**Activity: Separating curds and whey**

In this activity, students investigate how variations in processing cheese curd change the final cheese characteristics. As an extension, students learn how these cheese characteristics relate to the molecular structure of the cheese.

By the end of this activity, students should be able to:

* explain how manipulating the cheesemaking process and conditions produces variations in cheese texture
* better understand how the structure of milk changes in the cheesemaking process
* effectively conduct experiments to test a range of parameters in forming and processing cheese curds and draw valid conclusions.

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**Introduction/background**

Milk is about 86% water with the rest made up of fat, carbohydrate (mainly lactose), proteins (casein and whey), minerals and vitamins.

The cheesemaking process causes the casein protein to coagulate and release liquid whey.

The amount of whey released can be manipulated by adjusting the conditions at various stages of the cheesemaking process. Variations in the amount of whey retained in the cheese contribute to the wide range of differences in cheese texture and flavour.

In cheesemaking, one of the key stages where whey release is controlled is the cutting and processing of the curd. Curd size, temperature and agitation all have an impact on the final texture. The cheese also continues to release moisture during the ripening stage. Therefore, an aged cheese has lower moisture content and a harder texture than a fresh cheese.

Before doing this activity, it will be helpful for students to have a basic understanding of the key steps in cheesemaking and to have examined a variety of different types of cheese including a range of different textures.

Get articles: [The science of cheese](https://www.sciencelearn.org.nz/resources/827-the-science-of-cheese) and [Creating different cheese characteristics](https://www.sciencelearn.org.nz/resources/829-creating-different-cheese-characteristics)

Get activity: [Identifying cheese characteristics](https://www.sciencelearn.org.nz/resources/835-identifying-cheese-characteristics)

Students need to learn about safety hazards in cheesemaking and how to minimise them prior to this activity. It is essential that the work area and equipment used in this activity are cleaned and sterilised and that personal hygiene practices are followed.

Contamination of the milk or the resulting curd by foreign bacteria may affect the coagulation of the milk. Contamination may also make the cheese unsafe to taste.

Get activity: [Safety in cheesemaking](https://www.sciencelearn.org.nz/resources/836-safety-in-cheesemaking)

Get interactive: [Quality control in cheesemaking](https://www.sciencelearn.org.nz/embeds/36-quality-control-in-cheesemaking)

Cheesemaking supplies, including rennet, calcium chloride and starter cultures are readily available from home brew supply stores, online cheesemaking stores and some specialist delicatessens. Supermarkets stock limited quantities of silver top milk.

**What you need**

* Large stockpot
* 4 litres pasteurised, non-homogenised milk (silver top)
* Stove top or heating element
* Calcium chloride
* 1 sachet of mesophilic starter culture
* ½ rennet tablet
* Pipette
* 6 glass bowls or beakers – equal sizes – large enough to hold 600 ml of milk
* 3 pots large enough to hold the bowls or beakers
* Measuring jugs
* Electric jug
* 6 stainless steel spoons for stirring
* 6 stainless steel knives for cutting the curd
* 6 colanders and 6 sterilised Chux cloths or cheesecloth or alternatively 6 cheese moulds
* 6 ice cream containers
* Thermometer
* Access to the interactives [From milk to cheese](https://www.sciencelearn.org.nz/embeds/37-from-milk-to-cheese) and [Quality control in cheesemaking](https://www.sciencelearn.org.nz/embeds/36-quality-control-in-cheesemaking)
* Access to the animation [Cheese: a molecular view](https://www.sciencelearn.org.nz/videos/701-cheese-a-molecular-view)
* Copies of the student handout:[Curds and whey chart](#curds)

**What to do**

1. Start by discussing with students what they know about cheesemaking. Use prompts as necessary. How does milk become cheese? What are curds and whey? How are they formed?
2. Show these clips from the interactive [From milk to cheese](https://www.sciencelearn.org.nz/embeds/37-from-milk-to-cheese):

* ‘Coagulating the milk’ **without sound**. Ask the students to record what they think is happening. What does the cheesemaker do and why, and what is happening to the milk in the vat? Have students share their answers and discuss. Then play the full clip **with sound**. Have students check and, if necessary, add to their previous answer. (Add starter culture, add rennet and stir gently.)
* ‘Cutting the curd’ **without sound**. Ask the students to record what they think is happening. What does the cheesemaker do and why, and what is happening to the milk in the vat? Have students share their answers and discuss. Then play the full clip **with sound**. (The milk coagulates or thickens, the cheesemaker tests the coagulum to see if it’s ready then attaches cutting blades to the vat, the cutting blades stir continuously through the coagulated milk, breaking it up into small even-sized curds, and the curds are put into moulds.)

1. Show this clip from the interactive [Quality control in cheesemaking](https://www.sciencelearn.org.nz/embeds/36-quality-control-in-cheesemaking):

* ‘Testing coagulum before cutting’ **without sound**. Ask the students to record what the cheesemaker does and how he decides if the coagulated milk is ready to cut into curds. Share and discuss their ideas and then show the clip again **with sound.**

1. Prepare the milk. Depending on the length of class time available, these steps may need to be carried out prior to the lesson.

* Ensure all surfaces and equipment are cleaned and sterilised. Equipment can be sterilised either by immersing in boiling water or by using a chemical sanitiser. A chlorine-based sanitiser such as used for babies’ bottles is ideal.
* Heat 4 litres of milk to 32 °C in a large stockpot.
* Gently stir in 2 ml of calcium chloride, followed by ½ sachet mesophilic starter bacteria.
* Cover and leave to ripen for approximately 45 minutes.
* Measure 650 ml of the heated milk into each of the glass bowls or beakers.
* Crush ½ rennet tablet and dissolve in 120 ml of water.
* Divide the dissolved rennet equally between the 6 bowls of ripened milk and stir gently for 20–30 seconds to combine.
* Cover and allow the mixture to set, maintaining the temperature at 32 °C. This will take about 40 minutes. Keep warm by placing the bowl in a container of warm water or in a chilly bin.
* Measure 650 ml of the heated milk into each of the glass bowls or beakers.

1. Divide the class into 6 groups. After 35–40 minutes, test the coagulum for a ‘clean break’ and when ready, have each group carry out a different procedure below:
   1. Cut the curd into 1 cm cubes and leave to sit for 30 minutes without stirring.
   2. Cut the curd into 1 cm cubes and stir gently for 30 minutes.
   3. Cut the curd into 1 cm cubes and stir gently for 30 minutes while gradually raising the temperature to 40 °C. (You can achieve this by gradually adding boiling water to the container the bowl is sitting in.)
   4. Cut the curd into 3 cm cubes and leave to sit for 30 minutes without stirring.
   5. Cut the curd into 3 cm cubes and stir gently for 30 minutes.
   6. Cut the curd into 3 cm cubes and stir gently for 30 minutes while gradually raising the temperature to 40 °C. (You can achieve this by gradually adding boiling water to the container the bowl is sitting in.)
2. While waiting for the milk to coagulate, have students make predictions about the yield, texture and firmness of the resulting cheese for each of the procedures A–F. Record this on the [Curds and whey chart](#curds).
3. After 30 minutes, pour the curds and whey into a colander lined with cheesecloth to drain the whey. Tie the corners of the cheesecloth into a knot and hang over a labelled container to drain for 4 hours before transferring to a refrigerator in a covered container.
4. Remove the cheese from the refrigerator the next day and weigh each container.
5. Record the quantity of milk at the start and the final cheese weight and calculate the yield.
6. Test the relative firmness and texture of each of the cheeses produced and record results on the [Curds and whey chart](#curds).

**Discussion questions**

* How did the results compare with your predictions?
* Which sample yielded the most cheese?
* Were there any differences in the firmness or texture of the cheese samples?
* What do the results tell you about how different cheese textures are produced?
* What other steps in the cheesemaking process could alter the moisture content and texture of the cheese?
* Why do you think so many different cheese textures have evolved?

**Extension activity**

* Have students view the animation [Cheese: a molecular view](https://www.sciencelearn.org.nz/videos/701-cheese-a-molecular-view). Ask the students to explain each of the test results with reference to how the molecular structure of the milk is changing. Can they explain the significance of waiting until the coagulum reaches a ‘clean break’ before cutting the curd?

**Curds and whey chart**

***Predicted results – before completing the experiment, record your predictions of what the results may indicate:***

|  |  |
| --- | --- |
| 1. Which test do you think will yield the most cheese? |  |
|  |  |
| 1. Which test do you think will yield the least cheese? |  |
|  |  |
| 1. Suggest the order of firmness of the cheeses produced, from hardest to softest. |  |

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| --- | --- | --- | --- | --- | --- | --- |
| **Procedure** | | **Quantity of milk** | **Cheese weight** | **Cheese yield** | **Texture** | **Firmness** |
| **A** | 1 cm cubes  No stirring |  |  |  |  |  |
| **B** | 1 cm cubes  Stirring |  |  |  |  |  |
| **C** | 1 cm cubes  Stirring  Raise temperature |  |  |  |  |  |
| **D** | 3 cm cubes  No stirring |  |  |  |  |  |
| **E** | 3 cm cubes  Stirring |  |  |  |  |  |
| **F** | 3 cm cubes  Stirring  Raise temperature |  |  |  |  |  |