Key Stage 4 – Alternative antibiotics

Notes for teachers

At a glance

Antibiotics save lives – but for how long? As more and more antibiotic resistant strains appear how long is it before is antibiotics are missing from our bacteria-beating armoury?

The incentive for pharmaceutical companies to develop new antibiotics is low (they don’t make them enough money) so it is to scientists, like those at The University of Oxford, we turn to solve this problem – is there a viable alternative out there to current antibiotics?

In this activity students use a model to understand how antibiotic resistant bacteria develop and then investigate a possible solution.

Learning Outcomes

- Students explain how antibiotic resistant bacteria arise
- Students apply their understanding to explain how an alternative to antibiotics works
- Students write an opinion with their reasoning

Each student will need

- Copy of student worksheet pages 1 and 2

https://www.oxfordsparks.ox.ac.uk/content/bacteria-safari-forest-your-fingernail
For the class simulation

- Stickers/post-it notes
- Small sweets

Possible Lesson Activities

1. Starter activity

- Introduce antibiotic resistant bacteria to the class and initiate a discussion on what they already know. There are several ways of doing this. Suggestions include:
  - Write ‘MRSA’ on the board and ask students if anyone knows what this means. After hearing their ideas confirm that MRSA is a strain of antibiotic resistant bacteria.
  - Show the class some headlines from online news stories about the rise of antibiotic resistance bacteria.
  - Show a video about a survivor of an infection with an antibiotic resistant bacteria (see weblinks).
- If you find that students have little prior knowledge, play the video from the Antibiotic Guardian website (see weblinks).
- Give each student a copy of page 1 of the student worksheet and ask students to read through the information on the left hand side. Check that students understand that it is the bacteria that become resistant to antibiotics, not the people taking them.
- Play the animation 'Bacteria Safari: The Forest on your Fingernail', which introduces the work of microbiologists at The University of Oxford.

2. Main activity: Modelling why bacteria become resistant to antibiotics

- Ask the students to stand up. Tell them that they are all representing bacteria and the classroom is body they live in. Explain that they are all sharing the resources inside the body. They is only enough for them – no more.
- Some bacteria have a random mutation in their DNA which means that antibiotics do not kill them. It is important to point out here that bacteria do not mutate because of antibiotics i.e. they are trying to become resistant. Give five students a sticker/post-it note to place on their chest so they are marked out as being resistant.
- Tell them that the person they live in has started taking antibiotics. Give out sweets or cards to the students, which are representing the antibiotic. If you are not resistant the drug will kill you and you should sit down.
- The antibiotic resistant bacteria will still be standing. Question the class – what do you think will happen? (The resistant bacteria will reproduce by cell division – creating more resistant bacteria). Model this by giving the resistant students stickers to share around the class. All students are now resistant and should stand up.
- Model another round of antibiotics by giving out more sweets – discuss what will happen (no bacteria will die).
- Give each student a copy of page 2 of the student worksheet, and ask them to complete storyboard A and then answer the questions on page 1 of the worksheet.

Answers:
1. a) The resistant bacteria reproduced so there was more of them.

https://www.oxfordsparks.ox.ac.uk/content/bacteria-safari-forest-your-fingernail
b) The population of non-resistant bacteria would have stayed high, and the number of resistant bacteria would have been kept low (because of competition for resources).

c) It kills non-resistant bacteria so there is no competition for resources. The resistant bacteria can reproduce and grow in number.

3. Main activity: Alternative to antibiotics

- Introduce the fact that scientists are researching into alternatives to antibiotics. Bacteria will always become resistant to the drug used to defeat them – this happens because of evolution. So – why not try and use this to our advantage? One way this could be done is given on page 1 of the student worksheet. Ask students to read through this, complete storyboard B (from page 2) and answer the questions.

Answers:

2. a) The bacteria that are resistant to the drug continue to release the growth product. They use energy in making the product, so they do not reproduce. The other bacteria that surround it can no longer make the product so they start to reproduce. The numbers of the non-resistant bacteria increase but the resistant ones do not.

b) Yes – because bacteria will become resistant to whatever drug you use to try and kill them. If we continue to develop new antibiotics, bacteria will eventually become resistant to them, rendering the antibiotic ineffective. However, if scientists develop a drug that still works if the bacteria become resistant to it then that will always work.

4. Plenary

- Ask the class for a show of hands: who thinks new antibiotics should be developed and who thinks scientists should concentrate on alternatives?
- Invite students from each side to share the reasons for their choice.
- For a possible homework activity, ask students to read the article about a woman who died despite being given all available antibiotics (see weblink) and outline what the article is about.

Weblinks

Oxford Sparks animation:

https://www.oxfordsparks.ox.ac.uk/content/bacteria-safari-forest-your-fingernail

Video about a survivor of an antibiotic resistant infection

https://www.youtube.com/watch?time_continue=2&v=2PYY7thzdeM

Video about antibiotic resistance (from Public Health England)

https://antibioticguardian.com/

Woman dies despite being given all available antibiotics