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.

<table>
<thead>
<tr>
<th>AREA</th>
<th>EXAMPLES OF GOODS AND SERVICES</th>
</tr>
</thead>
</table>
| 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)  |
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.

<table>
<thead>
<tr>
<th>AREA TRAY</th>
<th>EXHIBITS</th>
<th>NOTES ON EXHIBITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and drink</td>
<td>1</td>
<td>Beer, lager, wine, whisky, vinegar, coffee</td>
</tr>
<tr>
<td>Food and drink</td>
<td>2</td>
<td>Bread, cheeses - Blue, Swiss, Cheddar, V</td>
</tr>
<tr>
<td>Food and drink</td>
<td>3</td>
<td>Yeast extract, soy sauce, fizzy drink, food labels</td>
</tr>
<tr>
<td>Food and drink</td>
<td>4</td>
<td>Yoghurt (pasteurised and live/bio), fizzy drink, probiotics, food labels</td>
</tr>
<tr>
<td>Food and drink</td>
<td>5</td>
<td>Mushrooms, Quorn, dried yeast</td>
</tr>
<tr>
<td>Agriculture and horticulture</td>
<td>6</td>
<td>Soil, peas/beans/clover, crop waste, composting, grass, silo/silage bale</td>
</tr>
<tr>
<td>Healthcare</td>
<td>7</td>
<td>Antibiotics, vaccines, human insulin (GM), leaflets, health foods and supplements</td>
</tr>
<tr>
<td>Environment and recycling</td>
<td>8</td>
<td>Domestic waste, dustbin, refuse collection, garden waste, compost(er), cow/sheep/goat</td>
</tr>
<tr>
<td>Energy</td>
<td>9</td>
<td>Toilet paper roll, “sewage”, drinking water, pollution news articles, cow/sheep/goat</td>
</tr>
<tr>
<td>Chemicals</td>
<td>10</td>
<td>Biological washing powder, alginate, fizzy drink, motor car, petrol pump</td>
</tr>
</tbody>
</table>

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

Student response sheet

<table>
<thead>
<tr>
<th>TRAY</th>
<th>EXHIBITS</th>
<th>AREA</th>
<th>INVOLVEMENT OF MICROBES</th>
</tr>
</thead>
</table>

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