



**Science Unit: *Science of Cooking***

**Lesson 1: *Science of Bread and Butter***

School Year:	2010/2011; 2012/2013
Developed for:	McBride Elementary School, Vancouver School District Sir Wilfrid Laurier Elementary School, Vancouver School District
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Grade level:	Presented to grades K-3; appropriate for grades K – 7 with age appropriate modifications
Duration of lesson:	1 hour and 20 minutes
Notes:	If the oven is not in the classroom where this lesson takes place, a second adult is needed to leave the class and check on the baking process.

**Objectives**

1. Learn a basic bread recipe, and become familiar with some fundamental ingredients and cooking methods.
2. Discover the science behind bread making and butter making. These lessons investigated the living things involved in bread-making and the changes in states of matter during cooking.
3. Link science with the everyday act of cooking and eating.

**Background Information**

The science of cooking is a rich topic with so many links to the familiar meals we prepare and eat every day. Some simple cooking recipes can be done in classrooms with minimal equipment (e.g. the butter recipe here). With an oven or stove-top in the school, many more cooking activities are possible.

**Vocabulary**

<u>Yeast:</u>	A living thing (a fungus) used in baking.
<u>Dough:</u>	A thick mixture of ingredients that is kneaded, shaped and baked.
<u>Kneading:</u>	To mix and work, by folding, pressing and stretching.
<u>Molecules and atoms:</u>	Tiny particles that make up everything around us. Molecules and atoms are too small to see individually, but with enough of them together they make objects we can see. Several atoms are bonded together to make a molecule.
<u>Solid:</u>	A state of matter. the molecules in a solid are packed tightly together. Solids keep their shape (even in a granular solid, the individual grains keep their shape).
<u>Liquid:</u>	A state of matter. The molecules in liquids are free to move but remain close to each other. Liquids can change shape, but always take up the same amount of space.
<u>Gas:</u>	A state of matter. The molecules in gases are free to move apart from each other. Gases spread out to fill the container they are in.
<u>State change:</u>	A change between any of the states of matter e.g. liquid to gas.
<u>Chemical reaction:</u>	A chemical reaction occurs when molecules break apart and their atoms rearrange to make new molecules. Sometimes the new molecules are a different state of matter, so the chemical reaction involves a state change.



## Materials

- bowl for each group of 3-4 students
- warm water, 1/3 cup per group, with measuring cup for an adult
- dry yeast, 1 tsp per group, with measuring spoon for the group
- sugar, 1/2 tsp per group, with measuring spoon for the group
- spoon for stirring, one per group
- salt, 1/4 tsp per group, with measuring spoon for the group
- flour, 1 cup per group, with measuring cup for the group
- vegetable oil, 1 tbsp per group, with measuring spoon for an adult
- foil square for each student, about 15cm square
- permanent marker to label foil
- baking trays to fit all students' breads on their foil
- beaten egg and brush
- oven, set to 350 degrees F at the start of the lesson
- test tube, or other tall narrow tube, for each student
- racks to hold test tubes, one for each group of students
- dry yeast, 1/8 tsp per student, with a measuring spoon per group
- sugar, 1/8 tsp per student, with a measuring spoon per group
- stir stick for each student
- 3 clean screw capped jars
- whipping cream, enough to fill each jar 1/3 full
- small cups to pour buttermilk into
- butter plates and knives
- salt to add to the finished butter

## In the Classroom

### Introductory Discussion

Ask students if any of them have done any cooking at home. Discuss what they have made and touch on the science involved.

Tell students that we will make bread and butter today, and find out about some of the science in cooking.

Tell the students that while they are making their bread and butter they will be looking for the different states of matter. Explain, or review as necessary, the states of matter with the students, showing examples with the starting ingredients. As a class, devise a hand signal that the students can make when they discover a state of matter (e.g. two fists together above their head symbolizing molecules next to each other). During the lesson, when a student makes this symbol, the class will pause to hear what state of matter has been found, and to find it themselves.

Brief description of science activities:

- Make bread dough, and bake it.
- Investigate how yeast makes bread dough rise by mixing yeast and sugar in warm water.
- Make butter from cream.
- Eat the science experiment!

Brief description of the processes of science that the students will focus on: accurate measuring, observing, predicting.

**Safety guidelines:** adults need to be in close supervision if the students are near the hot oven.



### Science Activities

(1) Activity Title: Make bread

Purpose of Activity: Learn how to make a simple bread, understand the role of the ingredients in the recipe, and to notice the states of matter and state changes occurring during bread-making.

Methods and Instructions:

Set-up prior to experiment: each ingredient needs to be portioned out for each group of students. The oven needs to be set to 350 degrees F.

Students work in groups of 3 or 4 to make the dough, and individually to shape their bread.

1. To each groups' bowl, an adult adds the warm water. (State of matter: liquid.)
2. Students take turns in their group to add the yeast and sugar to the warm water, then mix it. (Solids are added to a liquid, then the solids become liquids as they dissolve.)
3. Tell the students that yeast is a living thing, and it is starting to eat the sugar.
4. Students take turns in their group to add the last ingredients, the flour and salt (both solids), and mix it.
5. An adult adds the vegetable oil (liquid) to each bowl, and asks the student to give it a last mix.
6. Students then take turns in their group to use their hands and knead the dough. (Show the students how to fold the dough, push it flat, stretch it out and repeat). As the ingredients come together and the dough forms a ball, the solid and liquid ingredients combine into a solid.
7. Once the kneaded dough has a nice elastic texture (at least 5 mins), split each between the students. Give each student their own dough ball on a piece of foil. As the students knead for a few more minutes, add each students' name to their foil.
8. Students shape their dough into a pretzel shape, a letter or any shape that reduces the thickness of the dough (so that it cooks in a reasonable time).
9. Lay each students' dough shape on its foil on a tray. Brush them all with a beaten egg, and leave to rise for a few minutes. (Activity 2 can be set up while waiting. Alternatively, the breads can be put straight in the oven).
10. Bake the breads for about 15 minutes at 350 degrees F, or until golden brown on top. (Activity 2 can be observed, and Activity 3 done while the breads are baking).
11. Once the breads are baked, allow to cool for a few minutes, then distribute.
12. Ask students to break the bread open and look for the holes in it. These holes are formed by the gas that the yeast makes as it eats the sugar.

(2) Activity Title: Yeast makes gas.

Purpose of Activity: Observe how yeast makes gas as it eats sugar.

Methods and Instructions:

Set-up prior to experiment: yeast and sugar portioned out for each group of students.

Students work individually.

1. Ask students why the bread dough rises. What could make it puff up? Tell them that it puffs up from gas bubbles. This activity will show where those gas bubbles come from.
2. Students add yeast, sugar and warm water to their tube. They mix it with a stir stick, then stand it in a rack. (The yeast and sugar are solids, the water is a liquid. Mixing helps the yeast and sugar dissolve and become part of the liquid.)
3. Leave the tubes for 5 mins (students can put their breads in the oven (Activity 1) while waiting for this step).
4. Look at the tubes, and find gas bubbles spilling out of the top of the tube. (New state of matter: gas. A chemical reaction has occurred: we started with liquid and a gas was made.) These gas bubbles are



from the yeast. The yeast eats the sugar and changes it into a gas [and ethanol]. (With older students, this can be demonstrated with molecule models - a glucose molecule can be split apart into two carbon dioxide and two ethanol molecules).

5. The same chemical reaction is happening in the breads. The yeast is eating the sugar and turning it into a gas. The gas forms bubbles in the dough. Some of the bubbles cannot get out of the dough, and collect inside it and make holes.

### (3) Activity Title: Make butter

Purpose of Activity: Learn how to make butter from cream, and understand the chemistry of the process.

#### Methods and Instructions:

Students work in one large group, with 3 butter jars passing between them.

1. To each of 3 screw capped jars, fill one third full with whipping cream (liquid). Cap tightly.
2. Ask the students to take turns shaking the jar hard (students can pass the jars around a large circle, each taking turns to shake). As an adult receives the jar, give it a hard, sharp shake to speed up the butter-making.
3. Tell students that the cream is made up of water, fat, sugar and protein.
4. When the cream has a whipped appearance (it is becoming more solid), open one jar to show the students. Tell them that we have made whipped cream by shaking air into the cream. We will keep on shaking.
5. When the cream has separated into a ball of yellow fat (solid) and a white liquid, open the jar to show the students. The fat has separated out of the cream, leaving the "buttermilk" (water, sugar and protein).
6. Pour the buttermilk into cups for the students to taste.
7. Dump the butter onto plates, mix in a little salt, and eat with bread/crackers. (Ideally eat with the breads made in Activity 1, just warm from the oven).

### **Closure Discussion**

Ask students to recall some of what we did, and reiterate the science behind it.

Tell students that every time they help cook at home, whether it's making toast or a fancy meal, there is interesting chemistry happening.

### **References**

1. Zubrowski, Bernie. 1981. Messing around with Baking Chemistry. Little, Brown and Company. Detailed lesson ideas using baking powder and yeast, including recipes.
2. Cobb, Vicki. 1994. Science Experiments You Can Eat. Harper Collins. Lots of ideas, but beware, some of Cobb's activities do not work, so test them first!
3. McGee, Harold. 1984, 2004. On Food and Cooking. Scribner. An excellent, detailed resource for the science behind most foods and cooking you can think of.

### **Extension of Lesson Plan**

1. Other cooking ideas:
  - make scones with baking soda and an acid e.g. buttermilk/lemon juice.
  - make ice cream by shaking cream and cooling it with salted iced water.
2. See refs 1, 2 and 3 for other cooking science ideas.