Beating bacteria

**Beating bacteria teacher notes**

Part of the research and development to create new medicines involves testing large numbers of chemical compounds to look at their biological activity. Decisions have to be made to pick which should be taken on to further development and production. It can be relatively quick and easy to obtain some key experimental results on large numbers of compounds using isolated enzymes or cells. However other tests that involve the use of animals and human patients must only be carried out on a selected small number of compounds.

This exercise looks at a hypothetical, but realistic, project aimed at a new way of treating bacterial infections. Students first need to consider what features are important for a treatment using tablets (oral dosing). Once they have decided which compound to progress they look at production and marketing timescales.

There are two levels for the data analysis activity.

**Version 1.** The data for 10 compounds is presented in a table and students can sort the compounds “by eye” and decide which one to take forward into clinical trials in patients.

**Version 2**. The decision making involves data sets from 52 compounds. This is too much data to sort “by eye” and so sorting techniques using Excel spreadsheets are used just as in the pharmaceutical industry. Such computation techniques are often very sophisticated and the sciences of chemoinformatics and bioinformatics have developed to manipulate information on data sets from thousands of compounds.

# Aims and Objectives:

* To develop research and data analysis skills
* To develop decision making skills
* To learn about the critical factors which contribute to making a good medicine
* To learn about bacterial infections and their treatment using antibiotics.

Higher level:

* To show how ICT sorting techniques can be used to make sense of large sets of data.

## Resources:

# ‘Bacteria and antibiotics research task sheet’

Students will need to have a computer with Internet access available to them for the first background searching activity (this activity can be excluded if required).

**For Version 1:**

## ‘Beating Bacteria - Activity Version 1’ (Word document)

**For Version 2:**

‘Beating Bacteria - Activity Version 2’ (Word document)

‘Beating Bacteria 1’ (Excel spreadsheet)

(Note: spreadsheets ‘Beating Bacteria 2’, ‘Beating Bacteria 3’ and ‘Beating Bacteria 4’ are answer sheets for teacher use)

# Lesson Structure:

1. Students work in teams of three or four to use the internet to research bacteria and antibiotics and answer the questions on the “Bacteria and antibiotics research task” sheet. Give them a time limit. The first team to answer all the questions correctly could win a prize. Teams could trade answers with each other to develop negotiation skills. Go through the answers with the class.
2. In their teams students work through activities 1 - 4. There are 2 versions of the Activity Sheet.

* “Beating Bacteria - Activity Version 1” is for general use. (NB: You may want the students to calculate selectivity for themselves, or get them to put the potency and side effect data into a spreadsheet).
* “Beating Bacteria - Activity Version 2” has more challenging activities 1 and 2 aimed at higher ability students. Version 2 may take longer than Version 1

Activities 3 and 4 are the same for both levels

# Answers:

### Beating bacteria version 1:

Activity 1: The 3 key factors for an oral medicine as an antibiotic for are potency, selectivity and bioavailability.

Activity 2: Compound H is the best compound. C and E are good candidates but H is more potent. Although compound ‘I’ has the best selectivity, its bioavailability is not so good.

Activity 3: It will take 12 months for the company to do it themselves. The monitoring device can be ordered at the same time as ordering the raw materials. To contract it out to another UK company would take 14 months.

Activity 4: The earliest launch date is 6 years from the end of this year.

### Beating Bacteria version 2:

Activity 1: refer to the spreadsheets ‘Beating Bacteria 2’, ‘Beating Bacteria 3’ and ‘Beating Bacteria 4’, the 4 best compounds are AZ, AM, BL, AH

Activity 2: BL has the best bioavailability and should be taken on further.

Activities 3 and 4 are the same as in version 1.