

Baking Sciences: Leavening Logic



Lab Goal: Students will recognize ingredients that leaven baked goods and apply each in the preparation of pancakes or waffles. Students will compare and analyze the product of each leavener and evaluate their qualities.

Introduction/Food History:

Waffles and pancakes are favorite American specialties and can trace their origins to 17th century Dutch settlers in the New York vicinity. Originally called pannekoeken and stroopwafels, these “quick” breads were already popular during the Colonial days. Pancakes were seasoned with spices or flavored with pumpkin. Waffle irons were a standard appliance, and waffles were popular at holidays.

Pancakes are a flat, quick bread. For thousands of years people made flat ground grain or nut-cakes without the benefit of leavening. To lighten or “lift” flat breads, beaten egg whites and yeast became commonly used to lighten some baked goods.

Much later, in the late 1700’s **pearl ash**, a crude form of potassium carbonate (K_2CO_3) leached from wood ashes, purified by partial crystallization and dried by evaporation, was found to leaven baked goods. In the early 1800s **baking soda** was welcomed. By 1859 Americans were using **baking powder**.

Waffles and pancakes are a great part of this history since they have been made with and without leaveners. Explore and enjoy history through the following technology assignment.

Technology Assignment: Assign students to visit one or more of the following web-sites AND/OR do a search at the library for books on waffle, flat breads and pancake history and nutritional value. Prepare a written and 5-minute oral report to be given in class. Encourage food samples!

Report: Flat Breads, Waffles and Pancakes Student Name: _____

Sites to get you started: www.baking911.com Sarah Phillips
www.homebaking.org Home Baking Association
www.pancakes.com PJ’s Pancake House
www.pancakeparlour.com Shrove Tuesday
www.wheatfoods.org Wheat Foods Council

Site Name(s): _____ URL: _____

Site Name(s): _____ URL: _____

Book Title(s) and Author: _____

Other sources used: _____

Based on your research and/or reports, what is happening in the picture?
Hint: This event began in Olney, England, in 1445. _____



Teacher Supplies:

1. 10 small bowls (clear custard cups or plastic storage containers); stir sticks or spoons
2. Packages of baking soda, cream of tartar, baking powder; active dry yeast
3. Vinegar, milk, buttermilk, honey, baking cocoa, peanuts, water
4. Small clear beverage bottles (12 oz) and small balloons to fit over the bottle necks
5. Ingredients for the selected baking lab(s)
6. Waffle irons or griddles

Companies producing baking soda and baking powder state the biggest source of failure with their products in **home baking** is due to mistakenly substituting one for another.

About Leavening:

- Review leavening definitions in **Terms and Techniques**—baking powder, baking soda, yeast, cream of tartar, whipped eggs, and air from creaming fat with sugars.
- Have students write the chemical name for each. Discuss the differences between how each performs and is used.
- **Professional bakers** have a wider variety of chemical leaveners—single action (cream of tartar or tartaric acid), slow action (monocalcium phosphates) and double-action **baking powder** (SAS—sodium aluminum sulfate and monocalcium phosphates); **baking soda** and **ammonium bicarbonate**. They also use fresh, instant and active dry yeast and sourdough starters.
- **Home bakers** use beaten egg—whole, whites and yolks; air from creaming fat and sugars; active and fast rising dry yeast; sour dough; baking soda, cream of tartar and double acting baking powder.
- Do the Ingredient Lab to observe the reactions of chemical leaveners and to understand the differences between baking soda and baking powder
- Bake waffles or pancakes, using several leaveners.

More great leavening experiences at
Chemical Leavening 101, www.clabbergirl.com
www.redstaryeast.com and www.breadworld.com

Ingredient Lab: Leavening Switch

You will need: Supplies from 1 through 4 above.

Question to test, Test #1

- What difference(s) will you observe when substituting different leavening agents in a mixture?

Have each student write:

Our lab compared: _____

My hypothesis is: _____

Basic Experiments: What to Do

Test #1: Observe, time and record the length of reaction for each mixture by simply mixing each set of ingredients in a well labeled clear bowl. Do not combine the liquids with the leavening until you are ready to observe and time the reaction (CO₂ bubbles produced).

Bowl #1: Combine ¼ teaspoon baking soda, ½ teaspoon cream of tartar and ¼ cup hot (150°F) water

Bowl #2: Combine 1 teaspoon baking powder and ¼ cup hot (150°F) water

Bowl #3: ¼ cup cold milk mixed with 1 teaspoon vinegar OR lemon juice and ¼ teaspoon baking soda

Bowl #4: ¼ cup warm (90°F) water and 1 package (1/4 oz. or 2 ¼ tsp.) active dry yeast

Bowl #5: ¼ teaspoon baking soda and ¼ cup buttermilk

Bowl #6: Mix 2 teaspoons baking cocoa with ¼ cup hot water; stir in ¼ teaspoon baking soda

Bowl #7: Mix 2 teaspoons baking cocoa with ¼ cup hot water; stir in ¼ teaspoon baking powder

Bowl #8: Mix 1 tablespoon honey with $\frac{1}{4}$ cup hot water to dissolve; stir in $\frac{1}{4}$ teaspoon baking soda

Bowl #9: Mix 1 tablespoon honey with $\frac{1}{4}$ cup hot water to dissolve; stir in $\frac{1}{4}$ teaspoon baking powder

Bowl#10: Mix 1 teaspoon baking powder with $\frac{1}{4}$ cup cold water

Compare length and observed strength of reactions and report.

What to Do:

Test #2: Measure the strength of reaction by observing the volume of the reaction. Double or triple the amount of each mixture's ingredients. Label 10 small beverage bottles (8 oz. if possible) with #1-10. Pour each mixture into each bottle and stretch a small balloon over the neck of each bottle. Allow the reaction to go for least 10 minutes.

Report which bottles blew up the balloons the most and least.

Questions to test:

- Which reaction will take the longest to produce CO₂? Mixture _____
- Which will produce the least? Mixture _____
- The most? Mixture _____

Test #3: Peanut Lift

What to Do: Fill a 1-quart measuring cup or bowl with water, 1 tablespoon vinegar and 2 teaspoons baking soda. Stir to mix. Drop five or six peanuts into the mixture. Watch and describe what happens over the next 5 - 10 minutes.

What is your hypothesis about what will happen? _____

Questions to test:

- Why do the peanuts float to the top?
(A: CO₂ bubbles attach and carry them up—peanuts are oily so therefore light enough to lift.)
- Why do they fall to the bottom again?
(A: CO₂ bubbles burst at surface; peanuts drop again)

Baking Lab 1: Cornmeal Waffles (One day lab)

- Control Lab: Prepare the following Cornmeal Waffles as directed.
- Second Lab: Prepare the waffles omitting the baking soda and baking powder, as was done before baking soda was available (Leavened with only the beaten egg whites.)
- Third Lab: Prepare the waffles, omitting the soda and powder and adding ¼ cup warm (90°F) water and 1 pkg. fast rising yeast. (Batter must rest 10 minutes after mixing before baking on griddle.)

Ingredients	Measure	Weight
All-purpose flour	1 cup	3.75 oz.
Yellow cornmeal	3/4 cup	4.5 oz.
Baking powder	2 teaspoons	0.25 oz.
Baking soda	½ teaspoon	
Salt	1 teaspoon	5 grams
Buttermilk or soured milk*	1 ½ cups	12 oz.
Honey or sugar	2 tablespoons	0.9 oz.
Vegetable oil or melted butter	4 tablespoons	2 oz.
Eggs (divided), room temperature	3, large	5 oz.

Variations:
Substitute whole wheat flour for cornmeal. Substitute 2 tablespoons soy flour for 2 tablespoons all-purpose flour.

*Sour milk by mixing 1 tablespoon vinegar or lemon juice with milk to make 1 cup.

Directions

1. Coat a waffle iron with cooking spray. Preheat.
2. Measure dry ingredients by stirring, lightly spooning into cups and leveling with a straight edge OR weigh them with scales.
3. Combine the flour, cornmeal, baking powder and salt in a large bowl, whisking with a wire whisk to combine them well. Make a dent in the center of the dry mix.
4. In a separate bowl, mix the milk, melted butter or oil and egg yolks—stir well with a whisk. Add the buttermilk mixture to the flour mixture. Stir just until all ingredients are moistened.
Do not beat or over mix.
5. Beat the egg whites with a mixer at high speed, gradually adding the sugar, until stiff peaks form. (If honey is used, stir into the butter/oil mixture). Gently fold egg whites into the cornmeal batter.
6. Spoon about ½ cup batter onto hot waffle iron, spreading batter to edges. Cook for 3 to 5 minutes or until done; repeat.

Optional: Use the following form to evaluate the lab products.

<u>A Matter of Taste</u>		
Product Tasted: _____	Lab group: _____	Date: _____
I think the food product tastes: ___ very good ___ good ___ okay but not my favorite ___ needs improvement		
The food tastes: ___ sweet ___ bitter ___ salty ___ sour ___ not what I expected ___ just right		
The color is: ___ great ___ too pale ___ too dark ___ not right for the product		
The aroma (smell) is: ___ too strong ___ too weak ___ just right ___ not good		
The food looks: ___ yummy ___ okay ___ not good		
I would enjoy eating this food again. ___ yes ___ no ___ maybe		
Comments: _____		

Baking Lab: Historic Waffles (Two day lab)

Thomas Jefferson was a great lover of good food. He served Meriwether Lewis a yeast leavened waffle while he was his secretary in Washington D.C.—1801-1803—before embarking on the Corps of Discovery—and before chemical leavening was used.

Raised Waffles - Makes about 14 waffles

Ingredients

	Measure	Weight
Whole wheat flour*, divided	2 cups	7.5 oz. (200g)
All-purpose flour, divided	1 cup	3.75 oz. (100g)
Brown sugar, firmly packed	1 tablespoon	½ oz. (14g)
Salt	1 teaspoon	1/6 oz (5g)
Butter, melted	¼ cup (1/2 stick)	2 oz. (56g)
Active dry yeast	2 ¼ tsp (1 pkg)	¼ oz (14 g)
Milk or water, warm (105°F)	2 cups (1 pint)	1 lb.
Large eggs	2	1.5 oz.

* Whole white wheat flour is ideal; pastry flour is often used in waffles

Directions

1. Combine 1 cup whole wheat and ½ cup all-purpose flour, brown sugar, salt, butter and yeast in a large mixer bowl. Stir in the milk and beat on low speed for 1 minute. Beat on medium speed for 1 minute more. Add the remaining flour and beat until smooth, 1 to 2 minutes. Let stand at 75 to 80°F, covered (unsealed lid), for 4 hours or overnight (refrigerate, if overnight).
2. When ready to bake, beat the eggs into the mixture, Heat a waffle iron according to the manufacturer's directions. Pour 1/3 cup batter into each segment of the hot iron. Bake until golden brown; (baking time will vary with the type of iron used). Serve immediately with honey or jam.

More Lewis and Clark history at: www.lewis-clark.org www.pbs.org/lewisandclark/

Used with the author's permission: *The Food Journal of Lewis and Clark. Recipes for an Expedition.* By Mary Gunderson. www.historycooks.com

Critical Thinking Corner: Have students report on the following questions.

1. **Sample each of the test waffles.**
What differences do you note in crust color and crispness?
How does the flavor differ?
Which waffle did you prefer and why?
2. **Was the batter without the soda and baking powder more or less acidic?**
(A: More acidic) Why? (A: Buttermilk was used, but no reaction was available with baking soda or powder to neutralize it).
3. **How could you make the cornmeal waffle a whole grain waffle?** 51% of the flour and/or meal must be whole grain. (A: Try using wholegrain cornmeal instead of degerminated and see if you really notice it's whole grain—or substitute whole wheat flour for the all purpose flour.
4. **How many wholegrain servings do Americans need everyday?** (A: Three to five)
Why? (Visit 2005 Dietary Guidelines @ www.nutrition.gov or www.wheatfoods.org)

Real World Experience: Community Service Learning

Teaching others confirms your skills and shares knowledge. Everyone benefits from family meal time and looks for “fast meal” options—pancakes and waffles are one.

Plan, promote and hold a “Book and Cook” supper event for a local pre-school or parents at your school or an after school program. Use the time to explore food and people chemistry, learn to enjoy a whole grain waffle or pancake, promote reading and eating together while enjoying a simple meal or snack.

Books to share together before preparing waffles or pancakes:

...And these are just a start!

If You Give a Pig a Pancake By: Laura Numeroff.

Miss Mabel's Table By: Deborah Chandra

Mr. Wolf's Pancakes By: Jan Fearnley

Pancakes By: Tomie De Paola (pictures only)

Pancakes! Pancakes! By: Eric Carle

The Runaway Latkes By: Leslie Kimmelman

Uncle Phil's Diner By: Helena Clare Pittman

- Have the group explore some nutritious fruit sauces, toppings and
- Homemade syrup recipes.
- Mix-up and send home some whole grain pancake mix to “jump-start” a meal together at home.
- Get active with a “pancake flipping” race (See Shrove Tuesday web-sites), or other great ideas for pancakes can be found at www.lessonplanspage.com.



Visit Washington State University
Eat Together Eat Better for a Tool
Kit to promote shared meals!
www.nutrition.wsu.edu

Clip and Save:

From Family & Consumer Science at _____

Multi Grain Pancake Mix - Makes 5 cups mix

In a large bowl, combine with a wire whisk to blend well:

1¾ cup whole wheat flour

1¼ cup all-purpose flour

¾ cup quick oatmeal or oat bran

½ cup cornmeal

¼ cup granulated or brown sugar

2 teaspoons baking powder

1½ teaspoons salt

1 teaspoon baking soda

Option: ½ cup finely chopped unsalted sunflower seeds or nuts.

Portion 1¼ cups mix into small plastic food bags.

Label with: List of Ingredients and directions - Beat together 1¼ cups buttermilk or sour milk, 2 tablespoons oil and 1 large egg. Stir in mix. Bake on oiled and heated (400°F) griddle. Turn ‘cakes once - when bubbles appear and the side is golden.

Source: Hodgson Mill. www.hodgsonmill.com and www.homebaking.org

Explore the world of homemade syrups and flavored butters.

Honey or Fruit Butter

½ cup (1 stick) butter, softened slightly

3 tablespoons honey or fruit preserves

Mix the butter and honey until blended well. Chill in a pig shaped cookie cutter, if desired, and slide out to serve with the warm pancakes. Source: Land O' Lakes—www.landolakes.com

Brown Sugar Syrup

2 cups light brown sugar

1 ½ cups water

½ teaspoon vanilla or maple flavoring

Bring sugar and water to a boil in a saucepan, stirring occasionally. Reduce heat and simmer 3 minutes. Remove from heat and stir in choice of flavoring. Sharon Davis, FCS Education

Spicy Applesauce

3 pounds golden delicious apples, peeled, cored and cut into eight wedges

1/3 cup unsweetened apple juice

¼ cup firmly packed brown sugar

½ teaspoon ground cinnamon

1/8 teaspoon ground cloves

Combine all ingredients in a large Dutch oven; cover and cook over medium heat 15 minutes or until very tender. Spoon apple mixture into a large bowl; mash to desired consistency. Serve warm or chilled. Serves 8, about ½-cup servings.

Fruit Sauce

With a blender or food processor puree:

One, 15 oz. can drained peaches or apricots (or 1 ½ c. fresh peaches or nectarines)

2 cups strawberries or other fresh or frozen berries.

Serve warmed or cold over hot, crisp waffles or pancakes. Source: Sharon Davis, FCS Ed.

Cider Syrup

1 ½ cups unsweetened apple cider

1/3 cup firmly packed brown sugar

10 whole cloves

1, 3-inch stick cinnamon

Combine all ingredients in a small heavy saucepan. Place over medium heat, and cook 20 minutes or until reduce to ¾ cup. Discard cloves and cinnamon stick. Serve warm. Yield: ¾ cup (37 calories per tablespoon)

Source: Cooking Light magazine, Sept/Oct. 1991. cookinglight.com

Resources and References:

Books:

Baking Illustrated. America's Test Kitchen. 2004. www.cooksillustrated.com

Baking 9-1-1. Sarah Phillips. Simon & Schuster, NY. 2003. www.baking911.com

Cooking Wizardry for Kids. Margaret Kenda & Phyllis S. Williams. Barron's Educational Series. NY. 1990. www.barrons.com

Extending the Table. Joetta Handrich Schlabach. Herald Press. Scottsdale, PA. 1991. 800-759-4447. www.mph.org

Practical Baking. William J. Sultan. Von Nostrand Reinholdt. NY.

The Food Journal of Lewis and Clark. Mary Gunderson. 2003. istory Cooks. www.historycooks.com

Power Point: Baking Ingredients: From Flour to Table-- Quick Breads Kansas Wheat Commission, www.kswheat.com

Sites to Cite:

- www.baking911.com
- www.clabbergirl.com
- www.homebaking.org
- www.kswheat.com
- www.landolakes.com
- www.wheatfoods.org
- www.historycooks.com
- www.wholegrainscouncil.org