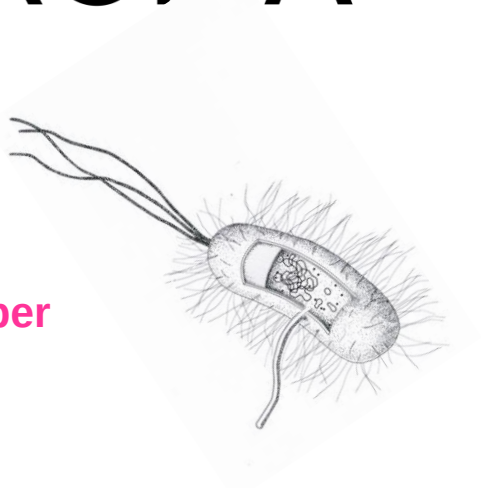
ARTIS MICROPIA

The antibiotics game



What are the consequences of improper or excessive use of antibiotics?

Bladder infection? Better stop by the doctor's for a course of antibiotics. We are also prescribed antibiotics for pneumonia, blood poisoning or osteomyelitis. Chemists in the Netherlands dispense antibiotics 7.2 million times per year.

WHAT ARE ANTIBIOTICS? Antibiotics are substances which kill bacteria or inhibit their growth. As a consequence, antibiotics help many people get better, but antibiotic usage also has risks. As a result of improper and excessive antibiotic use, certain strains of bacteria have become resistant to nearly every antibiotic. One notorious example of such a multi-resistant bacteria is the 'hospital bug' MRSA.

HOW DOES RESISTANCE DEVELOP? Bacteria can rapidly evolve and adapt to new conditions, including to the presence of antibiotics. It is therefore extremely important that you finish a course of antibiotics, even if you feel better again after a few days. There is always the possibility that living bacteria will still remain. The remaining bacteria can then re-infect you, while having become resistant to the antibiotics. If you become ill again now, the antibiotics will no longer make you better. As such, the search for new antibiotics has become a race against the clock.

THE OBJECT OF THE GAME: The object of the game is to show in a simplified way how antibiotics work and to demonstrate the potential consequences of improper or excessive antibiotic use.

AFTER PLAYING THE GAME, THE PUPIL WILL KNOW THAT:

- a combination of different antibiotics may be effective against a pathogen, but will also kill beneficial bacteria that you need in order to stay healthy.
- if you do not complete a course of antibiotics, the pathogens will sometimes survive. This increases the odds of resistance and there is a chance that that antibiotic will no longer make you better in the future.
- antibiotics are ineffective against viruses.

The various components can be covered in more detail, depending on the pupils' level. Need more information? Go to www.micropia.nl

Getting started!

Before the game begins, each pupil will receive a microbe card (see the six A4 cards at the back of this file). The teacher prints these cards and distributes them over the class members.
At the start of the game, everyone stands up. Some of you are the pathogens: an *E.coli* bacterium which can cause all kinds of infections. The rest are the body's own microbes and viruses. If the antibiotic in question affects a characteristic of your bacterium, then you will be dead and will have to sit down.

THE STORY:

'Sandra has been ill for some time and goes to the doctor. Her mother insists that the doctor prescribe her a course of antibiotics. But the doctor does not know exactly which pathogen is making the girl ill. For this reason, he prescribes a 'cocktail', a course consisting of four types of antibiotics which either stop or inhibit the activity of different components of the bacteria.'
'You are the microbes that inhabit in Sandra's body. Most of you are beneficial and very important for health. But…some of you are pathogens!
Each pupil with this microbe card (<<show pathogen *E.coli*, image A>>) is a pathogen.'

1. The first antibiotic to kick in is Lincomycin. This substance binds with the 50S ribosome and prevents protein synthesis. The 50S ribosome looks like this (image B). As a result, many of the proteins required for the bacteria's survival can no longer be produced. All bacteria that have this ribosome will die. So you can sit down. Unfortunately for the patient, the pathogenic bacterium does not have this ribosome and survives the antibiotic.

2. But there are still two other antibiotics in the course. The second antibiotic to kick in is called a type 1 pilus inhibitor. This substance prevents the development of pili, the hair-like appendages found on bacteria (image C). However, the pathogen does not have this characteristic, either, and is therefore still alive.

3. The third antibiotic to kick in is Cefixime. This substance prevents cell wall synthesis in gram-negative bacteria. The pathogen *E.coli* is a gram-negative bacterium, as is clearly apparent from its much thicker cell wall (image D) and is therefore not well equipped to withstand this.

The pathogen is now dead. But we are not done yet. Indeed, the course consisted of four different antibiotics.

4. The last antibiotic is Azithromycin. This prevents the development of flagella (image E). All microbes with these flagella are now dead.

But… as many people tend to do, this girl has stopped taking the antibiotics after a few days, because she actually felt better again. As a result, not all of the pathogens are dead. Prematurely discontinuing a course of antibiotics can cause bacteria to become resistant. The next time the antibiotic is used, it will no longer be effective against this pathogen.

5. Everyone whose card had a star (image F) on it can stand up again!

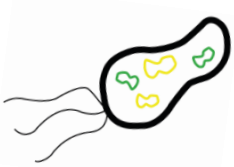
However, this pathogen is not the only one which survived. One group has a card with an image (image G) which is different from the images on any of the other cards. That is because it is a virus. And antibiotics are not effective against viruses.

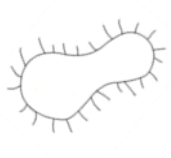
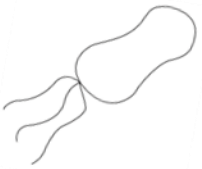
RESULT: The result of the game is that some of the pathogens have survived due to the course having been discontinued too soon. It is highly likely that these pathogens will become resistant to the antibiotics. If the girl falls ill again now, then there will be no point in taking the same antibiotics.
In addition, the viruses have also survived. So if you have a cold or a flu (illnesses caused by viruses) there is no point in taking antibiotics. On the contrary, taking antibiotics is not a good idea, as they kill your body's own bacteria – bacteria which you badly need in order to stay healthy!

TIPS FOR THE PUPIL:

- Always finish a course of antibiotics!
- First find out which pathogen is making you ill before taking large amounts of antibiotics!

LEGEND

A	The pathogenic *E. coli*	
B	The 50-S ribosome This ribosome produces important proteins.	

C	Pili Pili (singular: pilus) are hair-like structures found on the surface of bacteria. Bacteria can exchange genetic material or attach themselves to tissue via a pilus.	
D	Thick cell wall A cell wall determines the shape of a cell and gives it strength. The cell wall of gram-negative bacteria is much thicker than that of gram-positive bacteria.	
E	Flagella Flagella help bacteria move around.	
F	Yellow star Bacteria with this star are less sensitive to the antibiotics and survive.	
G	Virus Antibiotics are ineffective against infections caused by viruses.