



# SCIENTIST IN RESIDENCE PROGRAM™

## Science Unit: *Biology Inquiry*

### Lesson 2: *Cheese*

#### Lesson Summary

Students make and eat a simple cheese by using vinegar (an acid) to curdle milk. Discussions on the bacteria used to promote the curdling process during commercial cheese making.

School Year: 2016/2017

Developed for: Britannia Elementary School, Vancouver School District

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Grade level: Presented to grades 4-6; appropriate for K-7 with age appropriate modifications

Duration of lesson: 1 hour

Notes: This lesson was paired with a Decomposition lesson #SRP388. After observing spoiled curdled milk, a fresh cheese is made through a controlled curdling process.

#### Objectives

- a) Experience the science underlying the production of a familiar food.
- b) Understand that not all bacteria is “bad”, and in fact some kinds are used to make food.

#### Background Information

The first step in any cheesemaking is to curdle the milk proteins. Milk curds can be made by adding acid to milk, and cheesemakers often use an acid-producing bacteria (e.g. *Lactobacillus*). Cheesemakers also use an agent that cuts up the milk proteins (rennet) to make curds. The curds are separated from the liquid whey by draining and pressing.

Fresh cheeses, such as cottage cheese or quark, are these simple curds, with salt or other flavours added. To make aged cheeses, specific bacteria and mould cultures are added to produce the characteristic textures and flavours of each kind of cheese.

Milk is pasteurized to kill harmful bacteria (e.g. *E.coli* and *Salmonella*) in milk. However some spores remain, so milk has a shelf life and must be kept cold, to minimize the number of harmful bacteria growing up and being ingested. *Lactobacillus*, which is a harmless bacteria (and is in fact used to make cheese), survives the pasteurization process. When milk is left out and spoils, it is mostly due to *Lactobacillus* producing lactic acid which curdles the milk proteins.

See Ref. 1 for more detailed information on cheesemaking.



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## Vocabulary

<u>curds</u>	A solid mass of milk proteins, made by clumping the protein with an acid or enzyme. Curds contain the milk protein, casein, as well as milk fat.
<u>whey</u>	The liquid remaining after curd formation. Whey is made up of water, milk sugars and minerals.
<u>simple or fresh cheese</u>	Cheese curds, with little additional processing.
<u>aged cheese</u>	Cheese curds with additional bacterial and mould cultures, that over time (during “ripening”) add flavours and textures to the cheese.
<u>Lactobacillus</u>	A bacteria species that produces lactic acid as it grows. Used in the production of many kinds of cheeses, from simple to aged.

## Materials per student/student pair

- two medium plastic cups, ideally clear
- 1/4 cup measure (or share at table group)
- spoon
- cheese cloth (only two layers for fast draining), at least double the width of the cup
- 1 teaspoon vinegar (share a cup of vinegar at the table)
- plate
- elastic band
- teaspoon measure (or share at table group)
- sprinkle of salt
- 1/4 cup milk (whole milk most yummy)
- drinking water, about 1/4 cup
- crackers

## Additional Materials

- clean tub to contain materials at table group (and to use as waste tub)
- microwave to heat milk
- cottage cheese and other cheeses (e.g. Swiss cheese) for students to taste
- microwave-safe container to heat milk for whole class in



## In the Classroom

### Introductory Discussion

Initiate a discussion around how cheese is made, to find out what students already know, so that their knowledge can be integrated into the activity.

**Processes of science** in this activity: mechanical manipulation, close observation, accurate measuring, inferring.

### Cheese Activity

1. Start warming the milk for the whole class in the microwave. It needs to be very warm just before use. While it is heating, distribute materials, except for salt and crackers, to student pairs and table groups.
2. Students lay the cheesecloth (just two layers) over one of their cups, then secure with an elastic band near the rim of the cup. Then they should use the other cup to gently push down on the centre of the cheesecloth, while rolling the elastic band down a little, to make a well in the cheesecloth.
3. Students add 1 teaspoon vinegar to the other cup, followed by 1/4 cup warm milk. Let sit for a minute for the solid "curds" to form. The watery liquid that separates out from the curds is called "whey".
4. If age-appropriate, discuss how the curds are formed at the molecular level. Protein molecules in milk mix with the loose hydrogen atoms in the vinegar (an acid) and a chemical reaction happens, producing solid curds. (Heating the milk helps the reaction.)

Upper intermediate students may be interested in the deeper chemistry. The casein molecules (the name of the kind of protein in milk) have a negative charge. The loose hydrogen atoms in the acid have a positive charge (they are actually called hydrogen ions). Opposite charges attract, so the casein molecules and hydrogen ions group together to make the larger solid clumps (curds).

5. Students pour the curds and whey mixture into the cheesecloth on the cup, so that the curds are trapped in the cheesecloth and the whey drains into the cup below. Pour 1/4 cup of drinking water over the curds to rinse the extra acid off. Press the curds with the spoon, to drain any last liquid, then scoop out onto the plate.
6. The teacher should add a sprinkle of salt to each plate of cheese, and help students to mix it into the curds. Give each student cracker(s) on which to eat the cheese. Give students commercially produced cottage cheese to compare to their own cheese.





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7. Read out the ingredients on the cottage cheese tub, and compare to the students' cheese ingredients. Both will contain milk in some form. The cottage cheese will contain "bacterial culture", usually *Lactobacillus*, which releases acid as it grows and makes curds form. The commercial cottage cheese will likely also have gelling agents added (e.g. guar gum, carrageenan) and maybe preservative (e.g. potassium sorbate).
8. Discuss how commercial cheesemakers often use *Lactobacillus* to form curds, rather than directly adding an acid like vinegar, as the bacterial culture releases acid more slowly, which is preferable. Other bacterial and mould cultures are added to make aged cheeses, each giving the cheeses their characteristic flavours and textures.
9. Give students other cheeses to try, and discuss how they are made. For example Swiss cheese uses *Lactobacillus* to form the curds, and another bacteria (*Propionibacter*) is added to make the characteristic holes in Swiss cheese (this bacteria releases carbon dioxide gas which collects in pockets).

## References

1. <<https://www.uoguelph.ca/foodscience/book-page/cheese-making-technology-ebook>> University of Guelph thorough explanation of the cheesemaking process. Accessed May 26th 2017.