# Teaching ideas for Option B: Biotechnology and bioinformatics

This is a diverse option that includes aspects of health, ecology and biotechnology. The positive roles of microbes in the environment can be contrasted with the problems that some of them cause in human disease. The vast range of microbes makes them potentially useful in the future for bioremediation and production of biofuels.

## Ideas for the lesson

• For general information on the teaching of microbiology, [**www.microbiologyonline.org.uk**](http://www.microbiologyonline.org.uk) has useful links and resources.

• Invite students to draw up their own table of pros and cons of genetically modified plants and animals. Investigate the range of products that are now made using genetically modified organisms.

• Ask students to research the worldwide use of biofuels and their potential for the future.

• Recent oil spills provide the opportunity for students to research environmental protection and bioremediation. They should discuss how both physical and biotechnological techniques are used. Students can research new uses of bacteria in bioremediation and assess the likelihood of success of these projects as well as potential dangers.

• Compile a list of genetic diseases for which predisposition can be detected through markers. Discuss cases of women who have opted for mastectomy following investigation of their family history and diagnosis of predisposition. Websites such as [**www.cancer.gov/cancertopics**](http://www.cancer.gov/cancertopics) provide background information (search for ‘BRCA’).

• Ask students to draw parallels between the 1918 influenza pandemic and the threats posed by more recent outbreaks. There are good historical resources at [**www.bbc.com/news/health**](http://www.bbc.com/news/health) (search for ‘1918 killer flu’) and [**www.archives.gov/exhibits/influenza-epidemic**](http://www.archives.gov/exhibits/influenza-epidemic).

• The Virtual Museum of Bacteria ([**http://bacteriamuseum.org**](http://bacteriamuseum.org)) contains links to some useful exercises on epidemiology and pandemics.

• John Snow’s location of the source of cholera in London in 1854 is a good example of the detection of infection in water.

• Biofilms cause problems in hospitals, kitchens and industrial pipes but are useful in sewage treatment. Students should investigate useful and harmful biofilms and discuss their emergent and other properties. A visit to a local sewage treatment plant (if available) would be a good supporting activity.

## Practical activities

• Supply students with yoghurt, buttermilk or sour cream to carry out the Gram stain procedure (as set out in Practical **2**). Yoghurt contains two types of bacteria, chains of cocci or diplococci (*Streptococcus thermophilus*) and rod-shaped bacilli (either *Lactobacillus acidophilus* or *L. bulgaricus*). The bacteria will be Gram positive (staining purple) and the milk protein casein will stain pink.

• Supply students with the necessary ingredients and ask them to prepare bread dough that rises to the greatest height (or volume). This can be used as the basis of a practical in which students consider the optimum conditions for yeast activity. Students may also like to brew non-alcoholic ginger beer to investigate aerobic activity of yeast (for example, see [**www.scienceinschool.org**](http://www.scienceinschool.org) – search for ‘ginger beer recipe’).

## ICT

• Students should investigate the BLAST database and find out about its use in research. They should also examine the use of expressed sequence tags (ESTs) to identify potential genes.

• The database Ensembl can be used to investigate chromosome 21.

• Cladograms can be constructed using software to relate organisms from similarities in the DNA sequences.

## Theory of knowledge (TOK)

• Measurement of risk is difficult in many situations involving disease transmission and control. Recent measures taken to prevent the spread of swine flu can be discussed. How can sensible precautions be defined?

• Databases are a valuable tool in research but how reliable is data gathered in different ways in different laboratories?

## International mindedness

• International cooperation is vital in environmental protection and cleaning up after an oil spill. What is the role of international agencies, such as the United Nations, in coordinating such actions? What responsibilities do commercial companies and governments have when accidents occur?

• How important to developing countries is the use of biofuels that can be produced on a small scale?

• What are the attitudes of different countries and cultures to the use of new treatments such as gene therapy?