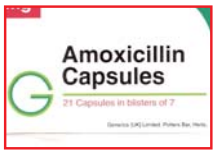
MiSAC*activities* 1

PRODUCED BY THE *MICROBIOLOGY IN SCHOOLS ADVISORY COMMITTEE*

Microbial technology

What microbes can do for us

The term "microbial technology" is used here to reflect the major contribution that the activities of microbes make to the processes of biotechnology. In fact, microbes and their enzymes are the major biological agents involved in biotechnology although much progress has been made with culturing animal and plant cells using techniques based on those developed for microbiology. Important examples of the contributions that benefit our everyday lives by their involvement in producing goods and providing services are summarised in the following table, arranged in 6 areas. The table provides reference material for the classroom activity described on page 2.

	AREA	EXAMPLES OF GOODS AND SERVICES
	Food and drink	dairy products (e.g. cheese, yoghurt) meat products (e.g. salami) bread, chocolate alcohol, vinegar, coffee mushrooms yeasts for baking, brewing yeast extract (e.g. *Marmite*) novel foods (e.g. *Quorn*) health foods (e.g. *Actimel*, *Yakult* (probiotics); algae) oriental foods (e.g. tofu) and flavours (e.g. soy sauce) food and drink additives (flavours, colours, acidifiers, antioxidants, thickeners, amino acids, vitamins) enzymes (e.g. soft-centre chocolates, starch products) quality assurance
	Agriculture and horticulture	soil fertility (e.g. root nodules, mycorrhiza) animal feed (e.g. silage, spent yeast from brewing) biological control of insect pests (e.g. fruit, vegetables, flowers) veterinary vaccines and antibiotics
	Healthcare	antibiotics (e.g. methicillin) vaccines (e.g. hepatitis A and B, influenza, pneumonia, polio) human insulin steroids diagnosis (antibodies, enzymes) vitamin supplements
	Environment and recycling	treatment of sewage, industrial effluent, oil spills at sea water and air quality assessment solid waste management (landfill, composting) metal recovery from ores (e.g. copper)
	Energy	gasohol/bioethanol, biogas/methane oil recovery
	Chemicals	organic acids (e.g. citric acid, lactic acid) carbon dioxide (excess from brewing) enzymes (e.g. washing powders, meat tenderisers) perfumes polymers (e.g. dextran, alginate) solvents, fuel (e.g. industrial ethanol)

Please turn over

Classroom activity

The activity uses sets of related exhibits drawn from a wide range of readily available products, materials and processes (or pictures or models of them) in which microbial action is involved in some way or other. The exhibits show the beneficial aspects of microbial activity. As a guide, items for the exhibits displayed on trays are suggested below but there is a wide variety of suitable products on which to draw and several ways in which they may be grouped. It may be felt necessary to simplify the table on page 1. This degree of flexibility is useful in adapting the activity for various purposes and age groups.

The activity is suited to use either in carousel form with each student provided with a copy of the table on page 1 and a response sheet (see example, bottom page 2), or with a different student group allocated to each set of exhibits and given responsibility for reporting its findings back to the whole class.

AREA	TRAY	EXHIBITS	NOTES ON EXHIBITS
Food and drink	1 2 3 4 5	Beer, lager, wine, whisky, vinegar, coffee Bread, cheeses - Blue, Swiss, Cheddar, V Yeast extract, soy sauce, fizzy drink, food labels Yoghurt (pasteurised and live/bio), fizzy drink, probiotics, food labels Mushrooms, *Quorn*, dried yeast	Labels on products carry useful information including details of food additives, names of the microbes involved, e.g. the bacteria in live/bio yoghurt, and contact details of customer relations departments. “V” (Tray 2) refers to the suitability of a cheese for vegetarians. Many such cheeses are made using rennet (chymosin) produced by genetically modified (GM) bacteria and yeasts instead of that from a calf’s stomach. Some producers use a chymosin-like enzyme, known as “fungal rennet”, from non-GM moulds.
Agriculture and horticulture	6	Soil, peas/beans/clover, crop waste, composting, grass, silo/silage bale	A packet of a legume seeds is suitable but in season the whole of a pea, bean or other legume plant (e.g. clover) showing root nodules provides a clearer lead to N-fixation; for ensilage use a picture of a silo or silage bales.
Healthcare	7	Antibiotics, vaccines, human insulin (GM), leaflets, health foods and supplements	Empty boxes and vials of medical products with information sheets are often available from a GP and information leaflets from a pharmacy or surgery.
Environment and recycling	8	Domestic waste, dustbin, refuse collection, garden waste, compost(er), cow/sheep/goat	Include local authority leaflets on recycling and pictures of a dustbin, collection and disposal (e.g.landfill), and garden composting. Toy models of ruminants provide a link to the anaerobic production of methane in landfill.
Energy	9	Toilet paper roll, “sewage”, drinking water, pollution news articles, cow/sheep/goat	Sewage treatment is also relevant toTray 8 but here the link is to on-site methane generation as an energy source, hence the ruminants. A closed bottle of water + 5-10% (v/v) soil and pieces of toilet paper, etc. gives the appearance of raw sewage.
Chemicals	10	Biological washing powder, alginate, fizzy drink, motor car, petrol pump	Concern about the cost of oil and climate change has focused attention on gasohol (ethanol + petrol) and bioethanol as motor fuel. Fermentation of sugar cane for this purpose began in Brazil in the 1970s. Interest in using sugar, wheat and maize is now worldwide e.g. US and Europe, notably Sweden. (Also relevant to Tray 9.)

General note It is advisable to present samples of foods, soil, grass, domestic refuse, water, etc. in closed transparent containers.

Student response sheet

TRAY	EXHIBITS	AREA	INVOLVEMENT OF MICROBES

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