. Taking antibiotics may speed up recovery from a sore throat by only one day.[4]	TRUE
10. If prescribed antibiotics, you should stop taking them as soon as you feel better.	FALSE

References

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5354621/

[2] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4378521/

[3] https://www.britannica.com/science/bacteria/Exchange- of-genetic-information

[4] https://www.ncbi.nlm.nih.gov/books/NBK401243/