How is milk processed?

Harmful and helpful bacteria
Before buying and eating any food it will have been checked or tested to make sure that it is safe. With some foods this is very easy. Salads, for example, are cleaned and checked for quality before they are bagged up. Visual checks are made and metal detectors used to remove any unwanted objects.

With some food it is more difficult to ensure that it is safe. For example, you cannot tell by looking at milk if it is safe. In its raw form, milk may contain bacteria that are harmful or pathogenic. On very rare occasions, bacteria can enter milk from cows, or during milking from the workers or the equipment. But a process of heating, holding and rapid cooling, called pasteurisation (after Louis Pasteur, the French scientist), ensures that this bacteria is destroyed.

Pasteurisation
Pasteurisation is the main method of processing milk.

This mild form of heat treatment kills any pathogenic bacteria that may be present, without affecting the nutritional value or the flavour. It also extends the shelf life by reducing the *spoilage bacteria*. Pasteurised milk can be kept for up to five days in a refrigerator.

The pasteurisation process involves heating milk to 71.7°C for at least 15 seconds. This is known as a HTST (High Temperature Short Time) process. As soon as the heating ends, the milk is cooled rapidly to less than 6°C (often to around 3°C). The device used for heating and cooling is called a heat exchanger, or pasteuriser.

Ultra Heat Treated (UHT) milk
This form of heat treatment kills all bacteria in milk and is practically sterile. The UHT process involves sterilising homogenised milk (see introduction 3.4) by a continuous process using direct or indirect heating.

With direct heating the milk reaches a temperature of 140-150°C either by injecting steam directly into the milk or by forcing the milk through a fine nozzle into a tank filled with steam. The milk is then cooled in a sterile vacuum chamber, where the added steam or excess water is evaporated.

With the indirect heating process, a temperature of at least 138°C is achieved by passing milk through a heat exchanger using steam under pressure for the final stage of heating. The milk is then aseptically cooled.

The cartons are filled under sterile conditions and heat sealed. The cartons are made of laminated material. There are three layers – paper, plastic and foil – coated onto polyethylene.

Unopened UHT milk can be kept for several months.

Homogenisation
Some heat treated milks are homogenised before heat treatment. These include some pasteurised milks (homogenised and semi-skimmed), UHT and sterilised milks.

Homogenisation is a process that involves forcing milk through a tiny hole under considerable pressure. This breaks up the fat globules making them smaller and a uniform size. If larger fat globules are left in milk, these rise to the surface and form a cream layer, but in homogenised milk, the fat stays evenly distributed throughout the bottle or carton.

How is milk processed
Activity 1
Investigating the effect of heat treatment on product flavour

When a food is heated many changes take place:

- Food may become thicker e.g. rice pudding thickens
- The flavour might change, e.g. a toasted cheese sandwich tastes different from a cold cheese sandwich
- Some materials may change their nature e.g. eggs become hard or set
- The nutritional value may be changed, e.g. some vitamins may be lost.

In the past, milk was pasteurised by a method known as the Holder process. This involved holding the milk at 65^{o}C for 30 minutes. Although this process destroyed harmful bacteria, the flavour and nutritional value of the milk was affected. Now the High Temperature Short Time (HTST) process is used which allows continuous production with minimal change to the product. This process results in relatively small changes in the milk's flavour and nutritional composition.

You will need:

Samples of fresh, UHT and sterilised whole milk.
Clean glasses and straws.
Water to rinse the mouth between samples.

1. Set up a sensory test for the samples. You may want to use a triangle test (see activity 1.2).
2. Ask your testers to describe the differences between each sample and ask them which one they prefer.

Can they tell the difference between the samples?
Does the heat treatment effect the preference of the testers?

Further test
In addition you could set up a test to compare other milks such as skimmed fresh milk, dried milk, evaporated milk.

How is milk processed
Activity 2
How to store pasteurised milk

Bacteria and other microorganisms are responsible for causing food spoilage. Bacteria, like any other living organism need the right conditions to thrive and become active. It is almost impossible to remove all the microorganisms in milk. However, once most have been destroyed, the remainder can be made inactive by correct storage.

Testing for food spoilage organisms
Milk spoilage organisms cause milk to turn sour. Sour milk not only tastes unpleasant, but also has an unpleasant smell and texture. Before milk leaves the pasteurisation plant it will have been tested to assess the keeping quality. The test uses a blue dye that goes colourless if a large number of milk spoilage organisms are present.

The methylene blue test
Why the test is carried out
To check to see if microorganisms which cause milk to turn sour are present.

How the test is carried out
Samples of milk at different stages of heat treatment are tested to see how well they discolour the chemical, methylene blue. The milk is considered to be satisfactory and will keep well if it stays blue when tested.

Sample results

Test	Type of milk	Colour
1	Raw	Pale/clear
2	Pasteurised	Blue
3	Sterilised	Blue

- Why is this test carried out on milk after it has been heat treated?
- What result would you expect if raw milk were tested?
- Explain why samples 2 and 3 do not discolour the dye
- Which is the control sample?