‘Say cheese!’

Overview

Pupils receive a scenario and carry out scientific tests on the growth of micro-organisms. Using what they’ve learned, they solve how to increase the growth of mould within a blue cheese.

Curriculum Links

These activities allow pupils to:

- Develop skills in scientific methods of enquiry to further scientific knowledge and understanding:
  - planning for investigations;
  - obtaining evidence; and
  - presenting and interpreting results.

- Learn about: Organisms and Health
  - cells and reproduction

- Learn about: Chemical and material behaviour
  - chemical changes

- In the context of the following Key Elements:
  - Investigate a product of economic importance to determine the science behind it (Economic Awareness); and
  - Identify how skills developed through science will be useful to a wide range of careers (Employability).

Health and Safety Warning

CCEA has assessed the health and safety risks associated with these activities. However, we strongly recommend that all teachers leading these activities carry out their own health and safety assessment, taking into account the ability of the students, the school’s resources and its quality of equipment, etc.
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Key Questions

- What has science got to do with making cheese?
- What if all micro-organisms were harmful to humans?
- In what ways are science skills put to use in a creamery?

Prior Learning

- acids and alkalis
- pH scale
- use of indicators (and carrying out titrations)
- carrying out investigations – fair testing
<table>
<thead>
<tr>
<th>Learning Intentions</th>
<th>Success Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils are learning:</td>
<td>Pupils will:</td>
</tr>
<tr>
<td>• in what ways some micro-organisms are useful to humans;</td>
<td>• be aware that micro-organisms are used in some products of economic importance;</td>
</tr>
<tr>
<td>• that food, pH, moisture, temperature and time are factors that affect the growth</td>
<td>• know that food, moisture, temperature, pH and time affect the growth of micro-</td>
</tr>
<tr>
<td>of micro-organisms;</td>
<td>organisms;</td>
</tr>
<tr>
<td>• that science skills are applied in industry; and</td>
<td>• demonstrate a range of practical skills when carrying out experiments, including</td>
</tr>
<tr>
<td>• that problems can be solved using the scientific method of enquiry.</td>
<td>the safe use of scientific equipment and appropriate mathematical calculations;</td>
</tr>
<tr>
<td></td>
<td>• know that scientific skills are useful in a range of careers; and</td>
</tr>
<tr>
<td></td>
<td>• describe how scientific skills of enquiry are important in industry.</td>
</tr>
</tbody>
</table>

### Thinking Skills and Personal Capabilities

<table>
<thead>
<tr>
<th>Thinking, Problem-Solving, Decision-Making:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• make predictions;</td>
</tr>
<tr>
<td>• make links between cause and effect;</td>
</tr>
<tr>
<td>• sequence, order, classify and make comparisons – seeing relationships and</td>
</tr>
<tr>
<td>patterns;</td>
</tr>
<tr>
<td>• justify methods, opinions and conclusions;</td>
</tr>
<tr>
<td>• examining evidence;</td>
</tr>
<tr>
<td>• use different types of questions; and</td>
</tr>
<tr>
<td>• generate possible solutions, try out alternative approaches and evaluate</td>
</tr>
<tr>
<td>outcomes – making decisions/solving problems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Managing Information:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• select, classify, compare and evaluate information;</td>
</tr>
<tr>
<td>• use a range of methods for collating, recording and representing information;</td>
</tr>
<tr>
<td>• communicate with a sense of audience and purpose.</td>
</tr>
</tbody>
</table>

### Cross-Curricular Skills

<table>
<thead>
<tr>
<th>Communication:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• present information effectively, using a formal style where appropriate</td>
</tr>
<tr>
<td>(procedural writing).</td>
</tr>
<tr>
<td>Cross Curricular Skills Assessment Tasks available</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Using ICT: Say Cheese (Presentation)</td>
</tr>
</tbody>
</table>
Activity 1
Local Vacancies

Divide the class into groups of three or four pupils. Give each group a copy of the recruitment section of a local newspaper or get them to log on to a local recruitment website. Ask them to:

- list all the posts that require science qualifications and/or skills;
- classify those science-related jobs into sectors;
- share their classifications with the class; and
- reclassify the jobs into the following sectors:
  - life and health science;
  - ICT;
  - advanced engineering (transport);
  - Agri-food; and
  - advanced materials.

Explain that experts have identified these sectors as ones that Northern Ireland can excel in globally (2009) and are the sectors where many more jobs are likely to be available in the future.

Ask pupils to look through their cupboards at home and identify which local Agri-food products their families buy. Share with the class the Agri-food sector profile which is available in the Sector Profiles Section of the STEM Futures folder and online at: www.nicurriculum.org.uk/stem

Invite each group to discuss the sector and record the following:

- one thing they already knew about the sector;
- two things they have learned; and
- one thing that has surprised them about the sector.

Activity 2
Working in the Lab

Present Resource 1 to your pupils. Explain that they’ve just been hired as lab technicians at Daisy Cow Creamery and that this is their job description. Explain that in a creamery, one of a laboratory technician’s jobs is to test a sample of milk from every tanker that arrives. Ask the class to suggest reasons for this.

Responses should include testing for:
- freshness;
- no added water;
- presence, level and type of acceptable bacteria; and
- presence of antibiotics.

Split the class into groups and provide each with milk samples. Ask them to carry out scientific tests to analyse:

- freshness (by smelling);
- acidity (using a universal indicator or a titration for more able pupils); and
- fat content (adding food colouring and observing the spread of colour).

NOTE: Resources 2—6 support this practical section. Teachers must carry out their own risk assessment.

Pupils can use Resource 5 and 6 to record their results.

Invite each group to analyse their results and draw conclusions on the freshness of the milk. Challenge each group to:

- state which sample[s] they would accept into the creamery; and
- discuss the reasons why a creamery does these initial scientific tests and why they are important in the dairy industry.

Discussion may include the following:

- A farmer may try to water down milk to produce a greater volume in order to make more money. What impact does this have for the consumer?
- All milk has some bacteria present, but high levels would spoil the milk before it could be used. It would also reduce its shelf life.

Finally, ask each group to consider the skills required for this type of laboratory job and share their thoughts with the rest of the class.

Activity 3
Cheesemongers

Explain to the pupils that cheese was originally produced as a way to preserve extra milk. Using Resource 7 as your guide, lead the class in cheese making. Divide the class into groups and ask them to observe as you carry out each step.

Emphasise the scientific aspects and safety requirements with each step, and describe the following basic stages:

1. sourcing fresh milk;
2. coagulation (using acid and/or enzyme rennet);
3. separation of curds (solid part) from whey (liquid part); 
4. forming the curd into a cheese mould; 
5. salting for preservation and flavour; and 
6. maturation.

When you have finished your demonstration, allow the groups to follow the same steps to make a cheese by following the same steps in Resource 7. Afterwards, give each group a set of cards depicting the cheese making stages (Resource 8) and have them sequence the cards in the correct order. (Answers appear in Resource 9.) Ask them to record the reasons for the key stages in the cheese-making process (Resource 10). A completed table is included for your use (see Resource 11).

Finally, ask each group to research the difference between hard and soft cheeses, especially in terms of the cheesemaking process, and then discuss their findings as a class. You can play the Fivemiletown video available on the STEMWorks microsite as an example of the process for making hard cheese.

Activity 4
Market Research

Present the scenario in Resource 12 to the class. In this, the creamery that they work for has just recently produced a new blue cheese. The management team were disappointed with the sales of the new blue cheese, so they decided to carry out customer research by asking customers in the local supermarket to fill out customer survey forms. Only six surveys were completed and returned.

Discuss with the class the reliability of this type of evidence. Responses should include:
• a small sample is unreliable; and/or
• there could be bias from local respondents due to having family who work for the creamery.

Invite the pupils to suggest to the management team ways they could source more reliable evidence.

Responses should include:
• putting the surveys into more supermarkets; 
• having an online version of the survey; and
• encouraging more customers to complete by offering prizes.

Activity 5
Secrets of Mould

Place the pupils into pairs and give each pair a copy of the scenario in Resource 12 again. Remind them that most of the customers were complaining that the soft cheese was not ‘blue’ enough. Show the class images of blue cheese and invite your pupils to suggest what causes the blue streaks in the cheese.

After the discussion, explain that the blue colour is caused by a mould growing in the cheese and that a mould is a living thing. Ask them to research more information on moulds by seeking answers to the following questions:
• What is mould? 
• Where are moulds found? 
• What conditions are necessary for mould growth? 
• How does mould reproduce? 
• In what ways is mould harmful? 
• How is mould used?

Suggest that they refer to biology textbooks or websites, such as http://www.ilovecheese.co.uk/UsingMould.html

When they’ve completed their research, allow the pairs to present what they’ve learned to the rest of the class.

Activity 6
Funky Fungi

Refer to the scenario in Resource 12, and explain that the mould in this new soft cheese developed by Daisy Cow Creamery is not growing very well, which is why the mould only appears in the cheese’s centre and not its edges. Their job is to work in pairs to investigate the factors that affect the rate of mould growth on a soft cheese.

Ask the pupils to plan and carry out an investigation in their pairs. Agree success criteria with the pupils in advance.
Step 1: The Variables
Before they begin, ask the pairs to list all the variables related to mould growth, for example:
- type and amount of mould used;
- type and amount of cheese used;
- temperature;
- moisture levels;
- oxygen;
- surface area of the cheese; and
- the time allowed to grow.

Their findings from the research they completed in Activity 5 may help them as they list the variables.

Step 2: The Independent and Dependent Variables
Either let the pupils decide on the independent variable or give them one to investigate, such as the type of cheese used. Together discuss what the dependent variable will be and how they will measure it. This could be the amount of mould present and they could measure the area of mould using a transparent grid and counting the squares it fills.

Step 3: Fair Testing

Health and Safety
Teachers are required to carry out their own risk assessment. For detailed safety information on the use of microorganisms in schools and colleges, please visit the Society for General Microbiology online or email them for a free copy of their Basic Practical Microbiology–A Manual. Alternatively, refer to the CLEAPSS Laboratory Handbook, sections 15.2 and 15.12.

Discuss with the class how and why we carry out fair tests in science. Have the pairs create a fair test and draw up their own record of results. For the test, you will likely need to provide the following:
- cheese;
- plastic bags or Petri dishes;
- glass jars with lids; and
- samples of blue mould from bread.

Provide them with a copy of Resource 13, which outlines some of the steps they should follow.

Step 4: Results Analysis
When they’ve completed the experiment, together discuss why the creamery they work for will need reliable results. Ask them to explain how they will get reliable results. (They could obtain these by either repeating the experiment or, if everyone’s investigation was the same, collating all the pairs’ data.) Discuss how to present their results graphically and ask each pair to draw an appropriate graph.

Step 5: Recommendations
Ask each pair to analyse their findings and draw conclusions. They should then consider how they could present their scientific advice on how to produce a blue cheese with good mould growth to the Daisy Cow creamery.

Preferably provide pupils with a real and relevant audience to present their work to. You could request a link with a relevant STEM ambassador through the STEMNET initiative which is co-ordinated by W5. STEM ambassadors can act as role models and help to inspire and engage young people about the value of STEM in their daily lives. For further information, please contact Mary Carson at W5 (marycarson@w5online.co.uk) or visit their website at www.w5online.co.uk/stemnet.

The pupils could make their pitch to their STEM Ambassador via video conferencing using the Elluminate software available through C2K. For advice and support to get started please contact the C2K Service Desk.

You may want to watch an episode of Dragon’s Den as a class to provide them with an example of how to conduct a pitch, or, if possible, work in collaboration with the English Department to develop pupils’ presentation pitches.

Provide time for pupils to research STEM career opportunities. Resources are available within the Futures – Skills & Employability/CEIAG section of the STEMWorks website at www.nicurriculum.org.uk/stem

Extension Activity
You may want to share with the class an example of another mould experiment, this time investigating and comparing the amount of mould growth on three types of cheeses. For this, visit http://www.selah.k12.wa.us/soar/sciproj2000/Jzeut.html
Temporary Lab Technician
The Lab Technician is responsible for:

- working effectively and efficiently in the creamery’s laboratory;
- setting up, adjusting and operating laboratory equipment and instruments, such as microscopes, the solids analyser, the milk tester, the refractometer, scales and other equipment, as needed;
- cleaning, sanitising and sterilising laboratory equipment, and calibrating equipment, as needed;
- testing and analysing raw materials and finished goods using microbiological and chemical analysis;
- reading plates and record test results on standardised forms and write test reports;
- preparing graphs and charts as needed, and enter all data into database;
- performing plant weight checks, temperature checks, ingredient usage and distribution, finished product appearance, code date verification, pH testing and metal detection verification;
- keeping the work area clean and tidy (sweeping and mopping);
- wearing company-appropriate laboratory and safety gear as required;
- communicating clearly with colleagues;
- lifting up to approximately 45 pounds, as required; and
- other related tasks.
Comparing the Freshness of Milk Samples  
(Teacher’s Experimental Notes)

**Health and Safety Warning**
- Teachers need to carry out their own risk assessment.
- Pupils should not taste the milk.

**Aim**
To compare the freshness of the milk samples

**Equipment**
- 4 milk samples:  
  - fresh whole milk;  
  - 2-day-old whole milk;  
  - 4-day-old whole milk; and  
  - 6-day-old, sour whole milk (or use buttermilk, whole milk, semi-skimmed milk, or skimmed milk at various levels of freshness);  
- 4 beakers; and  
- labels.

**Method**
1. Dispense each type of milk into beakers labelled A, B, C and D and make a private note of which milk is in each.
2. Have the pupils pour 20cm³ of each type of milk into separate beakers labelled A, B, C and D.
3. Allow them to smell two control samples of milk: one fresh and one sour.
4. Have them rate the freshness on a scale of 1–5 (1 = fresh and 5 = sour).
5. Ask them to record the results in a table.
Resource 3

Comparing the Acidity of the Milk Samples
(Teacher’s Experimental Notes)

Health and Safety Warning
• Teachers need to carry out their own risk assessment.
• Eye protection should be worn.

Aim
To compare the acidity of the milk samples

Equipment
• 4 milk samples:
  - fresh whole milk;
  - 2-day-old whole milk;
  - 4-day-old whole milk; and
  - 6-day-old, sour whole milk (or use buttermilk, whole milk, semi-skimmed milk, or skimmed milk at various levels of freshness);
• 4 beakers; and
• labels.

Method:
1. Dispense each type of milk into beakers labelled A, B, C and D and make a private note of which milk is in each.
2. Have the pupils pour 20cm³ of each type of milk into separate beakers labelled A, B, C and D.
3. Tell them to then add 2–3 drops of universal indicator to each beaker.
4. Have them record the colour change in the table of results.
5. Ask them to work out the pH using a universal indicator colour chart and to record this in their results.

NOTE: The pH of the milk could also be tested using a datameter with a pH probe.

Results
Fresh milk approx pH 6.7
Sour milk approx pH 4.3–4.5
Fresh buttermilk approx pH 4.7

Conclusion
Ask your pupils to draw conclusions based on their tests. Draw out or share the following key points during the discussion:
• Sour milk has a lower pH than fresh milk.
• Milk contains sugars called lactose. Bacteria feed on these sugars and break them down into lactic acid, which lowers the pH to make an acid and causes the sourness.
• The bacteria metabolise (ferment) the sugar to gain energy in order to grow and multiply. This continues until there is no sugar left.
Resource 4
Comparing the Fat Content in Milk
(Teacher’s Experimental Notes)

Health and Safety Warning
- Teachers are required to carry out their own risk assessment.
- Eye protection should be worn.

Aim
To compare the amount/concentration of fat in different types of milk.

Equipment
- 4 milk samples – buttermilk, whole milk, semi-skimmed milk and skimmed milk;
- 4 test tubes;
- test tube rack; and
- food colouring.

Method
1. Dispense each type of milk into containers labelled A, B, C and D and make a private note of which milk is in each.
2. Have the pupils pour 10cm³ of each type of milk into separate test tubes labelled A, B, C and D.
3. When the milk and test tube are perfectly still, they should add one drop of food colouring to each. Remind pupils to ensure they carefully drop the dye on top of the milk, taking care not to drop it down the side of the test tube.
4. Tell them to watch how the colour spreads and record their observations.

Results
The food colouring in the skimmed milk should spread quickly and become faint in colour. The colouring in the buttermilk will not spread as much or as quickly as in the skimmed milk. The whole milk should behave somewhere in between.

Graph
Pupils should use a bar chart to present their results because the independent variable is categoric.

Conclusion
The food colouring is water-based and will travel and diffuse better through the aqueous (water) medium than through the fat. So in skimmed milk, which has a very low fat content and is predominantly water, the food colouring spreads rapidly. Alternatively, in buttermilk the food colouring will take longer to disperse since there is less water for it to travel through.

Other Things to Try
Pour samples of milk into Petri dishes or on to shallow plates. Add food colouring, then dab a cotton swab with soap or detergent and insert it in the centre of the drop of food colouring. This should cause the food colouring to disperse rapidly into the milk. This is because the soap is a surfactant that changes the water/fat interactions and allows for rapid diffusion of the food colouring into the milk.
**Resource 5**  
**Quality Assurance Tests**  
**Pupil Record**

Rate freshness on a scale of 1–5 (1 = fresh and 5 = sour).

Use a universal indicator to measure the acidity and record the results in this table.

<table>
<thead>
<tr>
<th>Milk sample</th>
<th>Freshness</th>
<th>Acidity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Colour</td>
<td>pH</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Comparing the Fat Content in Milk (Method and Pupil Record)

Aim
To compare the amount/concentration of fat in different types of milk.

Equipment
• 4 milk samples – buttermilk, whole milk, semi-skimmed milk and skimmed milk;
• 4 test tubes;
• test tube rack; and
• food colouring.

Method
1. Pour 10cm³ of each type of milk into separate test tubes labelled A, B, C and D.
2. When the milk and test tube are perfectly still, add one drop of food colouring to each.
3. Watch how the colour spreads and record how fast it spreads using a scale of 1–5 (1 being slow and 5 being fast), or a stopwatch.

Graph
What type of graph should you present your results on and why?

Discuss the following questions in your group to draw your conclusion:
• Is there a pattern in your results?
• Can you explain what is happening? [Clue: food colouring is water-based/water soluble.]
• Can you state which type of milk was in each sample based on your results?

<table>
<thead>
<tr>
<th>Milk sample</th>
<th>Speed of food colouring spread</th>
<th>Other observations</th>
<th>Type of milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Health and Safety Warning

- Teachers need to carry out their own risk assessment.
- Do not eat or taste the cheese, as this cheese has not been made with sterilised equipment or under hygienic conditions.
- The teacher and pupils must not boil the milk to avoid the risk of scalding.

Equipment

- 200ml whole milk;
- 2tbsp of lemon juice or vinegar (You may use more if deemed necessary during the process);
- pinch of salt; and
- a thermometer.

Method

1. In a saucepan or beaker, heat the milk to 40°C and then remove from heat. Remember to check the temperature regularly using a thermometer.
2. Add the vinegar or lemon juice slowly, 1tbsp at a time, and very gently swirl. Note how the curds are forming. This should happen quite quickly. Don't stir too much or vigorously, as your curds won't form well. The curds are milk proteins that have separated out and bonded together as a reaction to the acid.
3. After a few minutes, make a sieve to separate the curds (solid part) from the whey (liquid part). To make the sieve, cover a large beaker with a piece of cheesecloth or old shirt and rubber band it into place. Press down on the cloth's centre to depress into a bowl shape. Pour the curds and whey gently into the cloth sieve. The whey will drain through to the beaker. The curds will stay in the cloth 'bowl'. They will look a bit like cottage cheese at this stage.
4. Gently and carefully squeeze out as much whey as possible from the remaining curds. If you like you can tie the cloth off with a bit of string and press it under something heavy, like a large book. Make sure you have something underneath it to collect the whey that will be pressed out. The more liquid that is removed from the cheese, the harder the final cheese will be.
5. After pressing, sprinkle the salt over the cheese and explain that this draws out more water by a process called osmosis.
6. In the creamery, the cheese would be rewrapped in another cloth and pressed again. It needs to be kept cold, so manufacturers place it in a fridge to mature for the specific time. This varies depending on the type of cheese made.
Copy and cut out the following cards, and provide a set to each pupil to sequence the process for making hard cheeses.

- Milking
- Reception
- Analysis
- Pasteurization
- Cooling
- Starters
- Coagulation
- Cutting
- Stirring

Images courtesy of www.thinkstockphotos.com
Resource 8 (2 of 2)

Card Sort (Pupils’ Copy)

Copy and cut out the following cards, and provide a set to each pupil to sequence the process for making hard cheeses.

- Removal of Whey
- Moulding
- Maturing
- Distribution
- Storing and Eating

Images courtesy of www.thinkstockphotos.com
Card Sort (Teacher’s Copy)

Copy and cut out the following cards, and provide a set to each pupil to sequence the process for making hard cheeses.

1. Milking
2. Reception
3. Analysis
4. Pasteurization
5. Cooling
6. Starters
7. Coagulation
8. Cutting
9. Stirring

Images courtesy of www.thinkstockphotos.com
Resource 9 (2 of 2)

Card Sort (Teacher’s Copy)

Copy and cut out the following cards, and provide a set to each pupil to sequence the process for making hard cheeses.

10. Removal of Whey

11. Moulding

12. Maturing

13. Distribution

14. Storing and Eating

Images courtesy of www.thinkstockphotos.com
### Resource 10

**Key Stages in the Cheesemaking Process**

Complete the table to explain the reasons for the key stages in the cheesemaking process.

<table>
<thead>
<tr>
<th>Cheese making stages</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk is tested</td>
<td></td>
</tr>
<tr>
<td>Milk is pasteurised</td>
<td></td>
</tr>
<tr>
<td>Milk is cooled</td>
<td></td>
</tr>
<tr>
<td>Starter culture is added</td>
<td></td>
</tr>
<tr>
<td>Rennet is added (coagulant)</td>
<td></td>
</tr>
<tr>
<td>Soft curds form and are cut</td>
<td></td>
</tr>
<tr>
<td>Whey is removed</td>
<td></td>
</tr>
<tr>
<td>Firm curd forms</td>
<td></td>
</tr>
<tr>
<td>Salt is added</td>
<td></td>
</tr>
<tr>
<td>Cheese is moulded into blocks</td>
<td></td>
</tr>
<tr>
<td>Cheese ripens and matures</td>
<td></td>
</tr>
<tr>
<td>Cheese is packaged and sold</td>
<td></td>
</tr>
</tbody>
</table>
### Key Stages in the Cheesemaking Process
(Professor’s Briefing Sheet)

Below are possible answers for the key stages in the cheese-making procedure.

<table>
<thead>
<tr>
<th>Cheese making stages</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk is tested</td>
<td>To make good quality cheese, to ensure the milk is fresh and to prevent food spoilage and food poisoning.</td>
</tr>
<tr>
<td>Milk is pasteurised</td>
<td>To prevent food poisoning and food spoilage.</td>
</tr>
<tr>
<td>Milk is cooled</td>
<td>To ensure that the bacterial starter culture is not killed and enzyme (rennet) is not destroyed (denatured) in the next step. It is cooled to 32°C to provide the optimum temperature for the starter bacteria to grow. Heat treatment is required during cheese making to regulate the size and acid development of the curd.</td>
</tr>
<tr>
<td>Starter culture is added</td>
<td>The starter culture is a very important factor in cheese making. Bacteria are added to milk to convert sugar (lactose) in the milk into acid (lactic acid). This lowers the pH of the milk and causes the curdling of the milk. The rate of acid production, which is the rate at which the bacteria ferments the sugars in the milk, varies. That, in turn, affects the flavour and affects the texture of the cheese.</td>
</tr>
<tr>
<td>Rennet is added (coagulant)</td>
<td>The enzyme rennet is added to speed up the rate of curdling. Cheesemakers look for a constant coagulation time of approximately 30 minutes. The temperature and pH are closely monitored as changes can destroy the enzyme. The cheese is ready when is has reached a specific pH. This can vary depending on the type of cheese, for example cheddar for cheese strings = pH6.1</td>
</tr>
<tr>
<td>Soft curds form and are cut</td>
<td>The aim of cheese making is to obtain a curd with a defined moisture content. This is achieved by a controlled expulsion of whey from the curd particles. The cutting of the curd is done to facilitate whey expulsion by creating a much greater surface for drainage. Stirring of the curd also promotes whey drainage by the mechanical action and by preventing the particles from adhering to one another.</td>
</tr>
<tr>
<td>Whey is removed</td>
<td>Whey is the liquid part. It is removed to leave the curds which form the cheese</td>
</tr>
<tr>
<td><strong>Salt is added</strong></td>
<td>Salting takes place after they have removed the whey. This is to add flavour, prevent further bacterial growth and remove more water from the cheese (through osmosis).</td>
</tr>
<tr>
<td><strong>Firm curd forms</strong></td>
<td>This is the cheese. Increased acidity causes the milk proteins (casein) to tangle into solid masses forming the curds.</td>
</tr>
<tr>
<td><strong>Cheese is moulded into blocks</strong></td>
<td>For pressing into the desired shape and removal of residual whey, the curd blocks are wrapped in cheese cloth and placed in a suitable cheese mould and pressed for some hours. The amount of pressure and the length of time varies with the type of cheese.</td>
</tr>
<tr>
<td><strong>Cheese ripens and matures</strong></td>
<td>All cheese varieties, except fresh cheese, go through a series of ripening processes involving microbiological, biochemical and physical changes to the product to give their distinct flavour and taste. This ageing process can last from several months to several years!</td>
</tr>
<tr>
<td><strong>Cheese is packaged and sold</strong></td>
<td>The cheese is cut into smaller blocks for the customer and labelled.</td>
</tr>
</tbody>
</table>
Resource 12

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**Scenario**

Daisy Cow Creamery has launched a new blue cheese at the local supermarket. They have just received the results from the customer survey that was completed last week. The main finding is that customers were complaining that the blue cheese was not “blue enough”.

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Cheese

“Say Cheese!”

it’s not very blue!

there’s not a strong flavour.
Funky Fungi Investigation

You and your partner are laboratory technicians at Daisy Cow Creamery. Customers are complaining that the new blue cheese isn’t blue enough. Your job is to carry out a scientific investigation to determine the factors affecting mould growth on cheese.

<table>
<thead>
<tr>
<th>Process</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1: Variables</strong></td>
<td>Recall the research you completed on moulds and list the variables related to mould growth.</td>
</tr>
<tr>
<td><strong>Step 2: The Independent Variable</strong></td>
<td>State the independent variable.</td>
</tr>
<tr>
<td><strong>Step 3: The Dependent Variable</strong></td>
<td>State the dependent variable and how you plan to measure it.</td>
</tr>
<tr>
<td><strong>Step 4: The Experiment</strong></td>
<td>Carry out your experiment.</td>
</tr>
<tr>
<td><strong>Step 5: Results Analysis</strong></td>
<td>In science, obtaining reliable results is crucial. How can you obtain reliable results? Record your results here. Once you’ve examined your results, create a graph to illustrate these.</td>
</tr>
<tr>
<td><strong>Step 5:</strong></td>
<td>Based on your findings, write to the Daisy Cow managers to provide your scientific advice on how to produce a blue cheese with good mould growth.</td>
</tr>
</tbody>
</table>
Useful Websites

These links were active at the time of publishing.

CCEA accepts no responsibility or liability for any material supplied by or contained in any of the linked websites and does not necessarily endorse the views expressed within them. We cannot guarantee that these links will work all of the time and we have no control over availability of the linked pages.

NI Recruitment websites
http://www.nijobfinder.co.uk/
http://www.nijobs.com/

Matrix Report from the Northern Ireland Science Industry Panel

A history of cheese
http://www.ilovecheese.co.uk/HistoryOfCheese.html

Some of the tricks used in food production
http://www.bbc.co.uk/iplayer/episode/b00s61h2/b00s61by/Jimmys_Food_Factory_Second_Helpings/

Cheese recipe using rennet
http://biology.clc.uc.edu/fankhauser/Cheese/Cheese98.htm

Process for making blue cheese
http://biology.clc.uc.edu/fankhauser/Cheese/Blue_Cheese/Blue_Cheese.htm

Activity that investigates microbial growth
https://learningni.net/content/03022007/fc4d5f76-8de1-4ef7-9ee5-a4246d2547b0/Whiteboard/wbpopup.htm

Cheese production information
http://www.milkfacts.info/Milk%20Processing/Cheese%20Production.htm

Cheese recipe – involves an acidic reaction with the proteins in the milk

The steps in cheddar cheese production
http://www.milkfacts.info/Milk%20Processing/Cheese%20Production.htm

The difference between the hard and soft cheesemaking processes
http://thefoodieshandbook.co.uk/cheese.aspx

An investigation of mould growth on three types of cheese
http://www.selah.k12.wa.us/soar/sciproj2000/Jzeut.html