Appendix 1: For Students Name:

Date:

Materials for Making Yogurt (what is each material used for)

This should be a blank numbered list for the students.

1)

2)

3)

4)

5)

6)

7)

8)

Procedure for making yogurt (steps) : This should be blank for the students

1)

2)

3)

4)

5)

6)

Appendix 1: Teacher Guide

Materials for Making Yogurt (what is each material used for)

This should be a blank numbered list for the students.

1) 500 mL Milk (prompt: how much milk?)

2) Beaker (prompt: where will we put the milk?)

3) lactobacillus (prompts, what turns the milk into yogurt? where do we get lactobacillus from?)

4) Hot plate (Prompt:how do we heat the milk?)

5) Cold water (Prompts: how do we cool the milk? How do we keep the water cold?)

6) Thermometer (Prompt: how do we know the temperature of the milk?)

7) Styrofoam container (Prompt: where do we place the cold water?)

8) Optional: sterile sample cups with covers for testing different time points. (Prompt: how can we easily test different time points without disturbing the cultures in their beakers?)

Procedure for making yogurt (steps) : This should be blank for the students

1) Heat 500 mL of **some type of** milk to 90 degrees on a hot plate for 10 minutes

Prompts: How much milk should we use? What temperature should we heat it to? We should heat it for ten minutes.

2) Cool to 40 degrees using a container of iced water.

Prompts: Should we add the lactobacillus after heating to 90 degrees? To what temperature should we lower it? Why?

3) Add 25 g of yogurt to the milk (5% w/v of milk).

Prompts: How much yogurt shall we add? Give answer: We should add 5% in mass of the volume of milk

4) Cover the beaker with aluminum foil.

Prompts: Should we leave the yogurt culture of milk+yogurt exposed to air? Why or why not?

5) Place yogurt cultures in incubator at 40 degrees **X** hours (ideal is 6-8 hours, but you can test a range or hours). If you want to test a range of hours, use small plastic sterile sample cups with covers, each labelled with a different time to be removed at those times.

Prompts: At what temperature will the fermentation work best?

6) Cool yogurt cultures overnight in a refrigerator overnight.

Prompt: Once it is done incubating, where should we store the newly made yogurt? Fact: refrigeration helps the yogurt set.

Predictions

1) How will the yogurt differ when it is made with whole milk, 2% milk, and non-fat milk?

   The milk should be creamier and more “solid”.

2) How creamy will the yogurt be when culturing the milk at 40 for 1 , 3, 5, 8 hours (very low, low medium, high, very high).

   1 hour: very low

   3 hours: low

   5 hours: medium

   8 hours: high

3) How will the pH be at 1 hour, 3 hours, and 5 hours, and 8 hours (very low, low, medium, high).

   1 hour: high

   3 hours: medium

   5 hours: low

   8 hours: very low

4) How sour will the yogurt be at 1 hour, 3 hours, and 5 hours, 8 hours (very low, low, medium, high)

   1 hour: very low

   3 hours: low

   5 hours: medium

   8 hours: high

Appendix 2

Results

What kind of milk did you use? Whole milk, 2% milk, non-fat milk

What range of culturing times did you test? eg. 0 hour ,1 hour ,3 hours ,5 hours ,8 hours

What was the pH of the yogurt over time?

Time	pH (Sourness)
0 hour (milk)	6.5
1 hour	6.5
3 hours	6.0
5 hours	5.5
8 hours	5
O/N	4.8

Rank the creaminess of the yogurt over time from 1-5, with 1 being the lowest creaminess and 5 being the highest creaminess

Time	Creaminess
0 hour (milk)	1
1 hour	1
3 hours	2
5 hours	3
8 hours	5
O/N	5

Conclusion

1) What is the effect of culture time on sourness? Why?

Longer culture time will lead to greater sourness. This is because as the bacteria reproduces through binary fission, more and more lactic acid is produced. The presence of acid gives a sour taste to the yogurt. The more lactic acid that is present, the sourer the final product will be.

2) What is the effect of the type of milk used on the texture and taste of the yogurt?

The fattier the milk the creamier and more solid the final product is.

3) What was the effect of time on the pH of the yogurt? Which culture leads to the yogurt with the lowest pH?

Longer culture time will lead to a lower pH. This is because as the bacteria reproduces through binary fission, more and more lactic acid is produced. The higher the amount of acid, the lower the pH measured.

4) Which culture time gave the most bacteria?

A longer culture time will lead to a greater number of bacteria as the bacteria have more time to reproduce through binary fission.

5) How would you change the procedure to make a yogurt you like better?

Possible answers: change the milk to make it more or less creamy, change the culturing time to make it less sour or more liquid or more sour or more solid and creamy. Add other food items like sugar, oreo cookies, fruit, etc.

Appendix 3: Breakdown of costs.

Material costs are calculated assuming that classrooms already have the basic equipment, such as an incubator (see Figure) and pH meter (or strips), hot plates, and beakers, and thermometers and that

school kitchens are equipped with the necessary cooking equipment (stove, pots, kitchen thermometers).

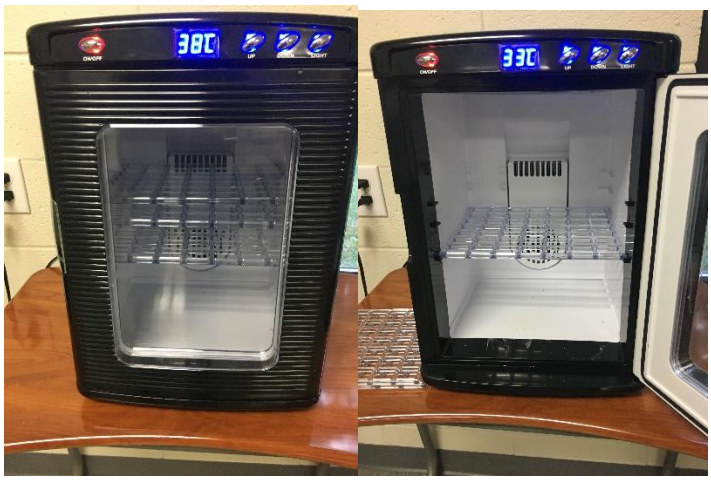

Figure: Type of low capacity table-top Incubator used in yogurt production, door closed (left), door open (right)

Cost breakdown

The basic costs are for simply for yogurt,milk, and glass jars.

The initial activity is a discussion section during which the students. A high quality single serve plain organic yogurt costs about $2, so factor in $2/student.

Making 1 gallon (3.8L) of organic yogurt requires 1 gallon of organic milk ($6) and 190 grams of organic yogurt (1.1 single serve plain organic yogurt, or 2 containers at $2 each for a total of $4). 175 mL single serve glass jars cost $1 each. Using these materials 21 single serve yogurts in 21 jars can be produced.

So the total cost of 1 gallon yogurt production is:

$6 (milk) + $4 (yogurt) +$21 (glass jars) = $31

The cost of production for a single service jar of organic yogurt is:

$31 / 21 jars yogurt= $1.47/jar yogurt

The cost per jar would go down with larger jars.

Appendix 4: Kitchen Safety Procedures

General rules

1) Wash hands upon entering and upon exiting the kitchen, after handling dirty utensils, and when switching between different kinds of foods

To wash hands:

(a)First rinse with warm water.
(b) Apply soap
(c) Rub soap for 20 seconds.
(d) Rinse hands with warm water.

2) Do not eat or drink in the kitchen.

3) Those with runny noses or, or fevers, or who are repeatedly sneezing may not enter the kitchen.

4) Wear clean clothing when entering the kitchen.

5) Do not wear jewelry in the kitchen.

6) All utensils must be washed, rinsed and sanitized before reuse.

(7) Work surfaces must be cleaned and sanitized after use.

Sanitizing utensils (3 sink routine)

(a) Wash dishes, pots, pans, and utensils and detached parts in hot, soapy water. Use a brush, if necessary (SINK 1)

(b) Rinse in clear water after washing (SINK 2).

(c) Place in sink filled with sanitize (SINK 3)

(c) Place items in on racks in the steam sanitizer to be sanitized.

(d) Air-dry dishes in a clean and sanitized dish rack.

Sanitizing utensils: warewasher

(a) Soak items in sink, scrape off food
(b) Load warewasher
(c) Air dry items on sanitized dish racks

Cleaning and sanitizing equipment and work surfaces

(1) Scrape or remove food bits from the surface
  (a) Use adequate cleaning tool: brush, pad, or cloth
(2) Wash the surface

Wash surface with cleaning solution and cloth towel.

(3) Rinse the surface

Use clean water.

Rinse with cloth towel.

(4) Sanitize the surface
Use sanitizing solution and cloth towel
Make sure to touch the whole surface with the sanitizing solution.

(5) Allow the surface to air dry

Store yogurt in refrigerator after culturing until being served.