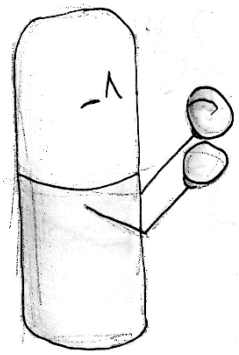
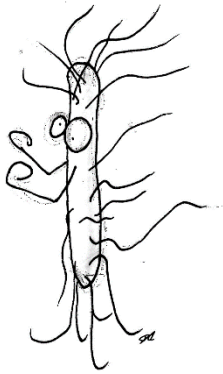


An Antibiotic Story



Overview

In this game, you are a bacterium. You have caused a urinary tract infection in a patient who is, therefore, being treated with antibiotics. The aim of the game is to survive five rounds of treatment…

Learning Objectives

By the end of this game you will:

1. Recall the mechanisms by which antimicrobial resistance genes can be spread
2. Describe how different bacterial physiologies affect their resistance to antibiotics
3. Communicate how antibiotic treatment can drive resistance

What you need

In order to play this game, you will need:

1. The "*An Antibiotic Story"* Spreadsheet. (This includes the rules and the phenotype card to record your adaptations)
2. A random number (1-6) generator (e.g. https://pickerwheel.com/tools/random-number-generator/) or D6 die

“Winning” the game

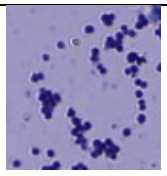
The game ends after 5 rounds. At this point, you will have either been eliminated or survived, and hopefully learnt something! You will be asked to answer questions after the game.

How the game works

Select your bacterium

To begin the game you must select your starting organism. You have two choices, each has different sensitivities to the antibiotics used.

Table 1. The bacteria species that can be selected for this game.

Identifier	Gram-stain	Effect of antibiotic
 *Escherichia coli*	Negative	Gentamicin – Susceptible Levofloxacin – Susceptible Penicillin **– Resistant** Polymyxin B – Susceptible
 *Staphylococcus aureus*	Positive	Gentamicin – Susceptible Levofloxacin – Susceptible Penicillin – Susceptible Polymyxin B **- Resistant**

Game structure

Once you have selected your bacterium, the rounds progress in the same order: (1) *Adaptation,* (2) *Treatment*. As the rounds progress the players either increase their arsenal of antibiotic resistance genes, or perish.

Adaptation phase

In this phase, player roll a dice (D6) or equivalent, and their bacteria gain or lose that specific ability. Any changes in a bacterium's phenotype should be noted on the player's *Phenotype card.*

Table 2. Potential phenotypic changes occurring in the *Adaption phase*

Number	Action	Phenotypic response
1	Mutation of DNA gyrase/ Topoisomerase IV	Resistance to Fluoroquinolones
2	Gain plasmid with efflux pump	Resistance to Aminoglycosides & Polymyxin B
3	Synonymous mutation	No change to phenotype
4	Transformed with DNA encoding bla_{PC1}	Resistance to β-lactam antibiotics
5	Lose all plasmids	All plasmid-encoded resistance is lost
6	Establish a biofilm	Resistant to all antibiotics for this round

Treatment phase

Here, your tutor will roll a die (D6) to subject all the bacteria to one of four antibiotics. Each antibiotic affects the types of bacteria differently, and the player must remove the specified cell number from their total.

Table 3. Antibiotics available for treatment phase and the consequences of administration

Number	Antibiotic
1	Polymyxin B
2,3	Levofloxacin
4,5	Gentamicin
6	Penicillin

Once the antibiotic has been administered your bacterium will either survive (has resistance to the treatment, continue to next round) or will perish (bacterium is susceptible, game over).

Recommended reading

Bush K. (2018) *Past and Present Perspectives of β-Lactamases* **Antimicrobial Agents and Chemotherapy** 62(10) e01076-18

Jacoby G.A. (2005) *Mechanisms of Resistance to Quinolones* **Clinical Infectious Diseases** 41: S120-S126

Mingeot-Leclercq M-P., Glupczynski Y. & Tulkens P.M. (1999) *Aminoglycosides: Activity and Resistance* **Antimicrobial Agents and Chemotherapy** 43(4): 727-737

Olaitan A.O., Morand S & Rolain J-M. (2014) *Mechamisms of plymyxin resistance: acquired and intrinsic resistance in bacteria* **Frontiers in Microbiology** https://doi.org/10.3389/fmicb.2014.00643

Zavascki A.P., Goldani L.Z., Li J. & Nation R.L. (2007) *Polymyxin B for the Treatment of Multidrug-Resistant Pahogens: a Critical Review* **Journal of Antimicrobial Chemotherapy** 60(6): 1206-1215