Stirring stuff

Curriculum links

<table>
<thead>
<tr>
<th>Key stage three programme of study: design and technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key concepts</td>
</tr>
<tr>
<td>1.1b and d, 1.3a and c, 1.4a and b</td>
</tr>
<tr>
<td>Key processes</td>
</tr>
<tr>
<td>2c - e</td>
</tr>
<tr>
<td>Range and content</td>
</tr>
<tr>
<td>3a, b, and e - g</td>
</tr>
<tr>
<td>Curriculum opportunities</td>
</tr>
<tr>
<td>4a - d</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SQA technology outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third level</td>
</tr>
<tr>
<td>TCH 309D, 310D</td>
</tr>
<tr>
<td>Fourth level</td>
</tr>
<tr>
<td>TCH 409D</td>
</tr>
</tbody>
</table>

Introducing the activity

The Tomorrow’s Engineers What is engineering? poster shows a soft drinks factory and tanker, and makes the point that engineers are involved in all aspects of food production. This activity focuses on one aspect essential to nearly all processed foods – mixing ingredients.

You could start with a survey of everyday food labels, counting the number of ingredients in each. Produce a tally chart of how many food products contain only one ingredient, two to four, five to ten, or more than ten. Pupils will find that the majority of foods contain many ingredients.

Through discussion, ensure that pupils realise:
- measured amounts of each ingredient need to be mixed together
- simply adding separate ingredients to the same vessel results in only limited mixing, depending on their physical form and the method of addition
- after initial mixing, some form of stirring is normally required, for even distribution through the product
- that stirring methods need to be matched to the materials being mixed. The pupil worksheet mentions soft drinks and bread dough as contrasting examples.

The practical activity

Depending on class size and facilities, pupils may work individually or in small groups.

The worksheet provides some initial questions to prompt pupils to think about what’s involved in mixing foods. The main activity then comprises two investigations (unstirred mixing and stirring techniques) and a food preparation (following a recipe in which pupils must decide on the most suitable method of mixing). It may be best to carry out the activity in a food technology room, making sure its hygiene standards are adhered to. If not, pupils should not eat the food.

A: Unstirred mixing

Each pupil or group should be given two ingredients, and challenged to think of, and then try out, three ways to mix the two ingredients without using mechanical stirring. It is suggested that each group uses a different pair of ingredients, covering various combinations of the five types of ingredient listed in the worksheet. Avoid pairing two miscible runny liquids, since these mix too easily. Possible methods include:
- pouring in simultaneously, so that the two streams meet in mid-air (but inside the vessel)
- spraying in a liquid ingredient
- swirling the vessel during addition
- shaking the closed vessel
- rotating the closed vessel about one or both horizontal axes.
Pupils then compare results across the class to deduce which method is most effective for each combination of ingredients. ‘Effective’ is defined as giving a thorough mix in the shortest time and/or with the least effort. They should discover that, when using a runny liquid, almost any method works while, with some ingredients, certain methods are clearly more effective than others.

**B: Stirring techniques**

Pupils plan and carry out tests to compare different methods of stirring, using the same pair of ingredients as before. They decide what factor they will investigate – or you may wish to allocate these, to ensure a balanced distribution across the class. The most obvious choices are stirrer blade design and its motion.

Stirrer blade designs include flat, curved, multiple tines and multiple wires. For their small-scale tests, pupils could use kitchen implements – knife (or spatula), spoon, fork and whisk respectively. The blade may follow various patterns of movement, such as horizontal (back and forth), circular (in one direction), circular (reversing direction at intervals), figure-of-eight, planetary (spinning on its axis while the axis itself follows a circle), or two blades counter-rotating.

Note: Studying stirring speed would be pointless, since it is a foregone conclusion that faster stirring gives faster mixing.

Pupils should follow up their experiments by researching commonly used methods of mixing food on a small scale (at home), medium scale (school kitchen or restaurant) and large scale (food manufacturing).

If possible, arrange for pupils to visit the school kitchen, to see the types of mixing equipment used for hand and machine mixing.

Through class discussion, pool the information gained from their practical work and research, to decide which mixing methods appear best for particular types of ingredients.

Pupils can now put their understanding to the test, by following a recipe which has had the mixing instructions removed. They must decide the most appropriate method to use, bearing in mind the nature of the ingredients. At that stage in the preparation, they should ask you to watch the mixing and judge the effectiveness of their chosen method.

**Reverse stirring**

Ask what will happen if a mixture is stirred, and then ‘un-stirred’ in the reverse direction. Will the mixture ‘un-mix’ and return to its original state? Pupils could try it with a thick liquid (such as flour/water paste or yoghurt) and one drop of colouring. Use only a quarter turn, and carefully reverse along the same track. Interesting discussions can arise from asking why it is not possible to un-mix a mixture, though the true answer (entropy) is well beyond pupils at this stage.

Note: Studying stirring speed would be pointless, since it is a foregone conclusion that faster stirring gives faster mixing.

Pupils should follow up their experiments by researching commonly used methods of mixing food on a small scale (at home), medium scale (school kitchen or restaurant) and large scale (food manufacturing).

If possible, arrange for pupils to visit the school kitchen, to see the types of mixing equipment used for hand and machine mixing.

Through class discussion, pool the information gained from their practical work and research, to decide which mixing methods appear best for particular types of ingredients.

Pupils can now put their understanding to the test, by following a recipe which has had the mixing instructions removed. They must decide the most appropriate method to use, bearing in mind the nature of the ingredients. At that stage in the preparation, they should ask you to watch the mixing and judge the effectiveness of their chosen method.

**Edited recipes**

You will need a series of simple recipes, edited so that they show where mixing is required, but specific mixing instructions have been deleted. It will be easier to judge the effectiveness of mixing if recipes are used that involve contrasting-coloured ingredients or where lumps, such as margarine, need to be incorporated to give a smooth product.

**Differentiation**

Pupils with more experience of home cooking will be at an advantage, being already well versed in a variety of mixing techniques, though they may not have thought the reasons for using different methods. Such pupils could be given the more challenging ingredients, such as solid fats. Novice cooks could be encouraged by using ingredients that can be mixed easily by several methods.

The focus of the activity could be biased towards practical outcomes, or towards theoretical understanding. That is, the effects of blade design and motion, or possible reasons for the differences in these effects. (See extension 4, next page.)
Possible extensions

1. How do manufacturers mix immiscible ingredients, such as oil and vinegar in mayonnaise / salad dressings, or fat and water in margarine?
2. What is the purpose of a liquidiser, and how does it work?
3. Why do some mixtures require gentle mixing – for instance, folding sugar into meringue? What is the best method to achieve this?
4. Discuss shapes of kitchen mixer attachments – beater, whisk, dough hook and blender/liquidiser blades.

Information sources

- http://www.foodmixers.com/how-to-select.asp (and linked pages)
- http://www.sideswipeblade.com/ (novel blade design)